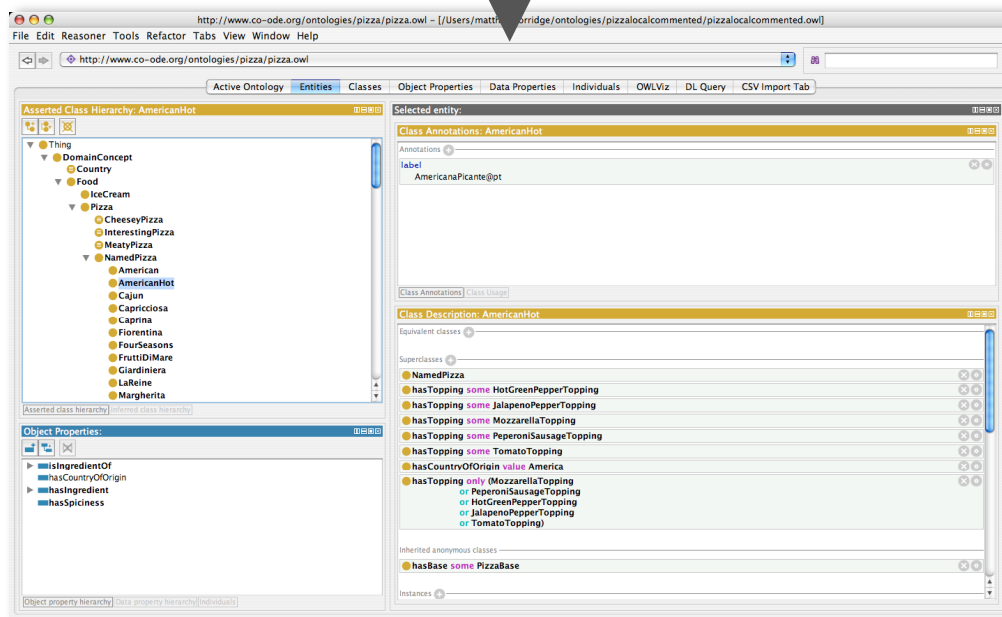
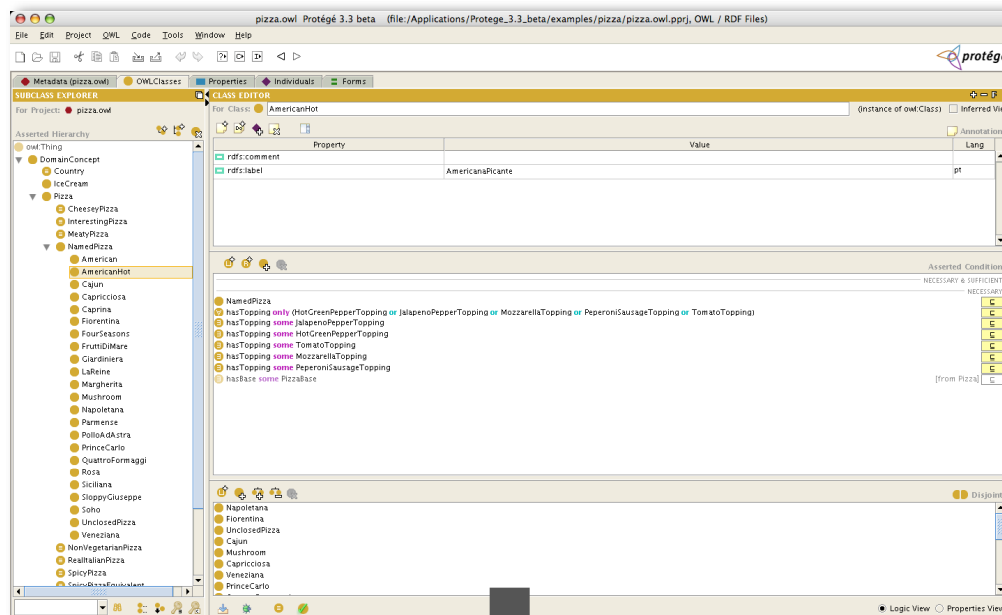
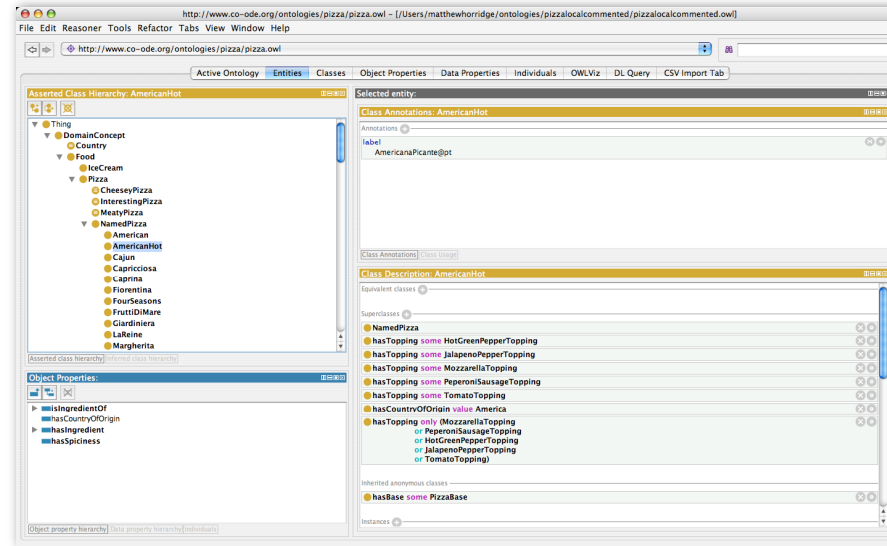


