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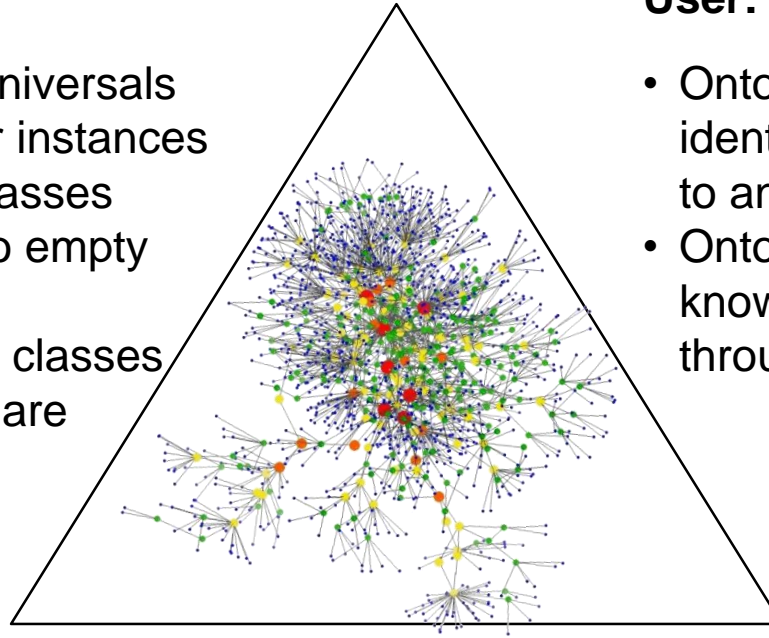
**International Conference  
on Biomedical Ontology**  
University at Buffalo, NY · July 26-30, 2011

**Higgs bosons, mars  
missions, and unicorn  
delusions:  
How to deal with terms  
of dubious reference  
in scientific ontologies**

# There are different views on the content of scientific ontologies

## Aristotelian Realist:

- Ontologies represent universals
- Universals exist in their instances
- Universals extend to classes
- No universals extend to empty classes
- OBO Foundry: Defined classes are allowed given they are not empty



## User:

- Ontologies provide semantic identifiers (and their meaning) to annotate **scientific discourse**
- Ontologies may support knowledge management through automated reasoning

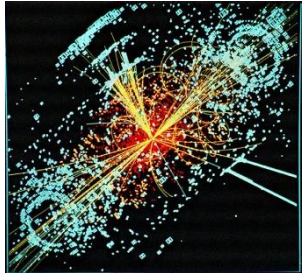
## Logician:

- Ontologies are sets of axioms containing class and relation symbols and logic constructors
- New classes can be created as long as they obey the syntax, e.g.  
 $A \text{ equivalentTo } B \text{ and } C$   
 $D \text{ equivalent to } (\text{not } A)$

# Scientific discourse may contain terms of dubious reference.

<b>Category of Entity / Concept of Reference</b>	<b>Term</b>	<b>Definition</b>	<b>Occurrences in MEDLINE</b>
Speculative, not scientifically plausible	Qi	The vital life force in the body, supposedly able to be regulated by acupuncture	299
Hypothetical	Higg's Boson	Hypothetical elementary particle predicted to exist by the standard model of particle physics.	19
Culture-specific constructs	Koro	Syndrome of someone's belief that his/her external genitals disappear	139
Subjects of unrealized plans	Manned mars mission	Process during which a human disembarks on Mars	8
Fictional concepts	Unicorn	Horse with a horn	65
Obsolete concepts of historic interest	Phlogiston	a fire-like element released during combustion	18

# Hypothetical entities and unrealized plans can be defined in terms of logic.



**Higgs Boson:**  
hypothetical  
elementary particle,  
so far not found by  
experiment:



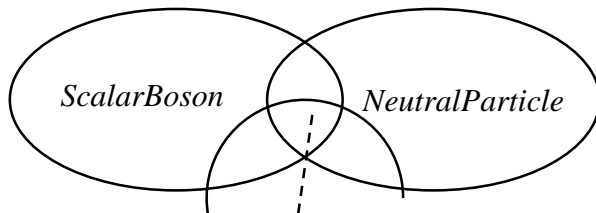
Large Hadron  
Collider (CERN)  
3 000 000 000 €

**Manned Mars Mission:**  
science fiction but also  
subject of scientific  
proposals:



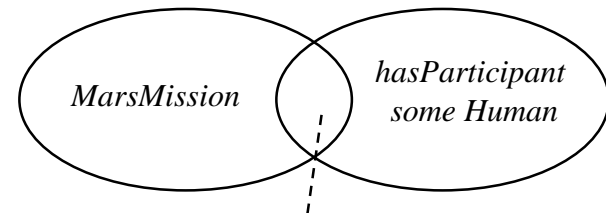
e.g. NASA Design  
Reference Mission 3.0

*HiggsBoson* EquivalentTo  
*ScalarBoson* and  
*NeutralParticle* and ...



not known whether empty

*MannedMarsMission* EquivalentTo  
*MarsMission* and  
**hasParticipant** *some Human*

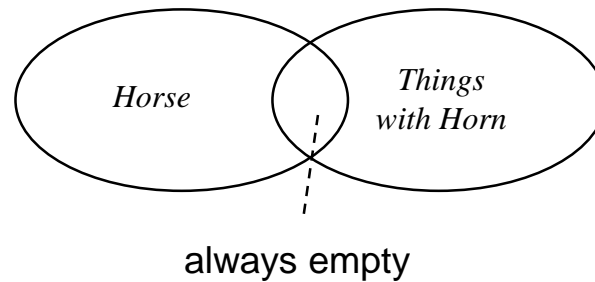


empty in 2011  
empty in 2031 ?

