

## UE07: OWL Reasoning

Semantic AI 2023, JKU

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Your tasks:

- Read and understand the given OWL ontologies.
- Do the OWL reasoning in your head and indicate the entailments in the given tables.
- You may use Protégé to check your reasoning (see 06-Intro-OWL).

### Part I: Instance Checking (8 points)

Given are the following OWL ontologies.

For each individual derive

- of which classes it is definitely a member, i.e., that individual is a member of that class in every possible world (mark with "+"),
- of which classes it is definitely not a member, i.e., there is no possible world in which that individual is a member of that class (mark with "-"),
- and of which classes it is possibly a member, i.e., there is at least one possible world in which that individual is a member of that class and at least one possible world in which that individual is not a member of that class (mark with "?" or leave empty).

#### Task 1

Class: A

Class: B

Class: C

EquivalentTo: A or B

Class: D

EquivalentTo: C and (not (B))

Individual: o1

Types: A

Individual: o2

Types: B

Individual: o3

Types: C

Individual: o4

Types: D

	A	B	C	D
o1	+	?	?	?
o2	?	+	?	-
o3	?	?	+	?
o4	?	-	+	+

#### Task 2

Individual: o1

Facts: p1 o2

Types: C

Individual: o2

Types: C

ObjectProperty: p1

Characteristics: Symmetric

Class: C1

EquivalentTo: p1 some C

Class: C2

SubclassOf: p1 some C

Class: C3

EquivalentTo: p1 only C

	C1	C2	C3
o1	+	?	-
o2	+	?	-

### Task 3

Individual: o1  
Types: C1  
Class: C1  
Class: C2  
EquivalentTo: C1  
SubclassOf: C3  
Class: C3  
SubclassOf: C4  
Class: C4  
Class: C5  
SubclassOf: C1  
Class: C6  
DisjointWith: C3

	C1	C2	C3	C4	C5	C6
o1	+	+	+	+	?	-

### Task 4

Individual: o1  
Facts: p1 o2, p1 o3  
Individual: o2  
Types: C1  
Individual: o3  
Types: C2  
  
ObjectProperty: p1  
InverseOf: p2  
ObjectProperty: p2  
Characteristics: InverseFunctional

	C1	C2
o1	+	+
o2	+	?
o3	?	+

### Task 5

Class: A  
Class: B  
Class: C  
EquivalentTo: A or B  
Class: D  
EquivalentTo: C and (not (B))  
Individual: o1  
Types: A  
Individual: o2  
Types: B  
Individual: o3  
Types: C  
Individual: o4  
Types: D

	A	B	C	D
o1	+	?	?	?
o2	?	+	?	-
o3	?	?	+	?
o4	?	-	+	+

## Task 6

Class: PERSON  
     EquivalentTo: HUMAN  
 Class: ANIMAL  
 Class: DOG  
     SubClassOf: ANIMAL  
     DisjointWith: OLDMAN  
 Class: HUMAN  
     EquivalentTo: PERSON  
     SubClassOf: ANIMAL  
 Class: OLDMAN  
     SubClassOf: PERSON  
     DisjointWith: DOG  
 Class: COLLIE  
     SubClassOf: DOG  
 Individual: flipper  
     Types: ANIMAL  
 Individual: rex  
     Types: DOG  
 Individual: mary  
     Types: HUMAN  
 Individual: john  
     Types: PERSON  
 Individual: jim  
     Types: OLDMAN  
 Individual: lassie  
     Types: COLLIE

	PERSON	ANIMAL	DOG	HUMAN	OLD-MAN	COL-LIE
FLIP-PER	?	+	?	?	?	?
REX	?	+	+	?	-	?
MARY	+	+	?	+	?	?
JOHN	+	+	?	+	?	?
JIM	+	+	-	+	+	-
LASSIE	?	+	+	?	-	+

