Concrete Names for Complex Expressions in Ontologies: A Survey of Biomedical Ontologies

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August 31, 2023

14th International Conference on Biomedical Ontology (ICBO 2023)

Motivation

Definitions in OBO

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Concrete Names for Complex Expressions

OBO Principle 6:

> *The ontology has textual definitions for the majority of its classes [...].*

Definitions in OBO

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Concrete Names for Complex Expressions

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Recommendation:

> *Logical definitions, when present, should agree with textual definitions and vice versa.*

Logical Definitions

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Concrete Names for Complex Expressions

A '**Liquid State**'

is a '**physical state**' that '**has the state**' of a '**liquid**'.

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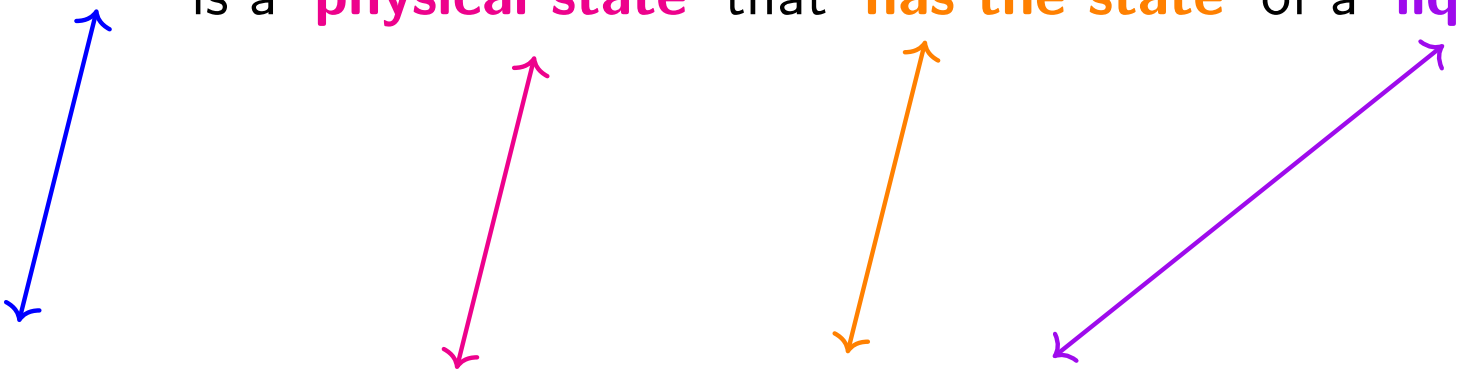

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Logical Definitions

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Logical Definitions

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$$\begin{aligned}\text{Clotting} \equiv\ & \\ \exists\ & \text{actsSpecificallyOn}.(\text{Blood} \sqcap \\ & \exists\ \text{hasPhysicalState}.(\text{PhysicalState} \sqcap \\ & \exists\ \text{hasState}.\text{Liquid})) \sqcap \\ & \exists\ \text{hasOutcome}.\text{SolidBlood}\end{aligned}$$

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Reusing Defined Names

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$$\text{Clotting} \equiv \exists\ \text{actsSpecificallyOn}.(\text{Blood} \sqcap \exists\ \text{hasPhysicalState}.(\text{PhysicalState} \sqcap \exists\ \text{hasState.Liquid})) \sqcap \exists\ \text{hasOutcome.SolidBlood}$$

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(Nikitina and Koopmann 2017)

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- How many concrete names are ***defined***?

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- How many concrete names are ***defined***?
- How often are such names ***reused***?
- How often are such names ***not reused***?

Abbreviations and Synonyms

Syntactic Definitions

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Abbreviation: named class N for complex class C

Synonym: named class N and named class S

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- Compound Definition:
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Explicit & Implicit Definitions

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- Explicit: $\mathit{EquivalentClasses}(\mathrm{N}, \mathrm{C}) \in \mathcal{O}$
- Implicit: $\mathcal{O} \models \mathit{EquivalentClasses}(\mathrm{N}, \mathrm{C}) \notin \mathcal{O}$

Uses and Possible Uses

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- Given an $\mathcal{O}$

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- Given (implicit & explicit) definitions *EquivalentClasses*(N, C)
- Number of occurrences
  - N in $\mathcal{O}$ — use of N
  - C in $\mathcal{O}$ — *possible* use of N

Empirical Results

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Concrete Names for Complex Expressions

1. Syntactic Definitions

Empirical Results

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- $309/744 \approx$ **41%** ontologies with abbreviations
- $136/744 \approx$ **18%** ontologies with synonyms

Empirical Results

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1. **Syntactic Definitions**
   - $309/744 \approx$ **41%** ontologies with abbreviations
   - $136/744 \approx$ **18%** ontologies with synonyms
   - cases with more than **10,000** and **100,000** definitions

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1. Syntactic Definitions

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Empirical Results

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Empirical Results

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1. **Syntactic Definitions**
   - many abbreviations defined in many ontologies
2. **Uses**
   - in **80%** of ontologies, **all** abbreviation are also used
   - abbreviations can be used up to **1,000–10,000** times

Empirical Results

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1. **Syntactic Definitions**
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   - many abbreviations used, sometimes frequently

Empirical Results

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1. **Syntactic Definitions**
   - many abbreviations defined in many ontologies
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   - many abbreviations used, sometimes frequently
3. **Possible Uses**
   - *explicit*: possible uses in $101/309 \approx$ **33%** ontologies
   - *implicit*: possible uses in **all** ontologies
   - cases of $\geq$ **1000** possible uses for a single abbreviation

Empirical Results

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1. **Syntactic Definitions**
   - many abbreviations defined in many ontologies
2. **Uses**
   - many abbreviations used, sometimes frequently
3. **Possible Uses**
   - abbreviations with many possible uses exist

Conclusion

Open Questions

Should equivalent named classes . . .

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- be *reused*?

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Let me know:

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Future Work

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- *exhaustive* reuse of abbreviations

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- exhaustive reuse of abbreviations
- using names *without needing new* named class

Future Work

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$\mathcal{O} = \{$ Napoletana SubClassOf Pizza and hasCountryOfOrigin value Italy,
Diavola SubClassOf Pizza and hasCountryOfOrigin value Italy,
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$\alpha =$ ItalianPizza EquivalentTo Pizza and hasCountryOfOrigin value Italy

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$$\mathcal{O} \not\models \alpha \text{ whereas } \mathcal{O} \cup \{\alpha\} \models \alpha.$$

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- naming things using some notion of *abstraction*

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$\texttt{ItalianPizza} \mapsto$ Pizza and hasCountryOfOrigin value Italy

$\texttt{PizzaWithOrigin}(x) \mapsto$ Pizza and hasCountryOfOrigin value x

Future Work

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Future Work

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Reasonable Ontology Templates (OTTR)
(`https://ottr.xyz/`)

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