

The Protégé 4 OWL Editor

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The screenshot shows the Protégé 3.3 beta interface. The main window is titled "pizza.owl Protégé 3.3 beta". The "CLASS EDITOR" is active for the class "AmericanHot". On the left, the "SUBCLASS EXPLORER" shows a hierarchy of classes: DomainConcept, Country, IceCream, Pizza, CheesyPizza, InterestingPizza, MeatyPizza, NamedPizza, American, AmericanHot, Cajun, Capricciosa, Caprina, Fiorentina, FourSeasons, FruttiDiMare, Giardiniera, LaReine, Margherita, Mushroom, Neapolitana, UncookedPizza, Venezia, NonVegetarianPizza, RealItalianPizza, SpicyPizza, and SpicyPizzaEquivalent. The "CLASS EDITOR" displays a table of properties for "AmericanHot":

Property	Value	Lang
rdfs:comment		
rdfs:label	AmericanaPicante	pt

Below the table, the "Asserted Conditions" section lists several logical constraints for the class, such as "hasTopping only (HotGreenPepperTopping or JalapenoPepperTopping or MozzarellaTopping or PepperoniSausageTopping or TomatoTopping)".

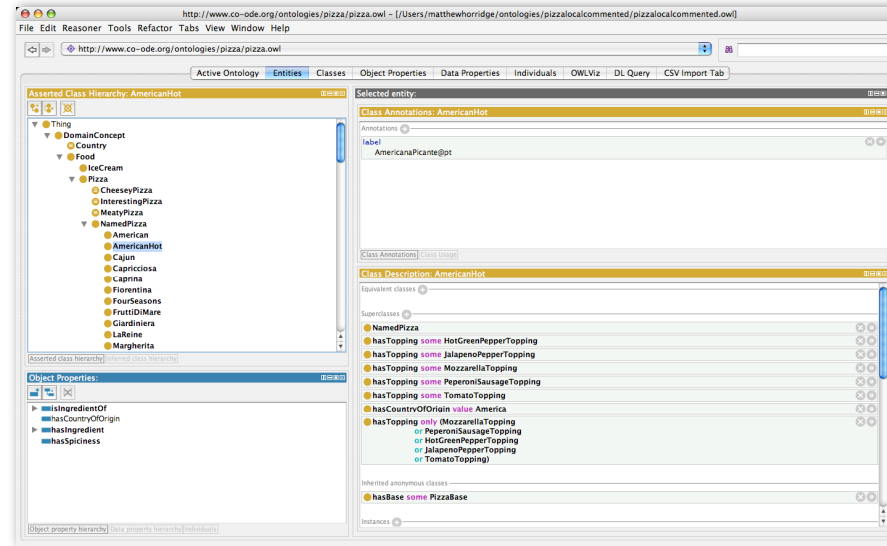


The screenshot shows the Protégé 3.3 beta interface with the reasoner active. The URL bar shows "http://www.co-ode.org/ontologies/pizza/pizza.owl". The "Active Ontology" is "http://www.co-ode.org/ontologies/pizza/pizza.owl". The "Selected entity" is "Class Annotations: AmericanHot". The "Class Annotations" section shows the label "AmericanaPicante@pt". The "Class Description: AmericanHot" section shows the following logical constraints:

- Equivalent classes
- Superclasses:
 - NamedPizza
 - hasTopping some HotGreenPepperTopping
 - hasTopping some JalapenoPepperTopping
 - hasTopping some MozzarellaTopping
 - hasTopping some PepperoniSausageTopping
 - hasTopping some TomatoTopping
 - hasCountryOfOrigin value America
 - hasTopping only (MozzarellaTopping or PepperoniSausageTopping or HotGreenPepperTopping or JalapenoPepperTopping or TomatoTopping)
- Inherited anonymous classes:
 - hasBase some PizzaBase

The "Object Properties" section on the left shows a hierarchy of properties: isIngredientOf, hasCountryOfOrigin, hasIngredient, and hasSpiciness.

OWL Editor Architecture



Tools: Species validation, Change history, Debugging

Ontology Management

Reasoners

OntologyFactories

OntologyStorers

ParserRegistry

RendererRegistry

Protégé 4 UI

The screenshot displays the Protégé 4 user interface for editing an ontology. The browser address bar shows the URL: `http://www.co-ode.org/ontologies/pizza/pizza.owl`. The main menu includes: Active Ontology, Entities, Classes, Object Properties, Data Properties, Individuals, OWLviz, DL Query, and CSV Import Tab.