## Task 7

Individual: o1  
     Types: C  
 Individual: o2  
     Facts: p o1  
     Types: C  
 Individual: o3  
     Types: C1  
 Individual: o4  
     Facts: p o1, p o5  
 Individual: o5  
     Types: not C, p exactly 0  
 Class: C  
 Class: C1  
     SubclassOf: p some C  
 Class: C2  
     EquivalentTo: p some C  
 Class: C3  
     EquivalentTo: p only C

	C	C1	C2	C3
o1	+	?	?	?
o2	+	?	+	-
o3	?	+	?	?
o4	?	?	+	-
o5	-	-	-	-

## Task 8

Class: Woman

Class: Teacher

Class: Artist

Class: JohnsFriends

EquivalentTo: MarysFriends, {Bob , Mary}

Class: MarysFriends

EquivalentTo: JohnsFriends, {MsKeller , Mueller}

Individual: Bob

Types: Teacher, not (Woman)

Individual: Mary

Types: Artist, Woman

Individual: MsKeller

Types: Woman

Individual: Mueller

	JohnsFriends	MarysFriends	Teacher	Artist	Woman
Bob	+	+	+	?	-
Mary	+	+	?	+	+
MsKeller	+	+	?	?	+
Mueller	+	+	?	?	?

## Part II: Subsumption Checking (2 points)

### Task 9

Given is an OWL ontology in Manchester Syntax.

```

ObjectProperty: eats
Class: Cereals
Class: Egg
Class: Fish
Class: Fruits
Class: Meat
Class: Milk
Class: Vegetables
DisjointClasses:
    Cereals, Egg, Fish, Fruits, Meat, Milk, Vegetables
Class: Person
    SubClassOf: eats some Food
    DisjointWith: Food
Class: Food
    EquivalentTo: Cereals or Egg or Fish or Fruits or Meat or Milk or Vegetables
    DisjointWith: Person
Class: Carnivor
    EquivalentTo: Person and (eats only (Fish or Meat))
Class: Frutarier
    EquivalentTo: Person and (eats only Fruits)
Class: Vegan
    EquivalentTo: Person and (eats only (Cereals or Fruits or Vegetables))
Class: Vegetarian
    EquivalentTo: Person and (eats only (not (Fish or Meat)))
Class: xPerson
    SubClassOf: Person and (eats some Fruits)
Class: yPerson
    EquivalentTo: Person and (eats some Fruits)
Class: zPerson
    EquivalentTo: (eats some Cereals) and (eats some Fruits) and (eats some Vegetables)
    SubClassOf: Person
    
```

Your task is to find the pairwise semantic relationships of classes **Carnivor**, **Frutarier**, **Vegan**, **Vegetarian**, **zPerson**, **xPerson**, **yPerson**. Indicate the relationships in the cells in the table below using the following symbols:

- subclass of  $\sqsubseteq$
- equivalent to  $\equiv$
- superclass of  $\sqsupseteq$
- disjoint with  $\sqsubseteq \neg$
- none of the above leave empty

As an example, the semantic relationship *xPerson is subclass of yPerson* is already indicated in the table.

	yPerson	xPerson	zPerson	Vegetarian	Vegan	Frutarier	Carnivor
Carnivor	$\sqsubseteq \neg$	$\sqsubseteq \neg$	$\sqsubseteq \neg$	$\sqsubseteq \neg$	$\sqsubseteq \neg$	$\sqsubseteq \neg$	$\equiv$
Frutarier	$\sqsubseteq$		$\sqsubseteq \neg$	$\sqsubseteq$	$\sqsubseteq$	$\equiv$	
Vegan	$\sqsubseteq$		$\sqsupseteq$	$\sqsubseteq$	$\equiv$		
Vegetarian	$\sqsubseteq$	$\sqsupseteq$	$\sqsupseteq$	$\equiv$			
zPerson	$\sqsubseteq$		$\equiv$				
xPerson	$\sqsubseteq$	$\equiv$					
yPerson	$\equiv$						