

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.

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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						