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	?	+

Was haben die properties mit den classes zu tun? Soweit ich verstehe passen die individuals nicht zur ontologie, da o1 über p2 von o3 UND o2 erreicht wird, was bei inverse functional ja nicht erlaubt ist.

Task 5

(selbes bsp wie 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 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
FLIPPER	?	+	?	?	?	?
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	+	-	-	- (weil es garkeine pro-perties hat)
o2	+	?	+	+
o3	? (not stated)	+	+	(idk, no p)
o4	?(not stated)	?	+	- (no p any C)
o5	-	-	-	-

Allgemeine Frage: ist es etwas FIX nicht, weil es nicht gestated ist? zB weiß ich dass eine property nicht gilt, wenn diese nicht genannt wurde??

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 ⊑
- equivalent to ≡
- superclass of ⊒
- disjoint with ⊑¬
- 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	⊑¬	⊑¬	⊑¬	⊑¬	⊑¬	⊑¬	≡
Frutarier	⊑ f sub y	⊑	⊑ f sub z	⊑ (f sub v)	⊑ (f sub v)	≡	
Vegan	⊒ v super y	⊑	⊑ v sub z	⊒ vegan s v	≡		
Vegetar-ian	⊒ v super y	⊑	⊑ v sub z	≡			
zPerson	⊒ z super y	⊒ z super x	≡				
xPerson	⊑ x sub y	≡					
yPerson	≡						