FMA in OWL meeting
November 12-13, 2009, Stanford University

The Foundational Model of Anatomy and its Ontological Commitment(s)

Stefan Schulz

University Medical Center, Freiburg, Germany

Ontological commitment

- "Agreement about the ontological nature of the entities being referred to by the representational units in an ontology" (modified definition following Gruber 93)
- Formal ontologies: subsumption and equivalence statements are either true or false
- Problem: truth-value of logical expressions depend on their interpretation re domain that they represent

Key questions for ontology engineering

- What are the particulars that are instantiated by ontology classes / concepts / types
- What are those entities dependent on (without what can't they exist)
- When do they come into / go out of existence
- Is it with respect to a certain perspective (granularity) that an entity can be referred to?

Alan Ruttenberg, tutorial at ICBO 2009

How to analyze FMA commitments

- Subjects to analysis: FMA triplets ($T1_{FMA}$ – r_{FMA} – $T2_{FMA}$)
- Type interpretation:
  - *T1* and *T2* are types.
  - All instances of *T1* are related to at least one instance of *T2* by **r**
  - In OWL: *T1* subClassOf **r** some *T2*
- Instance interpretation
  - **T1** and **T2** are instances (particulars)
  - (**T1**, **T2**) is in the extension of the relation **r**
- Special case: r = isa_{FMA}
  - *T1* and *T2* are types
  - **T1** is a particular and *T2* is a type
- DL: classes/types and instances/particulars mutually exclusive

Example 1:
Universal statement about right thumbs

$$\textit{Right Thumb}_{FMA}\ \textit{part\_of}_{FMA}\ \textit{Right Hand}_{FMA} \equiv$$

Right Thumb subClassOf **part_of** some *Right Hand*

True	False
All right thumbs that are part of a living organism	Severed right thumbs

Example 2a:
Universal statement about right hands

$Right\ Hand_{FMA}\ has\_part_{FMA}\ Right\ Thumb_{FMA} \equiv$

Right Hand subClassOf **has_part** some *Right Thumb*

True	False
All "canonic" right hands Some non-canonic right hands	Some non-canonic right hands (those with no thumbs)

Example 2b:
Assertion about individuals

$Right\ Hand_{FMA}\ has\_part_{FMA}\ Right\ Thumb_{FMA} \equiv$

Individual: **Right Thumb**; Facts: **part_of Right Hand**

Individual: **Right Hand**; Facts: **has_part Right Thumb**

(no universal statement)

True	False

• Right hand and thumb of one canonical individual
• Information artifact:
  • 2D or 3D representation
  • graph representation
	Classes of "real" hands and thumbs

Example 3:
Universal statement about information artifacts

$$\textit{Right Border of Heart}_{FMA}\ \textit{isa}_{FMA}\ \textit{Cardiac Border}_{FMA} \equiv$$

Right Border of Heart subClassOf *Cardiac Border*

True	False
• Information artifacts: Radiological images of the thorax	"Real" hearts (hearts do not have borders)

Example 4:
Type assignment to a natural language entity

Right border of heart viewed radiologically$_{FMA}$ *isa*$_{FMA}$ *General Anatomical Term*$_{FMA}$ ≡

Individual: **Right border of heart viewed radiologically**
Type: *General Anatomical Term*

True	False
• Natural language entities (terms)	Hearts, borders

Possible interpretation of FMA terms

- Types of canonical anatomical objects
- Types of anatomical objects, regardless whether canonical or non-canonical
- Particulars pertaining to one ideal human body
- Information artifacts
  - 2D representations: atlas images, radiological images
  - 3D representations: computer models of anatomy
  - mathematical graphs
  - entities of natural language

Conclusions

- FMA axioms suggest different and competing ontological commitments
- The same FMA type may be used in different senses:
  - Muscle_{FMA} has_part_{FMA} Belly of skeletal muscle_{FMA}
  - Muscle_{FMA} isa_{FMA} General anatomical term_{FMA}
- Assignment of truth values to FMA expressions is impossible as long the ontological commitment of FMA types is controversial