# Fictitious terms can be defined by logic, too.



*Unicorn* EquivalentTo  
*Horse* and  
**hasPart** *some* *Horn*



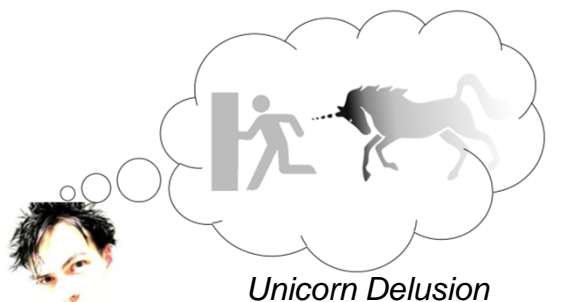
**Fictitious terms are used as metaphors or themes of delusions.**



*Unicorn Delusion Equivalent To  
Delusion and is About only Unicorn*

# Fictitious terms are used as metaphors or themes of delusions.

## Exist



*Unicorn Delusion*

subClassOf



*Pink Unicorn Delusion*

## Do not Exist



*Unicorn*

subClassOf



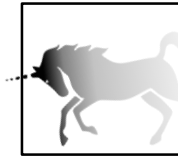
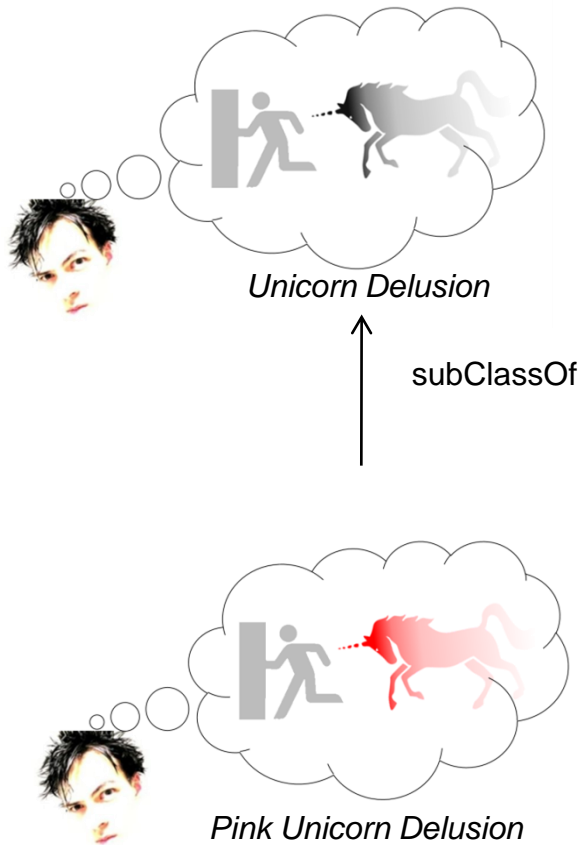
*Pink Unicorn*

isAbout

isAbout

# Fictitious terms are used as metaphors or themes of delusions.

## Exist



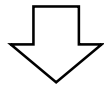
**Irrelevant  
for  
Realist  
Ontologies**



# Classes that refer to fictitious terms can be fully defined referring to universals only

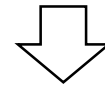
- Examples:
  - Higgs Boson Research Project
  - Manned Mars Mission Plan
  - Unicorn delusion
- Running example: Unicorn delusion

*Unicorn Delusion* EquivalentTo  
*Delusion* and isAbout only *Unicorn*



*Unicorn Delusion* EquivalentTo  
*Delusion* and isAbout only  
(*Horse* and hasPart  
some *Horn*)

*PinkUnicorn Delusion* EquivalentTo  
*Delusion* and isAbout only *PinkUnicorn*



*PinkUnicorn Delusion* EquivalentTo  
*Delusion* and isAbout only  
(*Horse* and (hasPart some *Horn*)  
and (bearerOf some *Pink*))