# The Protégé 4 OWL Editor

Matthew Horridge and Colleagues



# OWL Editor Architecture



Tools: Species validation, Change history, Debugging

Ontology Management

Reasoners

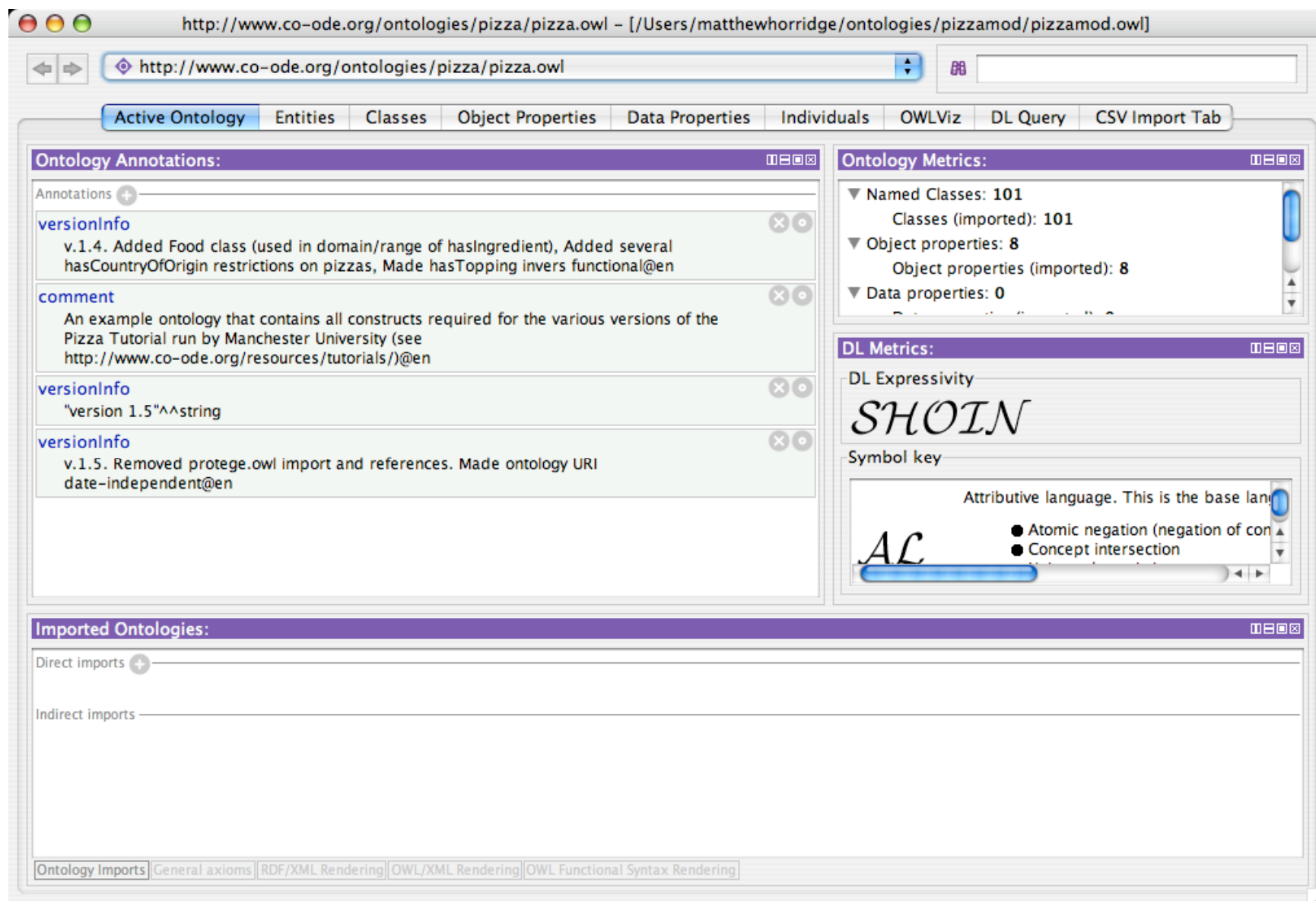
OntologyFactories

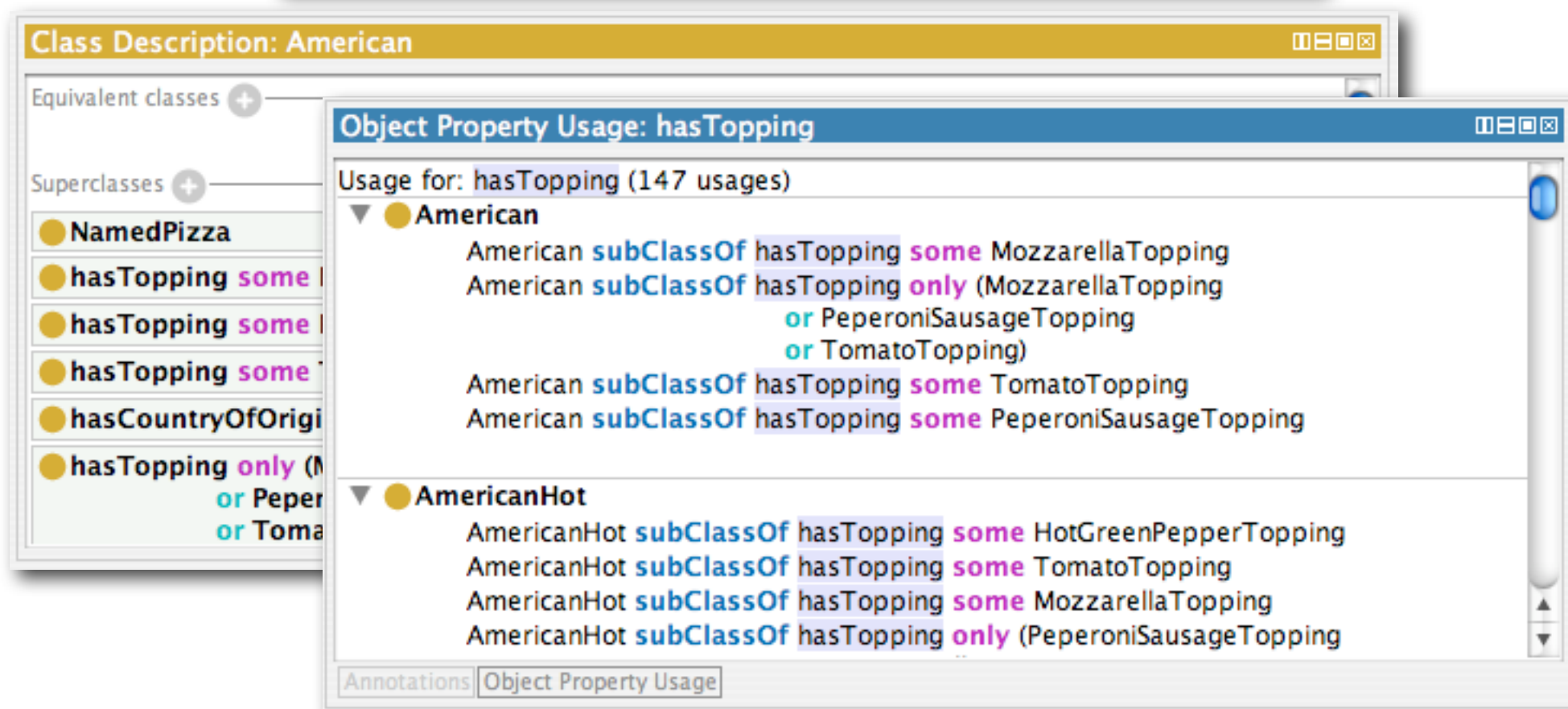
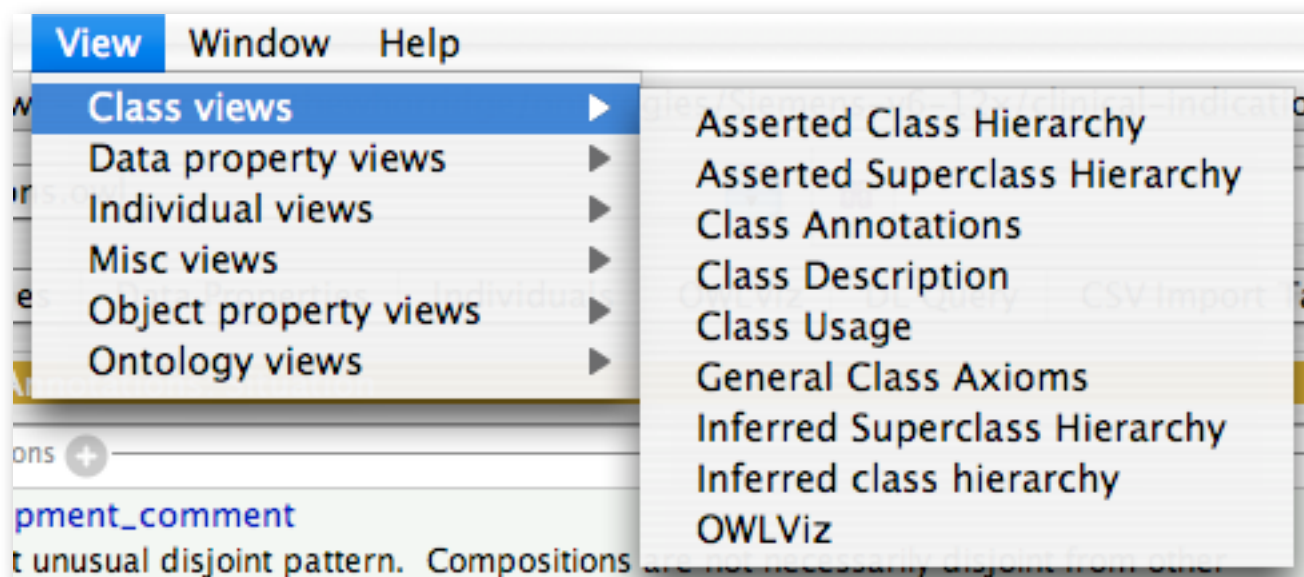
OntologyStorers

ParserRegistry

RendererRegistry

# Protégé 4 UI





http://www.co-ode.org/siemens-exp3/clinical-indications.owl - [/Users/matthewhorridge/ontologies/Siemens-v6-12x/clinical-indications.owl]

http://www.co-ode.org/siemens-exp3/clinical-indications.owl

Active Ontology | Entities | **Classes** | Object Properties | Data Properties | Individuals | OWLViz | DL Query | CSV Import Tab

### Asserted Class Hierarchy: Clinical\_modality

- Teratageneticity\_state
  - Non\_teratagenetic
  - Potentially\_teratagenic\_state
- Unit
  - Duration\_unit
- Self\_standing\_entity
  - Composition
    - Collections
      - Collective
      - Group
- Modality
  - Clinical\_modality**
    - Goal
    - Problem
    - Workflow\_trigger
  - Risk
    - Sudden\_arrhythmia\_risk**
- Quality
  - Biological\_quality
    - Age\_group
    - Body\_weight
    - Effortfulness
    - Female\_reproductive\_status\_qual
    - Frequency
    - Height
    - Last\_menstrual\_period
  - Observable

### Class Annotations: Clinical\_modality

Annotations +

**comment**  
"Clinical modalities are the notions of Problem, Family history, Goal, etc. used in the clinical layer of the reasoning.."^^string

**comment**  
"In v3 all indication rules are between modalities, so all indication rules are found under clinical modality.  
  
This may be overkill but makes inferences such as Problem->Presence easy."^^string

