Missing Manual Protege Ontology Tutorial

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1 Introduction

In this document, Protege OWL tutorial version 2.1, ontology has been explained in the DL syntax. The ontology of the original tutorial explained in the Manchester syntax.

1.1 Concepts and Disjointness

First create atomic concept in the taxonomy as shown in the following equations. This has been explained in the tutorial exercise 4.

$$Pizza \sqsubseteq \top \tag{1}$$
$$PizzaTopping \sqsubseteq \top \tag{2}$$
$$PizzaBase \sqsubseteq \top \tag{3}$$

As explain in the tutorial section 4.2, the disjoint concepts can be expressed as follows,

$$Pizza \sqcap PizzaTopping \sqcap PizzaBase \sqsubseteq \bot \tag{4}$$

Let's add subclasses to the $PizzaBase$ as explained in the exercise 6 in the tutorial.

$$ThinAndCrispyBase \sqsubseteq PizzaBase \tag{5}$$
$$DeepPanBase \sqsubseteq PizzaBase \tag{6}$$
$$ThinAndCrispyBase \sqcap DeepPanBase \sqsubseteq \bot \tag{7}$$

As explained in the exercise 7 in the tutorial, you need to create following axioms. For example, *necessary implication*s are,

$$CheeseTopping \sqsubseteq PizzaTopping \tag{8}$$
$$MeatTopping \sqsubseteq PizzaTopping \tag{9}$$
$$SeaFoodTopping \sqsubseteq PizzaTopping \tag{10}$$
$$VegetableTopping \sqsubseteq PizzaTopping \tag{11}$$

and disjointness is,

$$CheeseTopping \sqcap MeatTopping \sqcap SeaFoodTopping \sqcap VegetableTopping \sqsubseteq \bot \tag{12}$$

Rest of the *necessary implications* and *disjointness* are explain in the following equations.

$$MozzarellaTopping \sqsubseteq CheeseTopping \tag{13}$$
$$ParmezanTopping \sqsubseteq CheeseTopping \tag{14}$$

$$MozzarellaTopping \sqcap ParmezanTopping \sqsubseteq \bot \tag{15}$$
$$HamTopping \sqsubseteq MeatTopping \tag{16}$$
$$PepperoniTopping \sqsubseteq MeatTopping \tag{17}$$
$$SalamiTopping \sqsubseteq MeatTopping \tag{18}$$
$$SpicyBeefTopping \sqsubseteq MeatTopping \tag{19}$$

$$HamTopping \sqcap PepperoniTopping \sqcap SalamiTopping \sqcap SpicyBeefTopping \sqcap HamTopping \tag{20}$$

$$AnchovyTopping \sqsubseteq SeaFoodTopping \tag{21}$$
$$PrawnTopping \sqsubseteq SeaFoodTopping \tag{22}$$
$$TunaTopping \sqsubseteq SeaFoodTopping \tag{23}$$

$$AnchovyTopping \sqcap PrawnTopping \sqcap TunaTopping \sqsubseteq \bot \tag{24}$$

$$CaperTopping \sqsubseteq VegetableTopping \tag{25}$$
$$MushroomTopping \sqsubseteq VegetableTopping \tag{26}$$
$$OliveTopping \sqsubseteq VegetableTopping \tag{27}$$
$$OnionTopping \sqsubseteq VegetableTopping \tag{28}$$
$$PepperTopping \sqsubseteq VegetableTopping \tag{29}$$
$$TomatoTopping \sqsubseteq VegetableTopping \tag{30}$$

$$CaperTopping \sqcap MushroomTopping \sqcap OliveTopping \sqcap OnionTopping \sqcap PepperTopping \sqcap TomatoTopping \sqsubseteq \bot \tag{31}$$

$$RedPepperTopping \sqsubseteq PepperTopping \tag{32}$$
$$GreenPepperTopping \sqsubseteq PepperTopping \tag{33}$$
$$JalapenoPepperTopping \sqsubseteq PepperTopping \tag{34}$$

$$\begin{aligned} RedPepperTopping \sqcap GreenPepperTopping \\ \sqcap JalapenoPepperTopping \sqsubseteq \bot \end{aligned} \tag{35}$$

