What is an Ontology, really?

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Motivation

- Workshops live from good discussions
- Hypothesis: Mathematical theories are of limited use for ontology learning.

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What do we intend to learn? What are ontologies?

Orthodox Definitions of Ontology

Gruber (1993):
An ontology is an explicit specification of a conceptualization

Guarino et al 2009: What is an ontology?

Definition (Ontology)

$\mathbf{O}$ is an ontology for $\mathbf{C}$ in $\mathbf{L}$ iff

- $\mathbf{O}$ is a set of sentences of $\mathbf{L}$, and
- $\{M \in \mathbf{Mod_L} \mid M \models \mathbf{O}\} \approx$ Intended-Models$(\mathbf{L}, \mathbf{C})$

- $\mathbf{L}$: first-order logic
- $\mathbf{Mod_L}$: set of models of $\mathbf{L}$
- $\mathbf{C}$: Conceptualization[1]
- $\approx$: approximates

[1] For the sake of simplicity I omit the distinction between ontological commitment and conceptualization.

Argument with a false premise

- Ontologies are logical theories.
- Mathematical theories are logical theories.
- We have 2500 years of experience with maths.
- Thus, studying mathematical theories may help us to learn ontologies.

But, ...

ontologies are not logical theories.

Argument 1: Identity criterion

- Ontologies change over time
- Sets don't change over time
- Thus, ontology $\neq$ sets of sentences

Argument 2: Multiple languages

- The same ontology may be represented in OWL and FOL.
- Thus, ontology $\neq$ sets of sentences in a particular logic.

Argument 3: Criteria for change

Assume your ontology contains the axiom:

- Class: Biolgy DisjointWith: Chenistry

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Assume it is replaced by:

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Does it change the ontology / logical theory?

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Assume it is replaced by:

- Class: Pizza DisjointWith: Pasta

Does it change the ontology / logical theory?

Argument 4: Two ontologies, one logical theory

```
Class: url123
        Annotations: rdfs:label "Biology"
        DisjointWith: url456
Class: url456
        Annotations: rdfs:label "Chemistry"
```

Argument 4: Two ontologies, one logical theory

```
Class: url123
        Annotations: rdfs:label "Biology"
        DisjointWith: url456
Class: url456
        Annotations: rdfs:label "Chemistry"
```

```
Class: url123
        Annotations: rdfs:label "Pizza"
        DisjointWith: url456
Class: url456
        Annotations: rdfs:label "Pasta"
```

Argument 5: Different development process

Mathematics:

- Challenge: developing axioms, proving theorems
- May be done by a single person

Ontology:

- Challenge: creating consensus on conceptualization
- Axiomatization is easy
- Necessarily, a social activity which typically involves
  - design decisions
  - fights
  - compromises

Argument 6: Ontology without logic

- Gene Ontology (GO): extremely influential
- Developed in the OBO formalism
- For many years no logical foundation

Observation 1: Terms matter

Renaming symbols in a logical theory, does not change anything significant.

Renaming symbols in an ontology, will likely introduce errors.

Observation 2: Annotations matter

- ChEBI Ontology (for chemicals) is very successful.
- Axiomatization is extremely weak.
- ChEBI classes are annotated with chemical formulas, unambiguously identifying a class of molecules.

Annotations are an essential part of ontologies!

What is an ontology? (informal definition)

An ontology of a given domain of interest is a document that provides

- a vocabulary for describing the domain,
- annotations that document the vocabulary, and
- a logical theory (consisting of axioms and definitions) for the vocabulary,

and which serves as a constitutive dictionary of a formal language about the domain of interest.

Constitutive dictionary

A *constitutive dictionary* of a formal language about domain

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Criterion for a successful ontology

- wide adoption (like any language)
- little ambiguity

Summary

$$\text{Ontology} \neq \text{Logical theory}$$