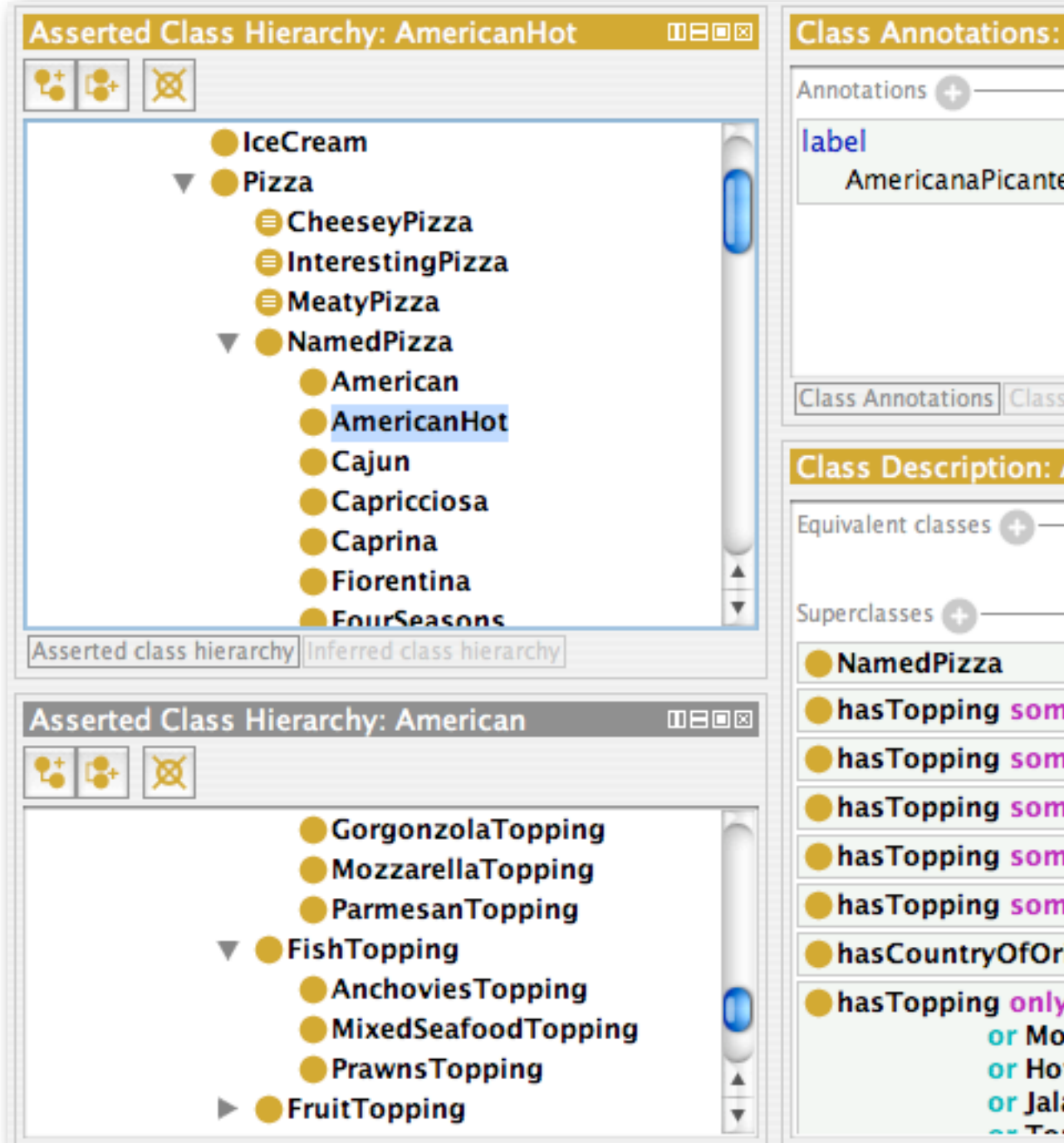
Class Annotations | Class Usage

### OWLViz: Clinical\_modality

Asserted model | Inferred model

```
graph LR; Composition -- is-a --> Modality; Modality -- is-a --> Clinical_modality; Modality -- is-a --> Risk; Clinical_modality -- is-a --> Problem; Clinical_modality -- is-a --> Workflow_trigger; Clinical_modality -- is-a --> Goal; Risk -- is-a --> Sudden_arrhythmia_risk;
```

Class description | OWLViz





## Class Description: American



Equivalent classes +

Superclasses +

- NamedPizza
- hasTopping some MozzarellaTopping
- hasTopping some PeperoniSausageTopping
- hasTopping some TomatoTopping
- hasCountryOfOrigin value America
- hasTopping only (MozzarellaTopping  
or PeperoniSausageTopping  
or TomatoTopping)

Inherited anonymous classes

- hasBase some PizzaBase

Instances +

Disjunct classes +

## Class Description: AmericanHot



Equivalent classes +

Superclasses +

- NamedPizza
- hasTopping some HotGreenPepperTopping
- hasTopping some JalapenoPepperTopping
- hasTopping some MozzarellaTopping
- hasTopping some PeperoniSausageTopping
- hasTopping some TomatoTopping
- hasCountryOfOrigin value America
- hasTopping only (PeperoniSausageTopping  
or MozzarellaTopping  
or HotGreenPepperTopping  
or JalapenoPepperTopping  
or TomatoTopping)

Inherited anonymous classes

- hasBase some PizzaBase



# Navigation

● hasTopping only (MozzarellaTopping  
or PeperoniSausageTopping  
or TomatoTopping)

## Object Property Usage: hasTopping

Usage for: hasTopping (146 usages)

### ▼ ● American

American subClassOf hasTopping some MozzarellaTopping

American subClassOf hasTopping only (MozzarellaTopping  
or PeperoniSausageTopping  
or TomatoTopping)