2 OWL Properties

As explained in the section 4.5 in the tutorial,

$$hasTopping \sqsubseteq hasIngredient \tag{36}$$
$$hasBase \sqsubseteq hasIngredient \tag{37}$$
$$isIngredientOf = hasIngredient^{-} \tag{38}$$
$$isBaseOf = hasBase^{-} \tag{39}$$
$$isToppingOf = hasTopping^{-} \tag{40}$$

I've created $isBaseOf$ and $isToppingOf$ directly under the root. When inferred, got a result as

$$hasTopping = isIngredientOf^{-}$$

and

$$hasBase = isIngredientOf^{-}$$

2.1 Functional Properties

Two properties are transitive according to the exercise 11 in the tutorial.

$$hasTopping^{+} \tag{41}$$
$$isToppingOf^{+} \tag{42}$$

However, the equation 42 is avoidable in the inference with the presence of reasoning. According to the exercise 12, *hasBase* should be a *functional* property as shown in the 43.

$$\top \sqsubseteq \leq\ 1\ hasBase \tag{43}$$

As explained in the exercise 13 & 14, domain and the range can be assigned to *hasTopping* role respectively in the equation 44 and the equation 45.

$$\geq\ 1\ hasTopping \sqsubseteq Pizza \tag{44}$$
$$\top \sqsubseteq \forall hasTopping.PizzaTopping \tag{45}$$
$$\geq\ 1\ hasBase \sqsubseteq Pizza \tag{46}$$
$$\top \sqsubseteq \forall hasBase.PizzaBase \tag{47}$$

3 Property Restrictions

As explained in the exercises 16 and 17, *Universal* restriction is written in the equation 48

$$Pizza \sqsubseteq \forall\, hasBase.PizzaBase \tag{48}$$

From the exercises 18, 19 and 20, define the $MargheritaPizza$,

$$MargheritaPizza \sqsubseteq \exists\, hasTopping.MozzarellaTopping \tag{49}$$
$$MargheritaPizza \sqsubseteq \exists\, hasTopping.TomatoTopping \tag{50}$$

I've purposely omitted the concept definitions for the $AmericanaPizza$, $AmericanHotPizza$ and $SohoPizza$ explained in exercises 21 through 23.

3.1 Classifying a ontology

Create a prob class to classifying a ontology as explained in the exercise.

$$ProbeInconsistentTopping \sqsubseteq CheeseTopping \tag{51}$$
$$ProbeInconsistentTopping \sqsubseteq VegetableTopping \tag{52}$$
$$\tag{53}$$

$$\begin{aligned} \mathcal{T} \models\ & ProbeInconsistentTopping \sqsubseteq \\ & CheeseTopping \sqcup VegetableTopping \\ \text{iff } & ProbeInconsistentTopping \quad \text{is inconsistent} \end{aligned} \tag{54}$$

3.2 Defined Classes

As explained in the exercise 28 and 29,

$$CheesyPizza \equiv Pizza \sqcap \exists\, hasTopping.PizzaTopping \tag{55}$$

From exercises 31 and 32,

$$\begin{aligned} VegetarianPizza \equiv\ & Pizza \sqcap \\ & \forall\, hasTopping.(CheeseTopping \sqcup VegetableTopping) \end{aligned} \tag{56}$$

As explained in the exercise 34, closure axiom on the hasTopping property for the MargheritaPizza is

$$\begin{aligned} MargheritaPizza \sqsubseteq\ & \\ & \forall\, hasTopping.(MozzarellaTopping \sqcup TomatoTopping) \end{aligned} \tag{57}$$

3.3 Value Partitions

$$SpicinessValuePartition \sqsubseteq ValuePartition \tag{58}$$
$$Mild \sqsubseteq SpicinessValuePartition \tag{59}$$
$$Medium \sqsubseteq SpicinessValuePartition \tag{60}$$
$$Hot \sqsubseteq SpicinessValuePartition \tag{61}$$
$$Mild \sqcap Medium \sqcap Hot \sqsubseteq \bot \tag{62}$$