How much formality do we need?

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Example

- Using Semantic Web standards (OWL-DL)
- Using Biomedical Ontology standards (OBO)
- Terminological Inference
Classes

- Amino Acid
- Protein
- Aminoaciduria
- Proteinuria
Relations (OBO RO)

- `hasPart` / `partOf`  
  (parthood in a broad sense): relates continuants

- `hasLocation` / `locationOf`  
  relates continuants or occurrents with continuants

- transitive, reflexive, antisymmetric
Description Logic $\mathcal{EL}^+$

- Subsumption $\sqsubseteq$
- Equivalence $\equiv$
- Existential quantification $\exists$
- Conjunction $\sqcap$
- transitive roles
Axioms

Protein $\subseteq \exists$ hasPart.AminoAcid

Aminoaciduria $\equiv$ Disorder $\sqcap$
   $\exists$ hasLocation.(Body $\sqcap$
      $\exists$ hasPart.(PortionOfUrine $\sqcap$
         $\exists$ hasPart.AminoAcid))

Proteinuria $\equiv$ Disorder $\sqcap$
   $\exists$ hasLocation.(Body $\sqcap$
      $\exists$ hasPart.(PortionOfUrine $\sqcap$
         $\exists$ hasPart.Protein))
Inference

Proteinuria \subseteq Aminoaciduria

(since Proteins have Amino Acids as parts, and partOf is transitive)

- Is this error due to formal underspecification?
- Is hasPart not always transitive?
Formal correctness but ontological sloppyness

AminoAcid: hidden ambiguity:

- AminoAcidSingleMolecule
- AminoAcidResidue
- AminoAcidSingleMoleculeCollection
  - AminoAcidSingleMoleculeCollectionLowConc
  - AminoAcidSingleMoleculeCollectionHighConc
Corrected Axioms

Aminoaciduria ≡ Disorder \( \sqcap \) \
\( \exists \text{hasLocation.}(\text{Body} \sqcap \exists \text{hasPart.}(\text{PortionOfUrine} \sqcap \exists \text{hasPart.}\text{AminoAcidSingleMoleculeCollectionHighConc})) \)

Proteinuria ≡ Disorder \( \sqcap \) \
\( \exists \text{hasLocation.}(\text{Body} \sqcap \exists \text{hasPart.}(\text{PortionOfUrine} \sqcap \exists \text{hasPart.}\text{ProteinMoleculeCollectionHighConc})) \)
Two sides of the same coin

Formal Correctness
assures consistency

Ontological Correctness
assures adequacy
Conclusion

- Even little formality must be rooted in a correct ontological foundation to prevent unintended models with inadequate inferences.
- If we do not know exactly what we are formalizing we cannot rely on machine reasoning. In this case we should give preference to informal, thesaurus-like knowledge representations.