American subClassOf hasTopping some TomatoTopping

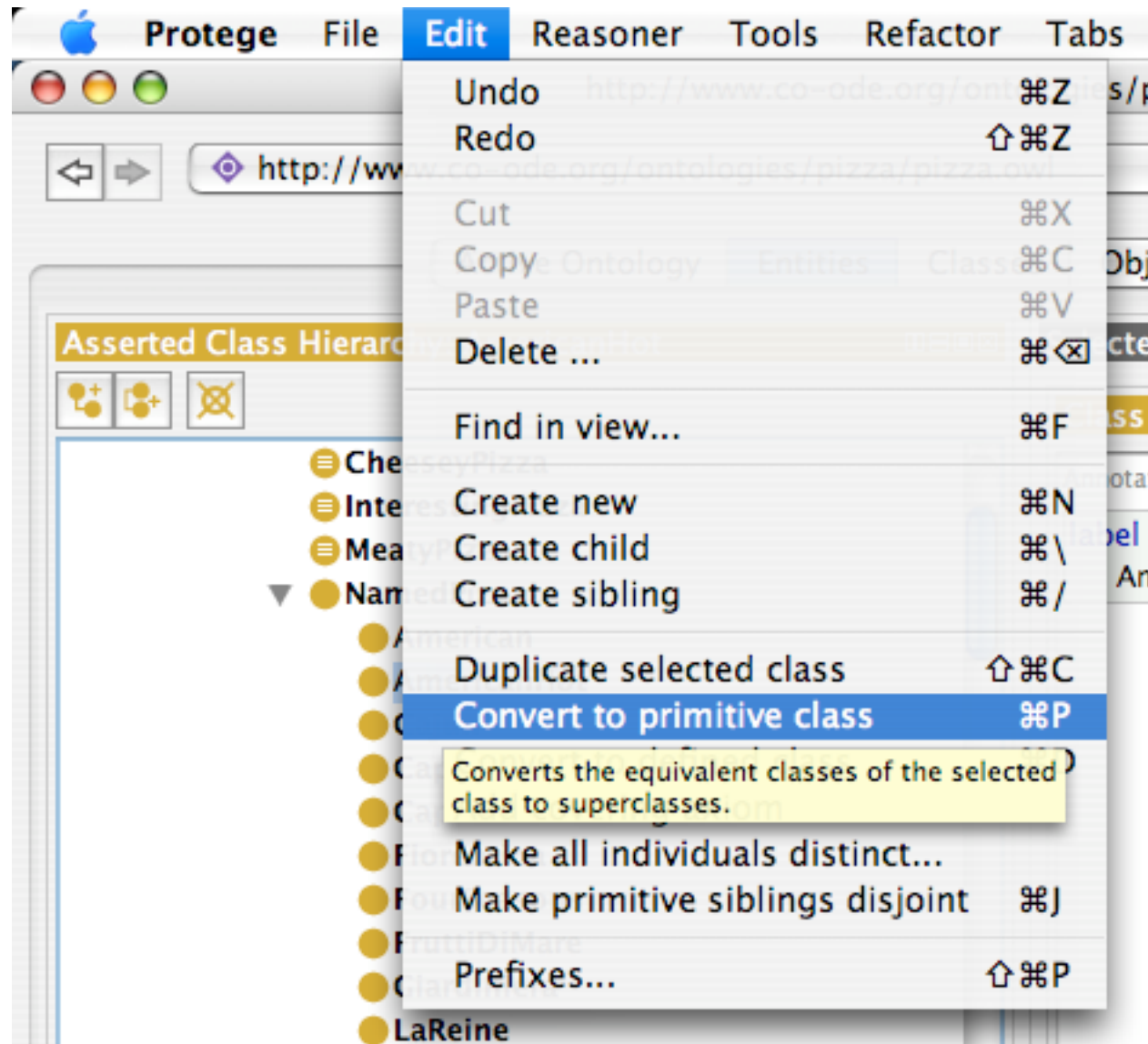
American subClassOf hasTopping some PeperoniSausageTopping

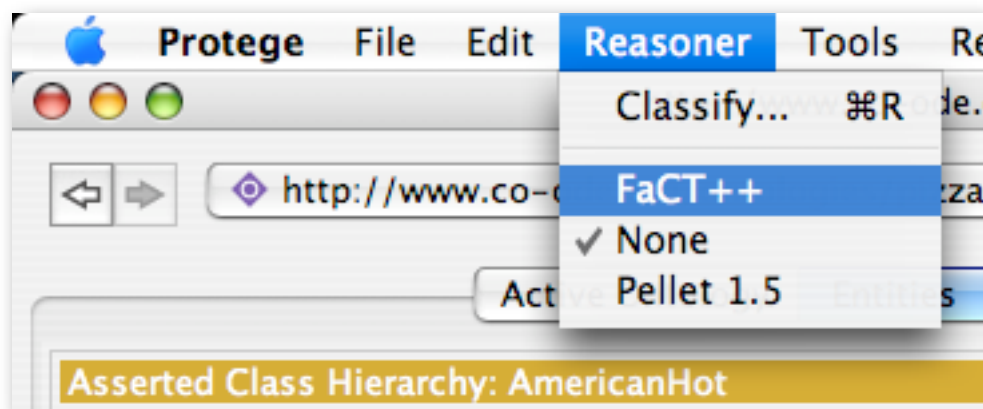
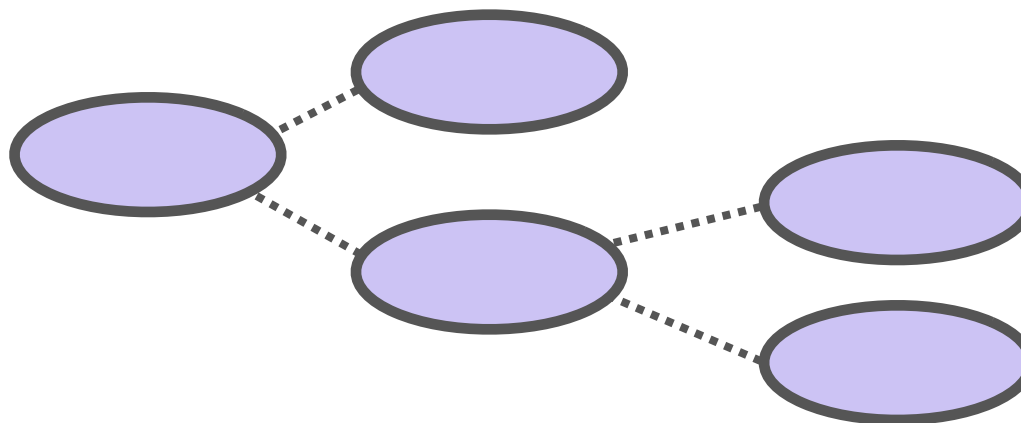
### ▼ ● AmericanHot

AmericanHot subClassOf hasTopping some HotGreenPepperTopping

Annotations | Object Property Usage

# Plugins





# OWL I.I

## Characteristics: hasSibling

- ☐ Functional
- ☐ Inverse functional
- ☐ Transitive
- ☒ Symmetric
- ☐ Antisymmetric
- ☐ Reflexive
- ☒ Irreflexive

## Description: likes

- Equivalent object properties +
- Super properties +
- Inverse properties +
- Disjoint properties +
- dislikes**
- Property chains +

## Description: hasUncle

- Equivalent object properties +
- Super properties +
- Inverse properties +
- Disjoint properties +
- Property chains +
- hasParent** **hasBrother** → **hasUncle**

## Class Description: PersonWithAtLeastTwoFemaleChildren

- Equivalent classes +
- hasChild** **min** 2 Female

## Class Description: Adult

- Equivalent classes +
- Person**  
**that** **hasAge** **only** int[>= 18]

# Asserted vs. Inferred

**Class Description: AmericanHot**

Equivalent classes +

Superclasses +

- NamedPizza
- hasTopping **some** HotGreenPepperTopping
- hasTopping **some** JalapenoPepperTopping
- hasTopping **some** MozzarellaTopping
- hasTopping **some** PeperoniSausageTopping
- hasTopping **some** TomatoTopping
- hasCountryOfOrigin **value** America
- hasTopping **only** (PeperoniSausageTopping  
or MozzarellaTopping  
or HotGreenPepperTopping  
or JalapenoPepperTopping  
or TomatoTopping)

CheeseyPizza ?