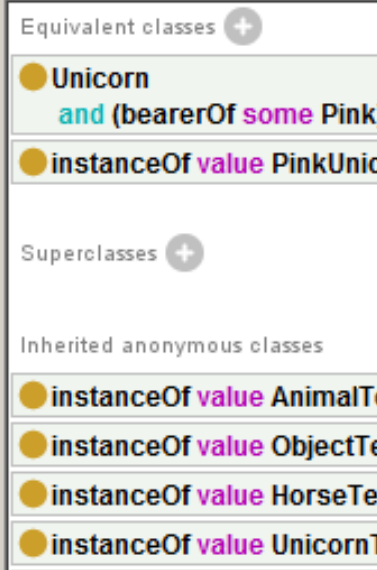
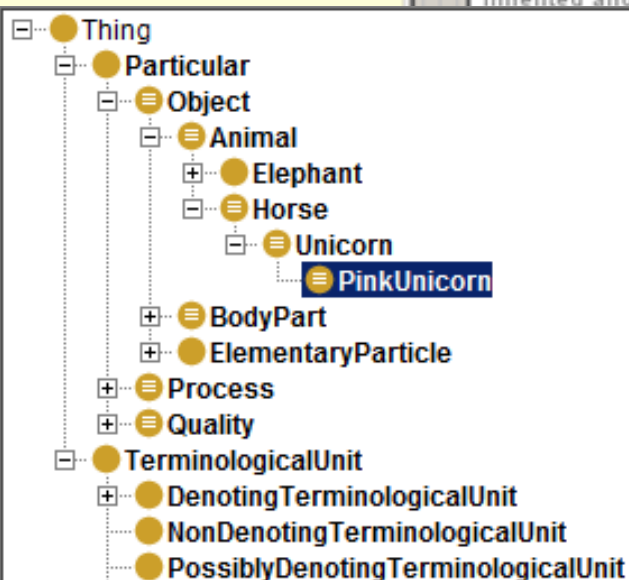
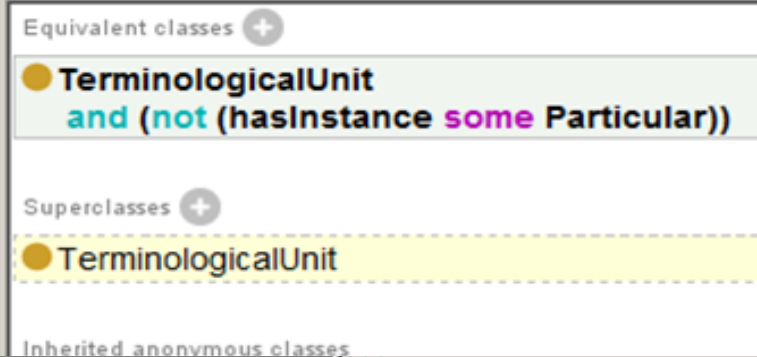
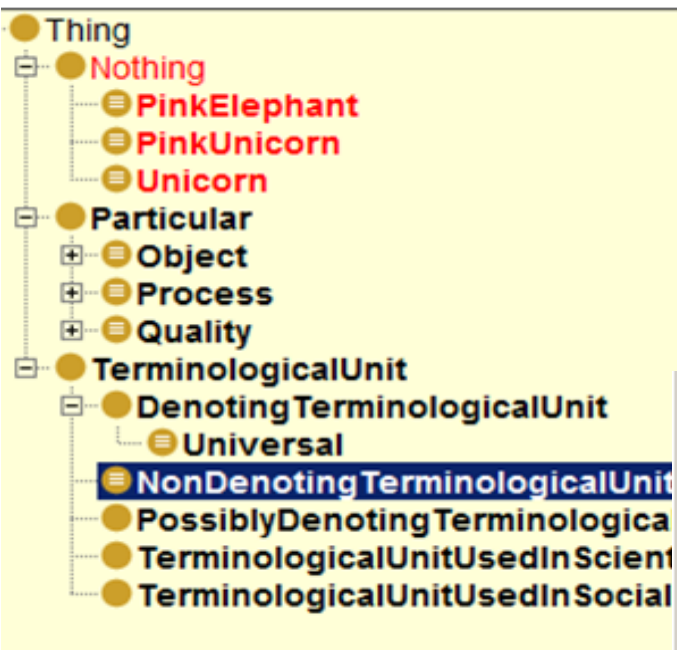
inferred  
subclass  
relation



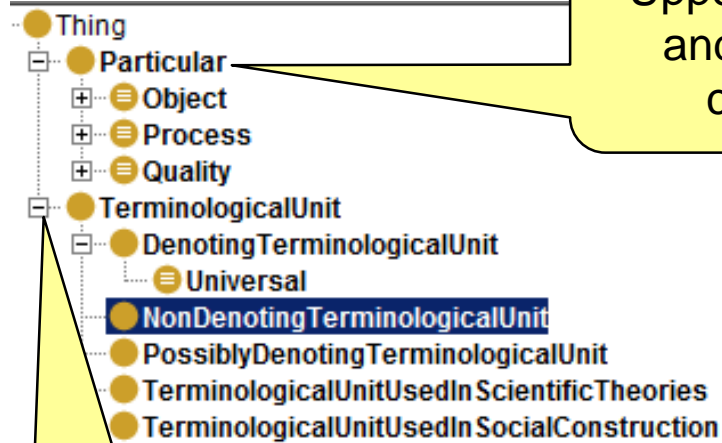
# There are two ways to deal with non-referring terms in ontologies

