

Exercises (2010)

1. Represent the following statements in the language of description logic and enter the corresponding OWL formulations in Protégé:

- (1.1) Every pizza is a meal.
- (1.2) Pizzas always have two toppings.
- (1.3) Every Margherita pizza has a tomato topping.
- (1.4) Everything with a topping is a pizza.
- (1.5) No Margherita pizza has a meat topping.
- (1.6) Pizzas, meat and toppings are different things.
- (1.7) Property 'has topping' is inverse-functional and has domain 'pizza' and range 'topping.'

Which of them can be satisfactorily represented in RDF(S)?

2. Sketch a normalised ontology (for use by a library) which covers the following items:

Items to be represented: Books, card catalogue, publications, librarians, photocopies, electronic copies, shelves, rooms, categories of work such as Computer Science, Art History, etc., borrowers, loans;

and provides sufficient concepts and roles to represent the statements:

- (2.1) Librarian in charge of publications.
- (2.2) Books authored by library staff.
- (2.3) Catalogued books.
- (2.4) Books on art history of which there are two or more copies in the library.
- (2.5) Journals for which there is an electronic copy but no paper copy.

3. Create a DL knowledge base that models the following facts:

- (3.1) Mammals are animals.
- (3.2) Cats are carnivorous mammals.
- (3.3) Elephants are herbivorous mammals.
- (3.4) Carnivores eat meat.
- (3.5) Vertebrate is any animal with a backbone.
- (3.6) Every fish is an animal that lives in water.
- (3.7) A bird is vertebrate that has wings, legs and lays eggs.
- (3.8) Those who eat meat are carnivores.
- (3.9) Rezy is a bird that eats insects and seeds only.

4. Using the individuals *laura*, *audrey* and *donna*, concepts *Person* and *NicePerson*, and role *hasFriend*, represent the following knowledge base as an \mathcal{ALC} knowledge base *KB*:

- Audrey is a person.
 - Laura is a nice person.
 - Donna is a friend of Laura's.
 - A nice person is a person all of whose friends are nice persons.
 - Every nice person has a friend.
1. Is the statement "Donna has a friend" a logical consequence of the knowledge base KB ? Explain your answer. If the answer is negative, give a model of the KB where the statement is false.
 2. Is the statement "Audrey is a friend of Donna's" a logical consequence of the knowledge base KB ? Explain your answer. If the answer is negative, give a model of the KB where the statement is false.

5. Consider the following RDF document:

```
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
  xmlns:geo="http://geography.org/#"
  xml:base="http://geography.org/">
  <rdf:Description rdf:about="#UK">
    <rdf:type rdf:resource="#country"/>
  </rdf:Description>
  <rdf:Description rdf:about="#capital_of">
    <rdf:type rdf:resource="#rdf:Property"/>
    <rdf:domain rdf:resource="#city"/>
    <rdf:range rdf:resource="#country"/>
  </rdf:Description>
  <rdfs:Class rdf:about="#country"/>
  <geo:city rdf:about="#london">
    <geo:capital_of rdf:resource="#UK"/>
  </geo:city>
  <rdfs:Class rdf:about="#city"/>
</rdf:RDF>
```

- (i) Describe in natural language the content of this document.
- (ii) Draw the graph representation of the document.

6. Consider the following \mathcal{ALC} -knowledge base $\mathcal{K} = (\mathcal{T}, \mathcal{A})$ consisting of the TBox \mathcal{T} :

$$\begin{aligned} \text{Clownfish} \sqcup \text{Surgeonfish} &\sqsubseteq \text{Fish} \\ \text{Clownfish} \sqcap \text{Surgeonfish} &\sqsubseteq \perp \end{aligned}$$

and the ABox \mathcal{A} :

nemo : Clownfish $\sqcap \exists \text{hasColour.Orange}$
dory : Surgeonfish $\sqcap \forall \text{likes.Clownfish}$
darla : Person
(dory, nemo) : likes
(dory, darla) : likes

Is the TBox \mathcal{T} consistent? If so, give an interpretation that is a model of \mathcal{K} .

7. Consider the following TBox \mathcal{T} :

Car $\sqsubseteq \exists \text{producedBy.CarMaker}$
CarMaker $\sqsubseteq \text{Manufacturer}$
 $\exists \text{producedBy.Manufacturer} \sqsubseteq \text{Product}$

Which of the following hold true?

- (i) Car $\sqsubseteq_{\mathcal{T}}$ Product
- (ii) Car $\sqsubseteq_{\mathcal{T}}$ CarMaker

8. Consider the following TBox \mathcal{T} :

$A \sqsubseteq \exists R.B$
 $A \sqsubseteq \forall R.C$

Which of the following hold true?

- (i) $A \sqsubseteq_{\mathcal{T}} \exists R.(B \sqcap C)$
- (ii) $A \sqsubseteq_{\mathcal{T}} \forall R.(B \sqcap C)$

9. Consider the following knowledge base \mathcal{K} :

Human \sqcap City $\sqsubseteq \perp$
Human $\sqsubseteq \exists \text{livesIn.City}$
Human $\sqsubseteq \text{PhysicalObject}$
bob : Human
john : Human
london : City
(bob, london) : livesIn

Is john an instance of the following concepts w.r.t. \mathcal{K} ?

- Human

- City
- \neg City
- \exists livesIn.City
- \forall livesIn.City