IN3060 - MANDATORY EXERCISE no. 5

Published date: 05.03.2021

First due date: 19.03.2021 23:59.

Delivery files: `oblig5.pdf`

Delivery attempts: 2.

Read the complete exercise set before you start solving the exercises.

1 Model Semantics

Let Γ_1 be the RDFS graph listed below.

```
@prefix :     <http://example.org/oblig5-1#> .
@prefix rdf:  <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix xsd:  <http://www.w3.org/2001/XMLSchema#> .

:Animal        rdf:type            rdfs:Class .
:Food          rdf:type            rdfs:Class .
:Bird          rdf:type            rdfs:Class ;
               rdfs:subClassOf     :Animal .
:Penguin       rdf:type            rdfs:Class ;
               rdfs:subClassOf     :Bird .
:Fish          rdf:type            rdfs:Class ;
               rdfs:subClassOf     :Animal, :Food  .
:Horse         rdf:type            rdfs:Class ;
               rdfs:subClassOf     :Animal .
:Vegetable     rdf:type            rdfs:Class ;
               rdfs:subClassOf     :Food .

:eats          rdf:type            rdf:Property ;
               rdfs:domain         :Animal ;
               rdfs:range          :Food .
:likes         rdf:type            rdf:Property ;
               rdfs:domain         :Animal ;
               rdfs:range          :Animal .
:hasNickname   rdf:type            rdf:Property ;
               rdfs:domain         :Horse ;
               rdfs:range          xsd:string .
```

```
:favouriteFood  rdf:type            rdf:Property ;
                rdfs:subPropertyOf  :eats .

:Tweety         rdf:type            :Penguin ;
                :favouriteFood      :Bruce .
:JollyJumper    rdf:type            :Horse ;
                :hasNickname        "JJ" ;
                :likes              :Tweety ;
                :favouriteFood      _:b .
:Bruce          rdf:type            :Fish ;
                :hasNickname        "Alonso" .
```

1.1 Exercise: Interpretation

1. Create an interpretation $\mathcal{I}_1$ such that $\mathcal{I}_1 \models \Gamma_1$.
2. Create an interpretation $\mathcal{I}_2$ such that $\mathcal{I}_2 \not\models \Gamma_1$.

1.2 Exercise: Entailment

For each of the statements below, if the statement is entailed by Γ_1, then prove this by giving a proof using the RDF and RDFS entailment rules se1, se2 and rdfs1–rdfs13 found at `http://www.w3.org/TR/rdf-mt/`. If Γ_1 does not entail the statement, then create a countermodel to prove it.

1. `:Tweety` is an animal.
2. `:Tweety` likes `:JollyJumper`.
3. `:Food` is the range of `:favouriteFood`.
4. `:Bruce` has some favourite food.
5. `:Bruce` is a vegetable.
6. `:Bruce` is a horse
7. `:Bruce` is a fish.

2 Semantic web and reasoning

Answer each of the following questions. A paragraph for each question should do.

1. Explain the terms "closed world assumption" and "open world assumption" and contrast the difference between them. Which assumption is used in the semantic web, and why is that?

2. Explain the terms "unique name assumption" and "non-unique name assumption" and contrast the difference between them. Which assumption is used in the semantic web, and why is that?

3. Explain the difference between "forward rule chaining" and "backwards rule chaining".

4. Explain what it means that the RDFS entailment rules are sound with respect to the RDFS semantics.

5. Explain what it means that the RDFS entailment rules are not complete with respect to the RDFS semantics.

3 RDF(S) formal semantics [IN4060]

Do this section's exercises if and only if you are taking IN4060 (and not IN3060). The background material needed to solve these exercises is found in chapters 3.1–3.2 of Foundations of Semantic Web Technology. You shall assume these semantics when solving these exercises.

The RDF(S) formal semantics is presented in this video[1]. Some time will also be dedicated to RDF(S) formal semantics in the group session Monday 15th.