1. To include them indirectly in full definitions that do not contradict the realist paradigm:  
Disadvantage: ontology provides no identifiers for e.g. Higgs boson or Manned mars mission, users need to coordinate.
2. Include them into OWL models as explicit non-ontological extensions of ontologies - for convenience.  
(OWL model  $\neq$  realist ontologies)

# Inclusion of a branch "Terminological Unit" in an ontology

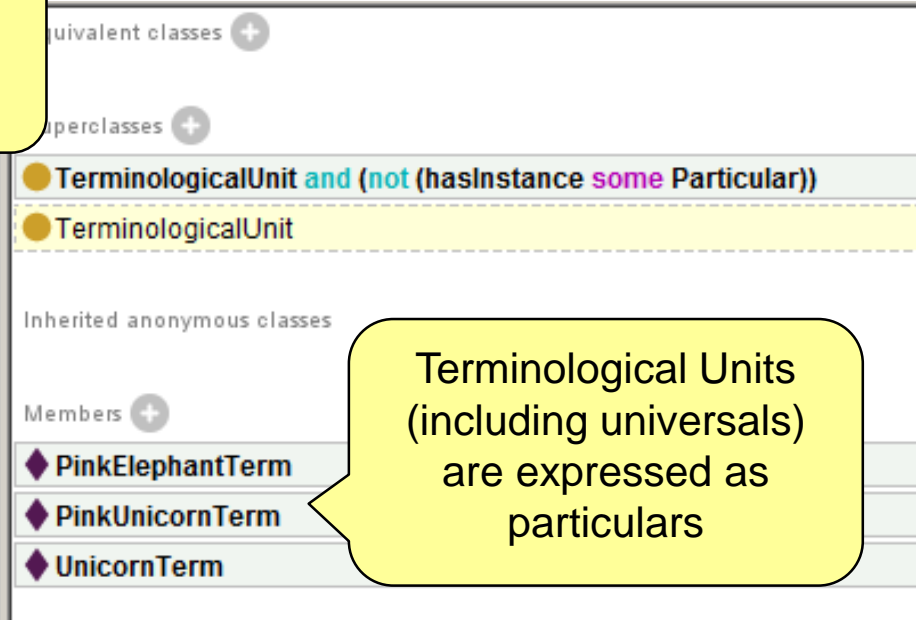


# Inclusion of a branch "Terminological Unit" in an ontology



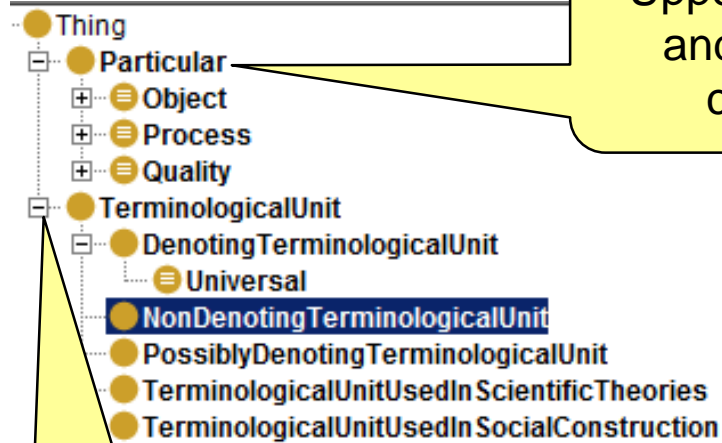
Classification of Terminological Units

Upper ontology and domain classes



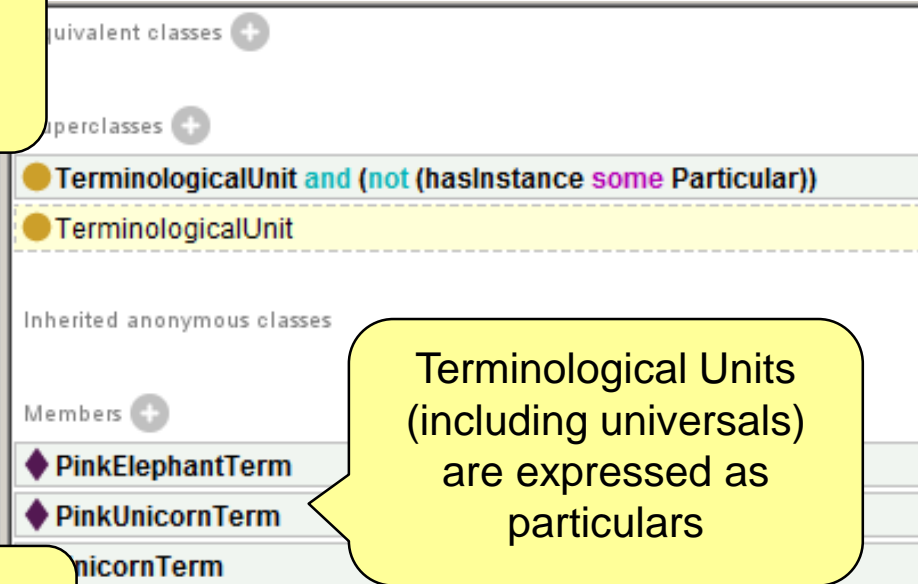
Terminological Units (including universals) are expressed as particulars