InterestingPizza ?

MeatyPizza ?

SpicyPizza ?

SpicyPizzaEquivalent ?

**Domains and ranges: isToppingOf**

Domains (intersection) +

- ☒ PizzaTopping

Ranges (intersection) +

- ☒ Pizza
- ☒ Food

**Description: myPizza**

Types +

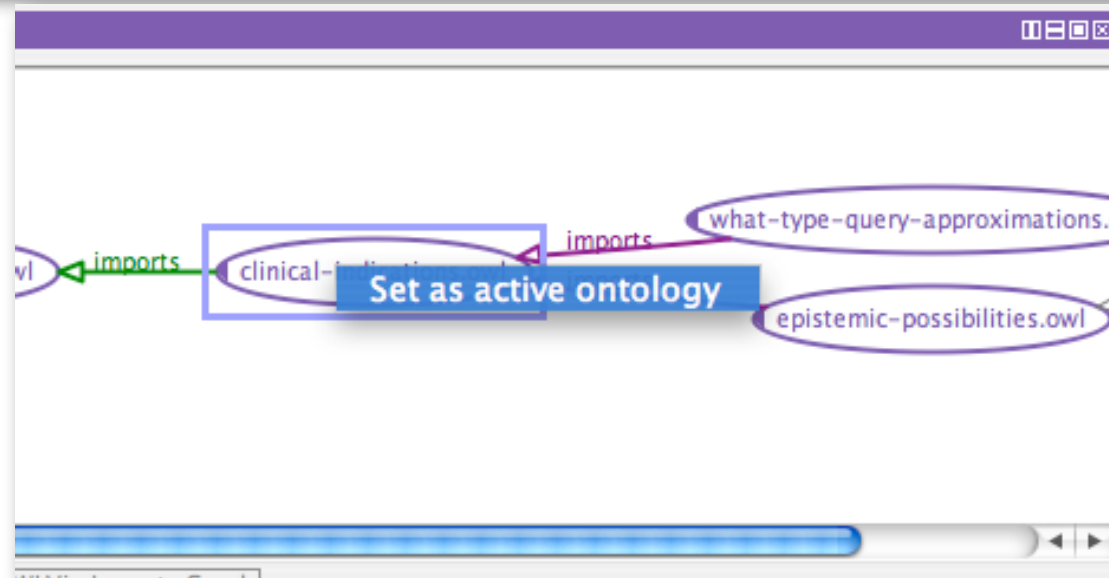
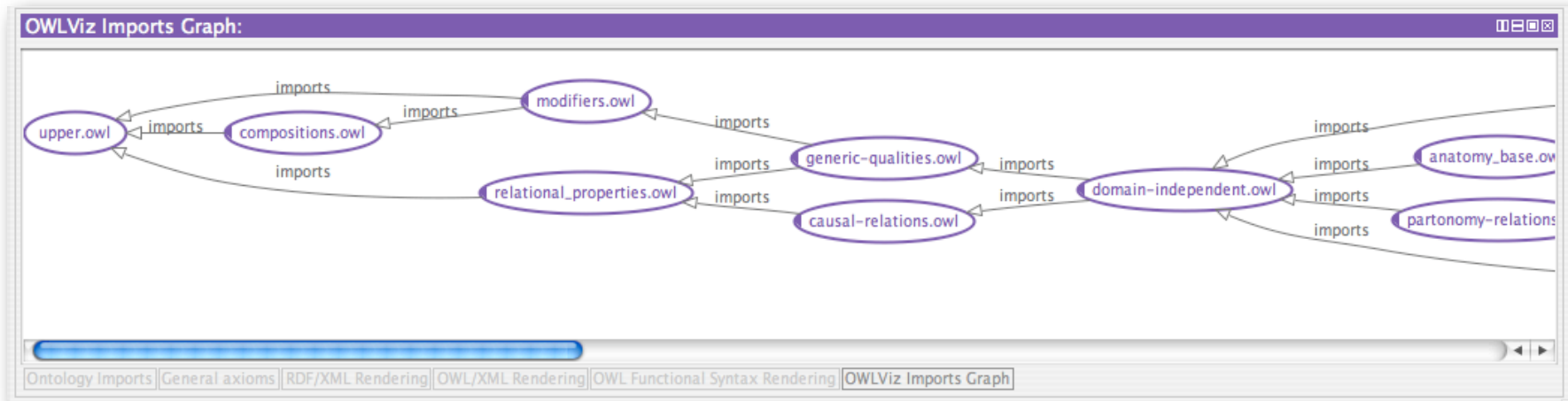
- ☒ Pizza
- ☒ CheeseyPizza
- ☒ MeatyPizza

