

Foundations of Semantic Web Technologies

Tutorial 3

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Exercise 3.1. Model the following statements in OWL DL by giving the corresponding OWL/RDF snippets:

- The class `Vegetable` is a subclass of `PizzaTopping`.
- The class `PizzaTopping` does not have common elements with the class `Pizza`.
- The individual `Aubergine` is an element of the class `Vegetable`.
- The abstract role `hasTopping` connects only elements of the class `Pizza` with elements of the class `PizzaTopping`.
- Pizzas always have at least two toppings.
- Every `Pizza` from the class `PizzaMargarita` has `Tomato` as topping.
- The class `VegetarianPizza` consists of those individuals that are both in the class `PizzaWithoutMeat` and in the class `PizzaWithoutFish`.
- No `Pizza` from the class `PizzaMargarita` has a topping from the class `Meat`.

Exercise 3.2. Decide, if the following statements would make sense in the context of the pizza ontology from Exercise 3.1:

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

Exercise 3.3. Assume a vocabulary with the individual names `bonny` and `clyde`, the class names `Honest`, `Wise`, `Crime` and `Human` as well as the role names `commits`, `marriedWith`, `suspects`, `report` and `know`.

Which of the following propositions can be made in OWL 1, which in OWL 2 and which ones not at all? In the positive case, provide the corresponding axioms.

- (a) Everybody, who is honest and who commits a crime, reports himself.
- (b) Who is wise and honest, doesn't commit crimes.
- (c) Bonnie does not report Clyde.
- (d) Nobody reports a human, which whom he has committed a crime jointly.
- (e) Clyde has committed at least 10 crimes.
- (f) Bonnie and Clyde have committed at least one crime together.
- (g) Who committed a crime together with his/her spouse is not honest.
- (h) Everybody knowing a suspect, is a suspect himself.

Exercise 3.4. We want to define the concept “vegetarian pizza”. Which of the following definitions are appropriate for this? Provide a natural language description for each of the logical statements.

- (a) $\text{VegetarianPizza} \equiv \text{Pizza} \sqcap \neg \exists \text{hasIngredient} . (\text{Meat} \sqcap \text{Fish})$
- (b) $\text{VegetarianPizza} \equiv \text{Pizza} \sqcap \forall \text{hasTopping} . (\neg \text{Meat} \sqcup \neg \text{Fish})$
- (c) $\text{VegetarianPizza} \equiv \text{Pizza} \sqcap \neg \exists \text{hasTopping} . \text{Meat} \sqcap \neg \exists \text{hasTopping} . \text{Fish}$
- (d) $\text{VegetarianPizza} \equiv \text{Pizza} \sqcap \exists \text{hasTopping} . \neg \text{Meat} \sqcap \exists \text{hasTopping} . \neg \text{Fish}$
- (e) $\text{VegetarianPizza} \equiv \text{Pizza} \sqcap \forall \text{hasIngredient} . (\neg \text{Meat} \sqcap \neg \text{Fish})$

Exercise 3.5. Let the following ontology in DL syntax be given:

$\text{hasTopping} \sqsubseteq \text{hasIngredient}$	$\exists \text{hasTopping} . \top \sqsubseteq \text{Pizza}$
$\text{Vegetable} \sqcap \text{Cheese} \sqsubseteq \perp$	$\text{Cheese} \sqcap \text{Meat} \sqsubseteq \perp$
$\text{Vegetable} \sqcap \text{Meat} \sqsubseteq \perp$	$\text{Cheese} \sqcap \text{Fish} \sqsubseteq \perp$
$\text{Vegetable} \sqcap \text{Fish} \sqsubseteq \perp$	$\text{Meat} \sqcap \text{Fish} \sqsubseteq \perp$
$\top \sqsubseteq \forall \text{hasTopping} . \text{PizzaTopping}$	

Consider the following additional class definitions:

$\text{CheesePizza} \equiv \text{Pizza} \sqcap \exists \text{hasTopping} . \text{Cheese}$
 $\text{PizzaSpinach} \equiv \exists \text{hasTopping} . \text{Spinach} \sqcap \exists \text{hasTopping} . \text{Cheese} \sqcap$
 $\quad \forall \text{hasTopping} . (\text{Spinach} \sqcup \text{Cheese})$
 $\text{PizzaCarnivorous} \equiv \text{Pizza} \sqcap \forall \text{hasTopping} . (\text{Meat} \sqcap \text{Fish})$
 $\text{EmptyPizza} \equiv \text{Pizza} \sqcap \neg \exists \text{hasTopping} . \top$

- (a) Which of the classes given above would be recognized as subclass of `VegetarianPizza` by a DL reasoner (according to a correct definition from Exercise 3.4)? Explain your answers.

- (b) The classification from (a) shows that some of the pizza classes do not model the intended concept. How could the definition be corrected?
- (c) How would the result from (a) change, if one would use just \sqsubseteq instead of \equiv when defining `VegetarianPizza`?