# Inclusion of a branch "Terminological Unit" in an ontology



Upper ontology and domain classes

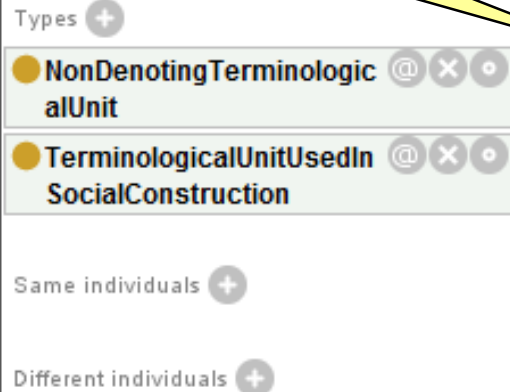
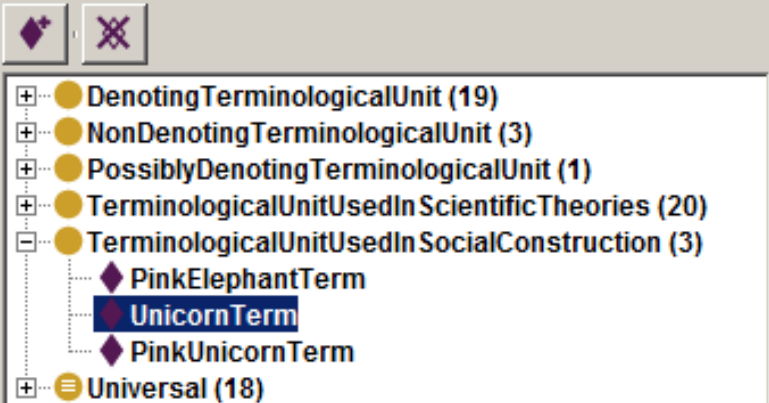
Classification of Terminological Units



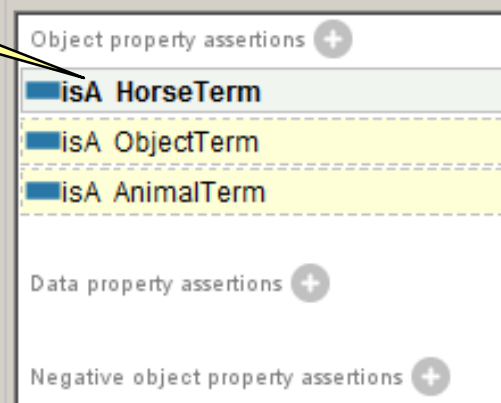
Terminological Units (including universals) are expressed as particulars

Is-a relates terms

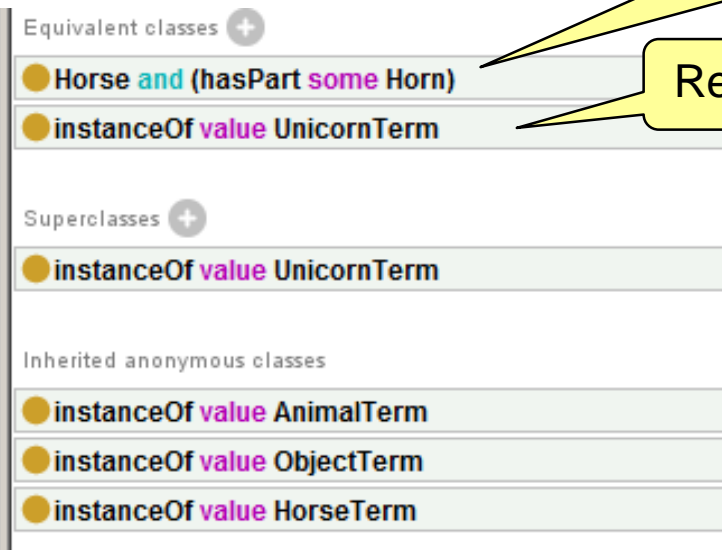
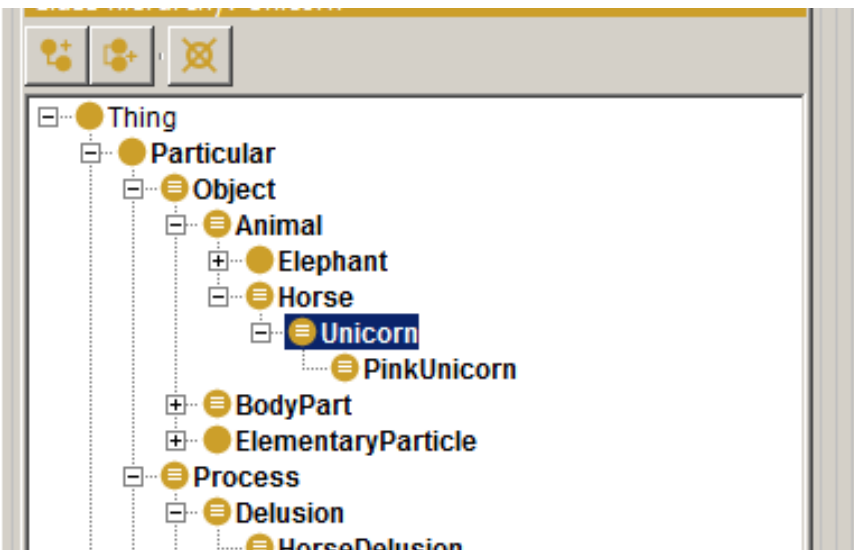
Individuals by type: UnicornTerm