**Property assertions: myPizza**

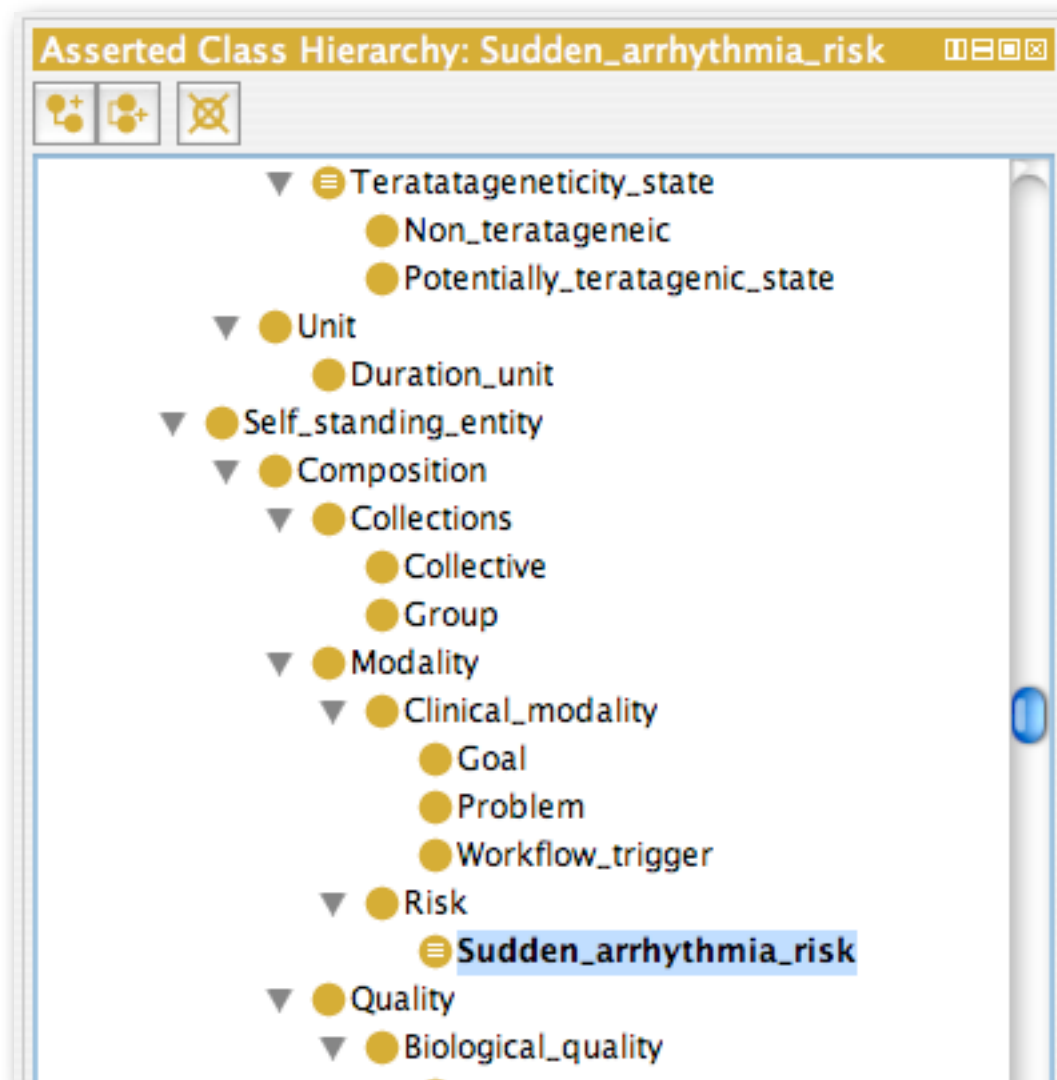
Object property assertions +

- ☒ hasTopping myMozzarella
- ☒ hasTopping myPepperoni
- ☒ hasIngredient myMozzarella
- ☒ hasIngredient myPepperoni

# Working with Multiple Ontologies







### Class Description: Situation

Equivalent classes +

Superclasses +

Composition

includes max 1 Breathing

## Class Description: Heart

Equivalent classes +

Superclasses +

- Organ
- has\_symmetry some Unpaired
- is\_contained\_in some Chest Asserted in: [http://www.co-ode.org/siemens-exp3/anatomy\\_base.owl](http://www.co-ode.org/siemens-exp3/anatomy_base.owl)
- is\_functional\_part\_of\_directly some Cardiovascular\_system

Inherited anonymous classes

- Biological\_entity  
and Physical\_object

## Class Description: Heart

Equivalent classes +

Superclasses +

- Organ
- has\_symmetry some Unpaired
- is\_contained\_in some Chest
- is\_functional\_part\_of\_directly some Cardiovascular\_system

