Übung zur Lehrveranstaltung

Grundlagen Semantic Web

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http://semantic-web-grundlagen.de

Übung 3: OWL

Aufgabe 3.1 Use OWL DL to model the following sentences:

- The class `Vegetable` is a subclass of `PizzaTopping`.
- The class `PizzaTopping` does not share any elements with the class `Pizza`.
- The individual `aubergine` is an element of the class `Vegetable`.
- The abstract role `hasTopping` is only used for relationships between elements of the classes `Pizza` and `PizzaTopping`.
- The class `VegPizza` consists of those elements which are in the class `NoMeatPizza` and in the class `NoFishPizza`.
- The role `hasTopping` is a subrole of `hasIngredient`.

Aufgabe 3.2 Decide which of the following statements would be reasonable in the context of the ontology from Exercise 3.1.

- The role `hasIngredient` is transitive.
- The role `hasTopping` is functional.
- The role `hasTopping` is inverse functional.

Aufgabe 3.3 Use OWL DL to model the following sentences.

- Every pizza has at least two toppings.
- Every pizza has `tomato` as topping.
- Every pizza in the class `PizzaMargarita` has exactly `tomato` and `cheese` as toppings.

Aufgabe 3.4 Translate the ontology which you created as a solution for Exercise 3.1 into DL syntax.

Aufgabe 3.5 Translate the ontology which you created as a solution for Exercise 3.1 into predicate logic syntax.

Aufgabe 3.6 Express the following sentences in $\mathcal{SROIQ}$, using the individual names `bonnie` and `clyde`, the class names `Honest` and `Crime`, and the role names `reports`, `commits`, `suspects`, and `knows`.

1. Everybody who is honest and commits a crime reports himself.
2. Bonnie does not report Clyde.
3. Clyde has committed at least 10 crimes.
4. Bonnie and Clyde have committed at least one crime together.
5. Everybody who knows a suspect is also a suspect.

Aufgabe 3.7 Translate the knowledge base

$$\begin{aligned} \mathtt{Human} &\sqsubseteq \exists \mathtt{hasMother}.\mathtt{Human} \\ \exists \mathtt{hasMother}.(\exists \mathtt{hasMother}.\mathtt{Human}) &\sqsubseteq \mathtt{Grandchild} \\ \mathtt{Human}\,&(\mathtt{anupriyaAnkolekar}) \end{aligned}$$

into RDFS syntax.

Aufgabe 3.8 Consider the two RDFS triples
`r rdfs:domain A .` and `A rdfs:subClassOf B .`
Understood as part of an OWL knowledge base, they can be expressed as $\exists r.\top \sqsubseteq A$ and $A \sqsubseteq B$.

Give a triple which is RDFS-entailed by the two given triples, but which cannot be derived from the OWL DL semantics.

Furthermore, give an OWL DL statement which is a logical consequence of the two OWL statements but cannot be derived using the RDFS semantics.

Aufgabe 3.9 Show using the $\mathcal{ALC}$ tableaux algorithm that the knowledge base

$$\begin{aligned} &\mathtt{Student} \sqsubseteq \exists \mathtt{attends}.\mathtt{Lecture} \\ &\mathtt{Lecture} \sqsubseteq \exists \mathtt{attendedBy}.(\mathtt{Student} \sqcap \mathtt{Eager}) \\ &\mathtt{Student}\,(\mathtt{aStudent}) \\ &\neg \mathtt{Eager}\,(\mathtt{aStudent}) \end{aligned}$$

is satisfiable.

Aufgabe 3.10 Show using the $\mathcal{ALC}$ tableaux algorithm that $(\exists r.E)(a)$ is a logical consequence of the knowledge base $K = \{C(a), C \sqsubseteq \exists r.D, D \sqsubseteq E \sqcup F, F \sqsubseteq E\}$.

Aufgabe 3.11 Show using the $\mathcal{ALC}$ tableaux algorithm that the knowledge base $K = \{\neg H \sqcup \exists p.H, B(t), \neg H(t)\}$ is satisfiable.

Aufgabe 3.12 Show using the $\mathcal{ALC}$ tableaux algorithm that the following knowledge base is unsatisfiable.

$$\begin{aligned}
\texttt{Bird} &\sqsubseteq \texttt{Flies} \\
\texttt{Penguin} &\sqsubseteq \texttt{Bird} \\
\texttt{Penguin} \sqcap \texttt{Flies} &\sqsubseteq \bot \\
\texttt{Penguin}&(\texttt{tweety})
\end{aligned}$$