Property assertions: UnicornTerm



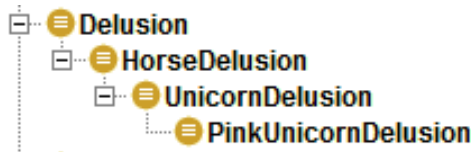
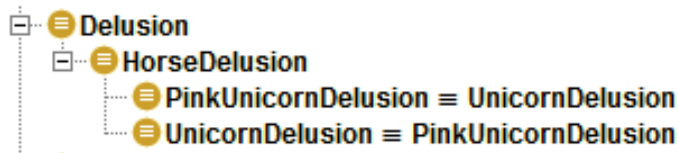
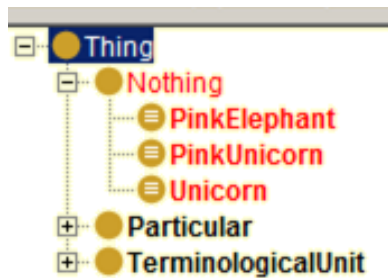
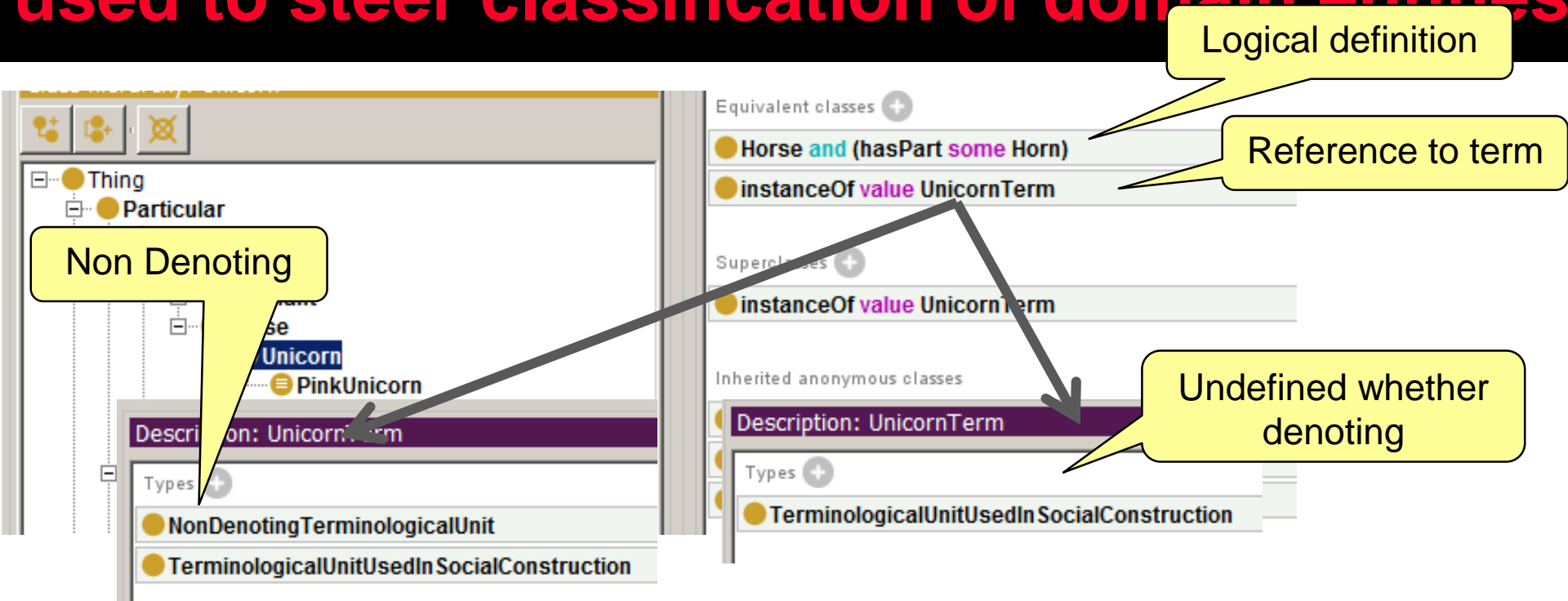
# Classification of Terminological units can be used to steer classification of domain entities



