Logic-Based Ontology Engineering
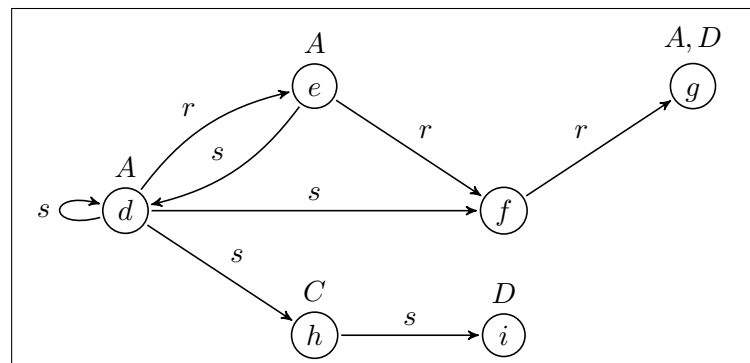
Summer Semester 2018

Exercise Sheet 1

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Exercise 1.1 We consider the following graph G:

and the following set of concepts S_C:

- $\neg A$
- $\neg A \sqcap \neg B$

- $\exists r.(A \sqcup B)$
- $\forall r.(A \sqcup B)$

- $\exists s.\exists s.\neg A$
- $(\leq 1\, s\, \top)$

First, we read the graph G as an interpretation, where the vertices are elements of the domain and the labels of vertices and edges result from the interpretation function.

(a) List for each of the concepts in S_C which elements of the domain they have as instances.

Now, we read the Graph G as an ABox $\mathcal{A}$, where the vertices are individuals (a.k.a. objects) and the edges are object or data properties.

(b) List for each of the concepts in S_C which ABox individuals they have as instances w.r.t. the ontology $\mathcal{O}_b = (\mathcal{A}, \emptyset, \emptyset)$.

(c) List for each of the concepts in S_C which ABox individuals they have as instances w.r.t. the ontology $\mathcal{O}_c = (\mathcal{A}, \{C \sqsubseteq \neg A, D \sqsubseteq \forall r.B\}, \{\mathsf{Tra}(r), \mathsf{Sym}(s)\})$

The next exercises work with the ontology editor Protégé. Please install Protégé on your computer following the instructions from the lecture's web page https://tu-dresden.de/ing/informatik/thi/lat/ studium/lehrveranstaltungen/sommersemester-2018/logic-based-ontology-engineering.

Exercise 1.2 Chose from the File menu the item "Open from URL" to load the pizza ontology into Protégé from the URL https://protege.stanford.edu/ontologies/pizza/pizza.owl.

Activate the view "Ontology metric", which is accessible from the menu "Window" → "Views" → "Ontology views" → "Ontology metrics".

(a) What is the axiom count and what is the logical axiom count? Why does it differ?

To find out details of the pizza ontology, use the tabs for "Entities", "Classes", and "Object properties".

(b) Find axioms in the pizza ontology that respectively

- use nominals,

- use negations,

- declare a sub-property of an object property, and

- declare an inverse property.

(c) Start the reasoner from the menu "Reasoner". In the tab "Classes" in the view for "Class hierarchy" the class "Ice Cream" is shown in red. Why?

(d) What are the inferred superclasses for the classes "CajunSpiceTopping" and "SloppyGiuseppe"?

(e) Make the object property "hasIngredient" functional. Synchronize the reasoner (in the "Reasoner" menu). How do the reasoning results change?

Exercise 1.3 Pick an ontology that was mentioned in the lecture. Find the corresponding owl file on-line and load it into Protégé.

(a) Retrieve the number of logical axioms, of classes and of (object) properties.

(b) How many classes does owl:Thing subsume directly, i.e. not via transitivity of subsumption?

(c) Write down 3 complex classes that use the vocabulary of the ontology: one existential restriction, one (qualified) number restriction and another one of your choice.

(d) Use the reasoner and the "DL query" tab in Protégé to find the subsumers, the subsumees and the instances of the 3 complex classes from the previous exercise.

Exercise 1.4   (a) Model the following ontology in Protégé and save it as an owl file.

$$\mathcal{T} = \{ \qquad\qquad\qquad\qquad\qquad Bone \sqsubseteq BodyPart,$$
$$Exoskeleton \sqsubseteq BodyPart,$$
$$Leg \sqsubseteq BodyPart,$$
$$Wing \sqsubseteq BodyPart,$$
$$Mammal \sqsubseteq Animal \sqcap ((\geq 4\ hasLimb.Leg) \sqcup Cetacean),$$
$$Insect \sqsubseteq Animal \sqcap (\leq 6\ hasLimb.Leg) \sqcap (\leq 4\ hasLimb.Wing)$$
$$\sqcap (\exists hasBodyPart.Exoskeleton),$$
$$Animal \sqcap (\exists hasBodyPart.Exoskeleton) \sqsubseteq \forall hasBodyPart.\neg Bone \qquad\qquad \}$$

$$\mathcal{R} = \{ Ran(hasBodyPart) \sqsubseteq BodyPart,$$
$$hasLimb \sqsubseteq hasBodyPart,$$
$$hasCover \sqsubseteq hasBodyPart \qquad\qquad \}$$

(b) Populate the ABox of this ontology with an individual "MobyDick" without using the concept Cetacean such that MobyDick is inferred to be an instance of Cetacean.