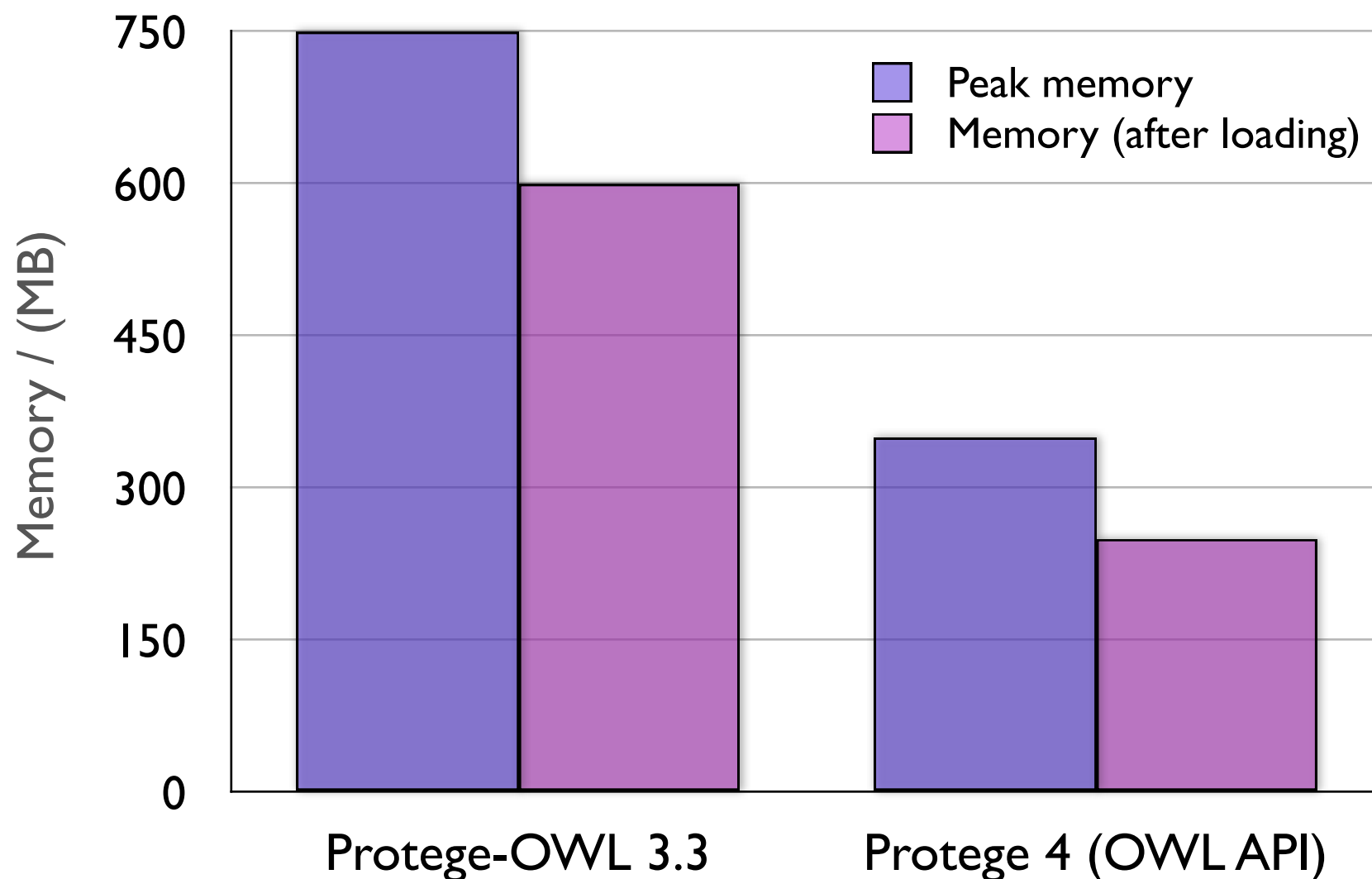
Inherited anonymous classes

- Biological\_entity

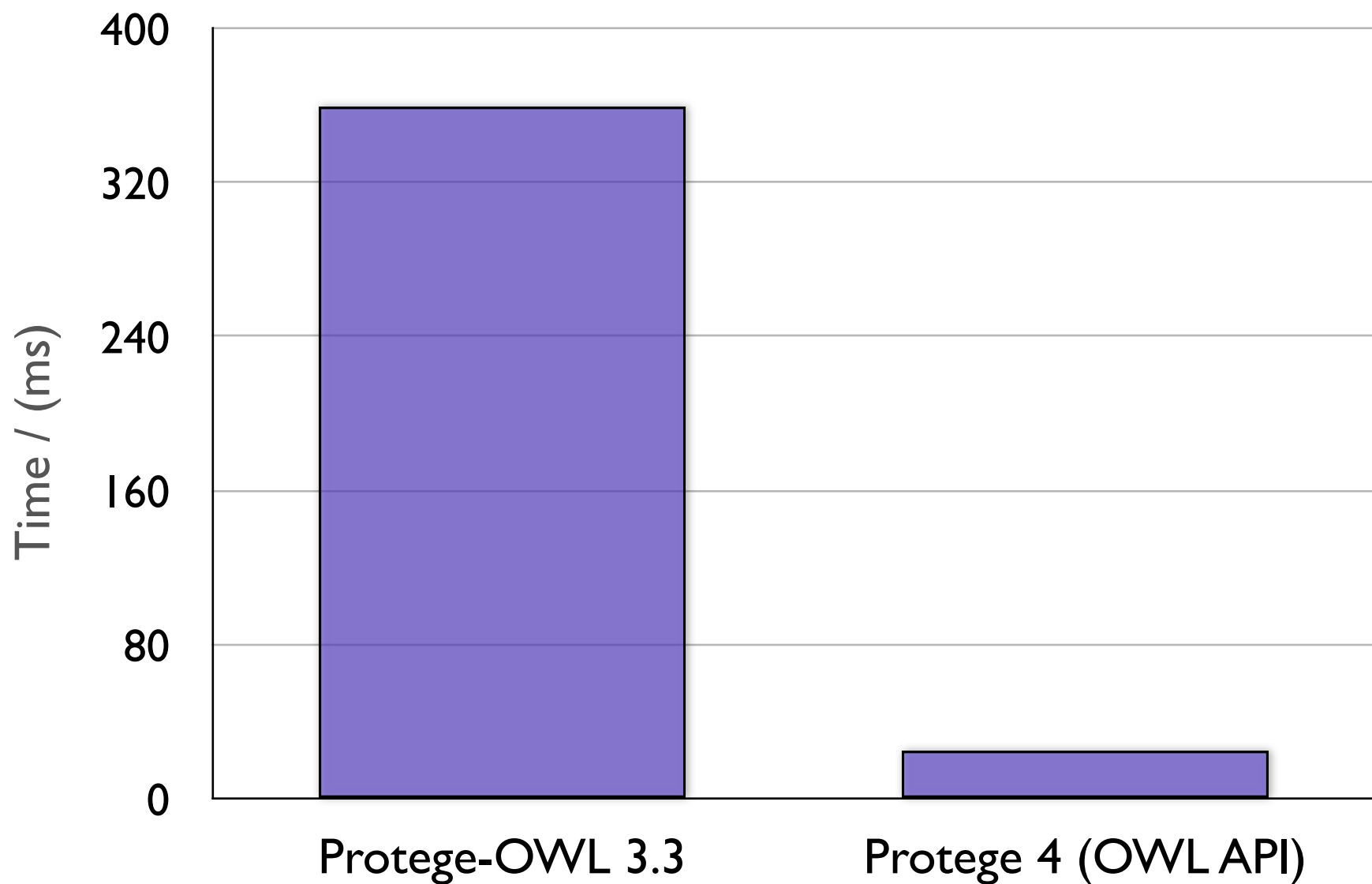
- Switch to defining ontology
- Pull into active ontology
- Move axiom to ontology...
- Convert selected rows to defined class

# Performance

# NCI Thesaurus: Memory Required to load from RDF/XML



# NCI Thesaurus Load Time



# Conclusions

- New architecture, with a “Native” OWL API
- Flexible dynamically configurable GUI
- Large performance improvements

# Resources

<http://protege.stanford.edu/download/registered.html#p4>

<http://www.co-ode.org>

<http://owlapi.sourceforge.net>

<http://www.webont.org/owl/1.1/>