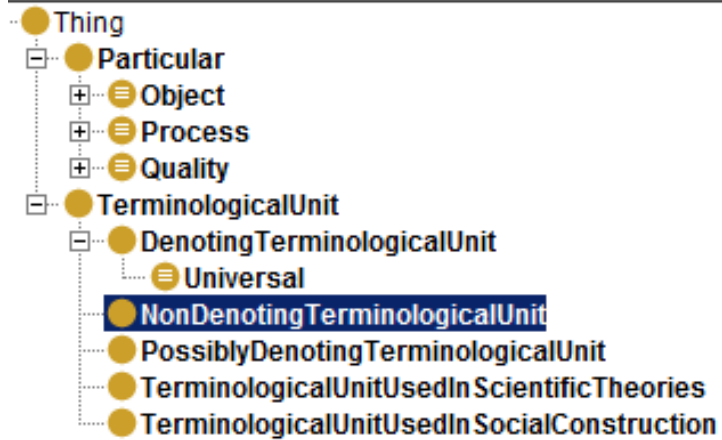
Logical definition

Reference to term

# Classification of Terminological units can be used to steer classification of domain entities



# Inclusion of a branch "Terminological Unit" in an ontology



Equivalent classes +

Superclasses +

TerminologicalUnit and (not (hasInstance some Particular))

