Principles of Knowledge Representation and Reasoning

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Exercise Sheet 7

Due: December 09th, 2015

Exercise 7.1 (Structural Subsumption Algorithm, 4)

Given the $\mathcal{FL}^-$ concepts C' and D' and terminology $\mathcal{T}$ you are asked to use the structural subsumption algorithm from the lecture to prove or disprove $\mathcal{T} \models C' \sqsubseteq D'$. You will need to apply normalization and unfolding as preprocessing steps.

- $\mathcal{T} = \{A \sqsubseteq \forall r_1.(\exists r_2 \sqcap C), B \sqsubseteq \forall r_1.(\exists r_3 \sqcap \forall r_2.D), D \equiv \exists r_2 \sqcap \forall r_2.C\}$
- $C' \equiv A \sqcap B$
- $D' \equiv \forall r_1.(\forall r_2.\exists r_2) \sqcap A$

Exercise 7.2 (Ontological Modeling and Upper-Level Ontologies, 3 + 1 + 4)

(a) As a first step you are asked to design your own ontology of kitchen items. So, go into your kitchen, relax, and categorize the things you see, i.e., pots, bowls, mugs, a stove, some furniture etc. You are absolutely free to come up with any structure you think makes sense. Model your ontology using Protégé and save your file in the OWL/XML format.

(b) Next, import the Upper-Level Ontology DOLCE-Lite[1] into your Protégé project. To do so, click `Active Ontology > Ontology Imports > Direct Imports` then select `Import an ontology contained in a document located on the web` and enter the URL of where DOLCE-Lite lives: `http://www.loa-cnr.it/ontologies/DOLCE-Lite.owl`. Now go back to the `Entities` tab and you will see your kitchen ontology along with the DOLCE-Lite ontology. Because the ontology from task a) presumably contains physical objects only, move your concepts under the DOLCE-Lite concept named `physical object` (`particular > spatio-temporal-particular > physical endurant > physical object`). As a result you see that your kitchen items inherit some properties, among others, for example, they have a spatial location. Use Protégé to determine the expressiveness of the description logic used. Is its satisfiability problem decidable? Finally, save your ontology as an OWL/XML document.

(c) Now you can use the ontology to represent the following facts I to IV as ABox assertions in your ontology (i.e., you have to create individuals, assign them to concepts, and interlink them using roles). Mind the hints added to each of the tasks I to IV, and consider the explanations provided by the authors of DOLCE-Lite in terms of Protégé annotations and in the document linked in the footnote.

[1] Some explanations on the rationale of the choice of concepts and roles defined in the DOLCE-Lite ontology are provided in the annotations to each concept / role. Some more complete explanations can also be found here: `http://www.loa.istc.cnr.it/old/Papers/WonderWebD17V2.0.pdf`. Mainly, these explanations are philosophical in nature.

I) The pot has a bump.

II) The stove is in the kitchen.

III) The mug is made of porcelain.

IV) Water is boiling in the pot for the whole day.

Again, save your ontology as an OWL/XML document.

Hints: For your specifications the following DOLCE-Lite concepts and roles may be useful: Concepts: feature/relevant-part, physical-quality/spatial-location_q, temporal-location_q, space-region, amount-of-matter, time-interval, perdurant/state; Roles: inherent-in[2], q-location[3], generic-constituent, participant/total-constant-participant, specific-constant-dependent/host-of. Feel free to use further concepts and roles provided by DOLCE-Lite or to define your own concepts/roles if you think that the listed ones do not entirely fulfill your modeling needs.

Send your file(s) to `lindner@informatik.uni-freiburg.de`.

[2]In the document from footnote 1, `inherent-in` is called qt in Figure 3.
[3]In the document from footnote 1, `q-location` is called ql_t in Figure 3.