3.1 Exercise

What is the difference between the semantics for RDF(S) in given 3.1–3.2 of Foundations of Semantic Web Technology (FSWT) (which is the actual semantics for RDF(S)) and the semantics given in the lectures? You need not present all the details, but highlight the differences; a paragraph should be enough.

3.2 Exercise

Let Γ_2 be the RDFS graph listed below, a slightly different graph than given in the exercise above.

```
@prefix :     <http://example.org/oblig5-2#> .
@prefix rdf:  <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix xsd:  <http://www.w3.org/2001/XMLSchema#> .

:Animal         rdf:type            rdfs:Class .
:Penguin        rdf:type            rdfs:Class ;
```

[1] https://www.uio.no/studier/emner/matnat/ifi/IN3060/v20/forelesningsvideoer/rdfs-interpretations.mp4?vrtx=view-as-webpage

```
                rdfs:subClassOf     :Animal .

:likes          rdf:type            rdf:Property ;
                rdfs:domain         :Animal ;
                rdfs:range          :Animal .

:Tweety         rdf:type            :Penguin .
:JollyJumper    :likes              :Tweety .
```

Create an RDFS-interpretation for this graph, i.e., an interpretation $\mathcal{I}$ that satisfies the criteria given in the book, such that $\mathcal{I} \models \Gamma_2$.

Every *RDFS-interpretation* is an *RDF-interpretation*, which again is a *simple interpretation*. So your interpretation need to satisfy the requirements for a all of these interpretation types. To simplify the exercise somewhat, your interpretation $\mathcal{I}$ should consist of only IR, IP, I_{EXT} and I_S (, and not I_L and LV) as listed on page 76 in FSWT. Furthermore, your interpretation need **not** satisfy

- the last two of the three bullet points on RDF-interpretations on page 80–81,
- the last two bullet points for RDFS-interpretations on page 83,
- the RDF and RDFS axiomatic triples (listed on 81 and 83–84.),
- any of the requirements in chapter 3.2.4, Interpretation on Datatypes.

To easily identify what parts are relevant, see this copy of chapter 3.2.

In summary, your interpretation needs to "only" interpret the URIs explicitly listed in the RDFS graph Γ_2 and you need to make sure the interpretation is a valid RDFS-interpretation (with the simplifications above taken into account).

3.3 Exercise

Let Γ_3 be the RDFS graph listed below.

```
@prefix :     <http://example.org/oblig5-3#> .
@prefix rdf:  <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .

:OrderOfMammals   rdfs:subClassOf   :OrderOfAnimals .
:OrderOfBirds     rdfs:subClassOf   :OrderOfAnimals .

:Elephant   rdf:type      :OrderOfMammals .
:Eagle      rdf:type      :OrderOfBirds .
```

```
:Bobo        rdf:type      :Elephant .
:Joe         rdf:type      :Eagle .
```

`:OrderOfMammals` is the class of all species of Mammals, i.e., the members of the members of the class are (individual) mammals.

One could expect `:Bobo` to be different from `:Joe`, since no animal can be an eagle and an elephant at the same time. However, nothing in Γ_3 prevents the classes `:Elephant` and `:Eagle` from overlapping. Therefore, create a counter-model, i.e. an RDFS-interpretation $\mathcal{I}$ for this graph where `:Bobo` and `:Joe` are interpreted as the same individual, i.e., $\texttt{:Bobo}^{\mathcal{I}} = \texttt{:Joe}^{\mathcal{I}}$.

4 Ending notes

Mandatory exercises are to be handed in using Devilry. Make sure that your are registered in the system by logging on and finding that an `oblig5` is available as an assignment in IN3060. *Check this before you start solving the exercises!* If you are not registered in the system, give notice to `jieyingc@ifi.uio.no`.

Your delivery shall include one file, `oblig5.pdf`. The preferred way of writing (mathematics), e.g., characters and symbols like Γ, $\Delta^{\mathcal{I}_1}$, is to use LaTeX. You may use other text formatters and other symbols than, e.g., Γ, as long as your text is clear and easy to understand.

Good Luck!