TerminologicalUnit

Inherited anonymous classes

Members +

PinkElephantTerm

PinkUnicornTerm

UnicornTerm

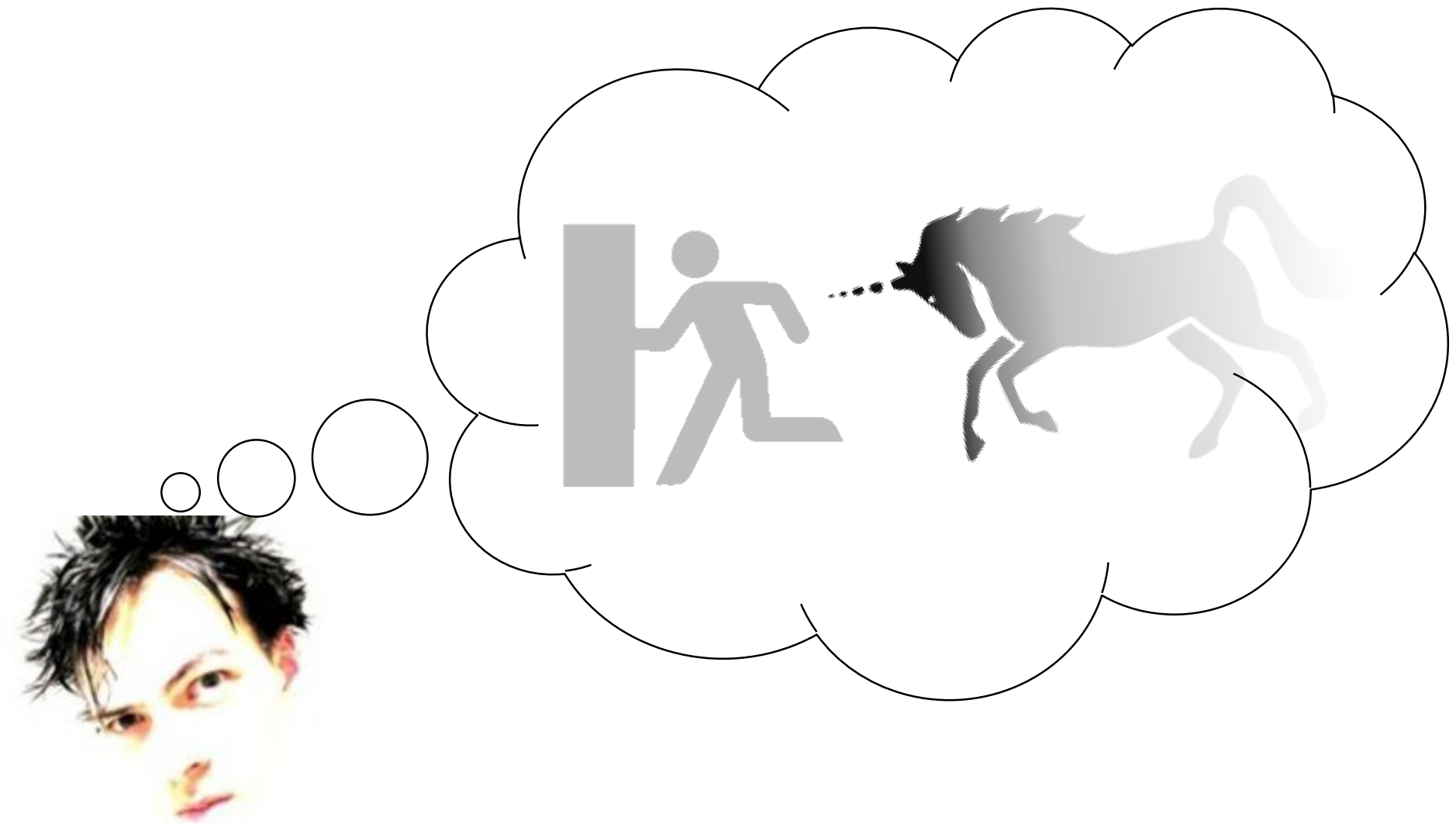




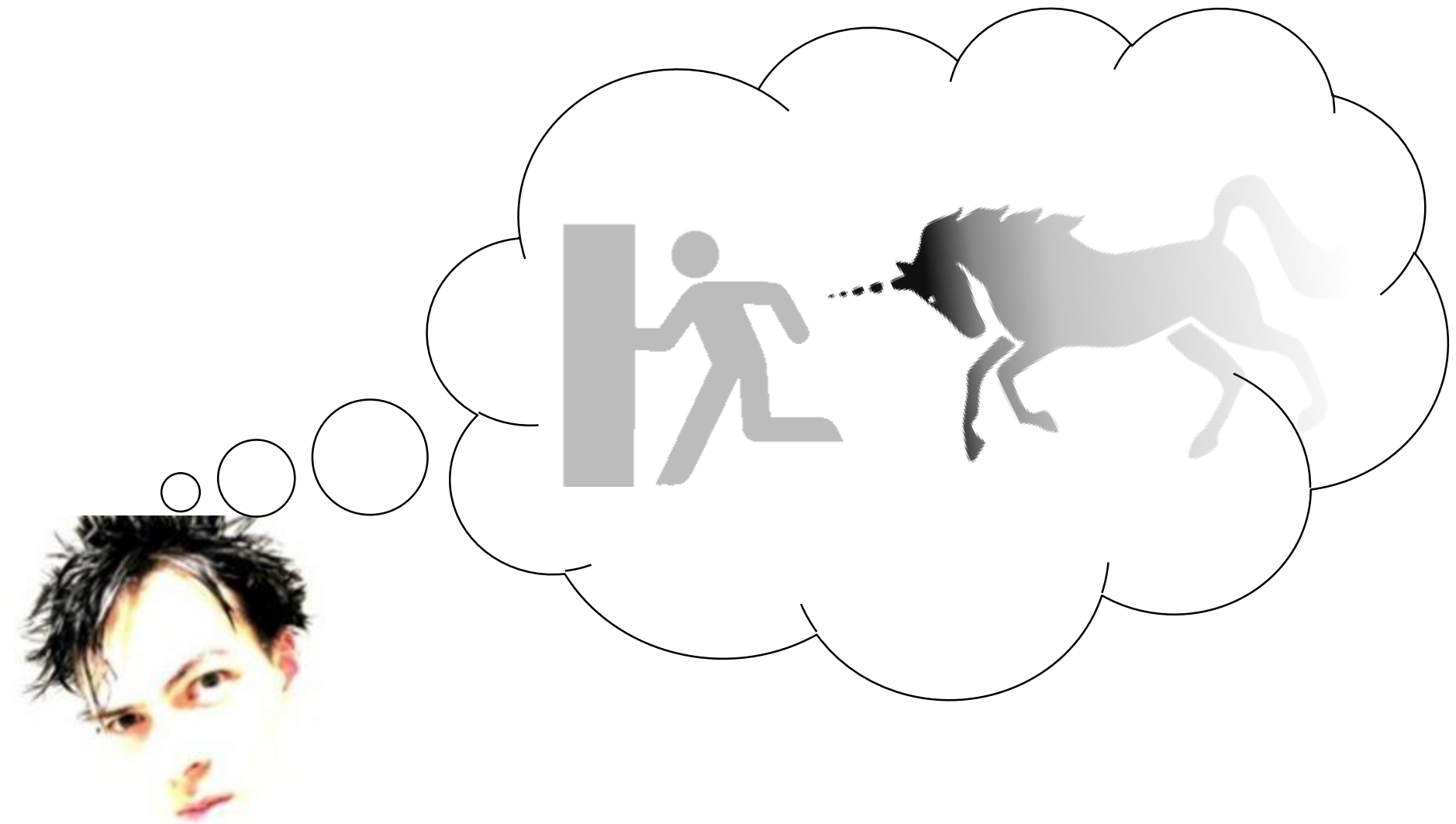
Thank You

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# Fictitious entities: used as metaphors or theme of delusions



# Fictitious entities: used as metaphors or theme of delusions



# Fictitious entities: used as metaphors or theme of delusions

[Reprod Domest Anim.](#) 2008 Jun;43(3):382-4. Epub 2007 Dec 30.

**Case of pregnancy in two cows with unicorn horn of the uterus either by artificial insemination at ipsilateral or embryo transfer at contralateral corpus luteum in the ovary.**

[Moriyama C](#), [Kobayashi I](#), [Tani M](#), [Oishi T](#), [Kajisa M](#), [Horii Y](#), [Kamimura S](#).

## Source

The United Graduate School of Veterinary Science, Yamaguchi University, Yoshida, Yamaguchi, Japan.

## Abstract

Two Holstein heifers and a cow were diagnosed with White Heifer Disease by ultrasonography. Case 1 was a 14 month-old heifer with aplasia of both sides of the uterine horn. In case 2, a primiparous cow and case 3, an 18 month-old heifer, both showed aplasia of the right uterine horn. Case 2 became pregnant by artificial insemination at ipsilateral ovulatory follicle and corpus luteum in the left ovary, while case 3 became pregnant by embryo transfer at 7 days after oestrus with contralateral corpus luteum in the right ovary.