Ontology Annotations:

- versionInfo** (v.1.4): Added Food class (used in domain/range of hasIngredient), Added several hasCountryOfOrigin restrictions on pizzas, Made hasTopping invers functional@en
- comment**: An example ontology that contains all constructs required for the various versions of the Pizza Tutorial run by Manchester University (see <http://www.co-ode.org/resources/tutorials/>)@en
- versionInfo**: "version 1.5"^^string
- versionInfo** (v.1.5): Removed protege.owl import and references. Made ontology URI date-independent@en

Ontology Metrics:

- Named Classes: 101 (Classes (imported): 101)
- Object properties: 8 (Object properties (imported): 8)
- Data properties: 0

DL Metrics:

DL Expressivity: *SHOIN*

Symbol key: *AL*

Attributive language. This is the base language.

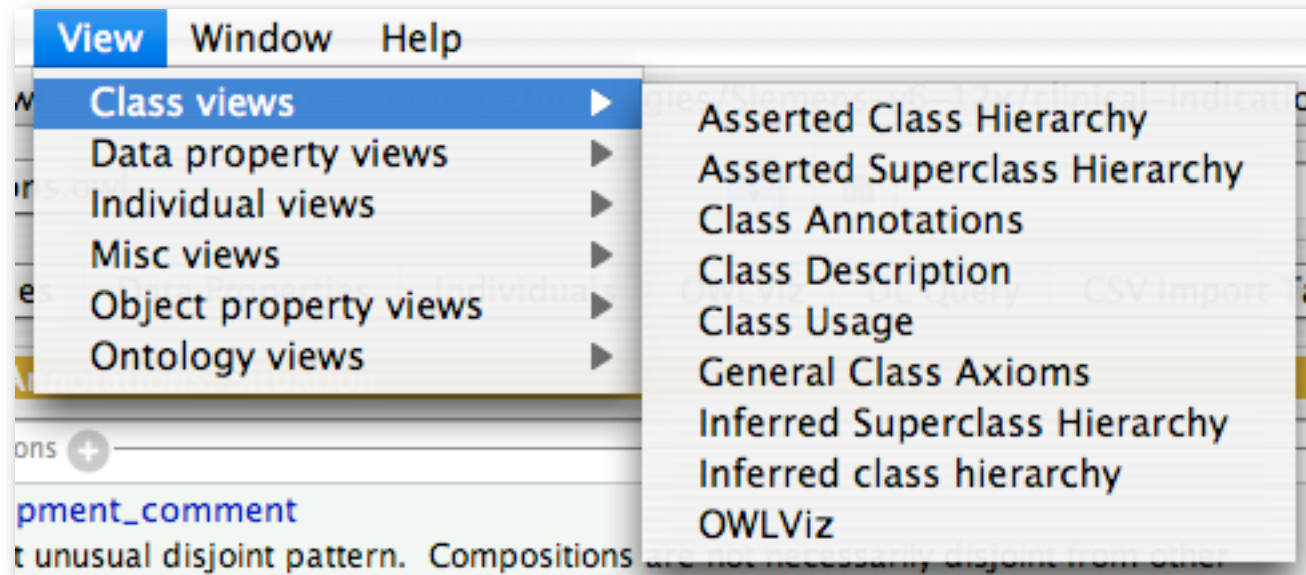
- Atomic negation (negation of concept)
- Concept intersection

Imported Ontologies:

Direct imports: (empty)

Indirect imports: (empty)

Bottom navigation: Ontology Imports, General axioms, RDF/XML Rendering, OWL/XML Rendering, OWL Functional Syntax Rendering



Class Description: American

Equivalent classes +

Superclasses +

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

Object Property Usage: hasTopping

Usage for: hasTopping (147 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
 - AmericanHot **subClassOf** hasTopping **some** TomatoTopping
 - AmericanHot **subClassOf** hasTopping **some** MozzarellaTopping
 - AmericanHot **subClassOf** hasTopping **only** (PeperoniSausageTopping)

Annotations | Object Property Usage

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_teratagenaic
 - 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 TD
    Clinical_modality -- is-a --> Modality
    Modality -- is-a --> Composition
    Modality -- is-a --> Risk
    Clinical_modality -- is-a --> Problem
    Clinical_modality -- is-a --> Workflow_trigger
    Clinical_modality -- is-a --> Goal
    Sudden_arrhythmia_risk -- is-a --> Risk
    
```

Class description | OWLViz

Asserted Class Hierarchy: AmericanHot

- IceCream
- ▼ ● Pizza
 - ☰ CheeseyPizza
 - ☰ InterestingPizza
 - ☰ MeatyPizza
 - ▼ ● NamedPizza
 - American
 - AmericanHot
 - Cajun
 - Capricciosa
 - Caprina
 - Fiorentina
 - FourSeasons

Asserted class hierarchy
Inferred class hierarchy

Asserted Class Hierarchy: American

- GorgonzolaTopping
- MozzarellaTopping
- ParmesanTopping
- ▼ ● FishTopping
 - AnchoviesTopping
 - MixedSeafoodTopping
 - PrawnsTopping
- ▶ ● FruitTopping

Class Annotations:

Annotations +

label
AmericanaPicante

Class Description:

Equivalent classes +

Superclasses +

- NamedPizza
- hasTopping some
- hasTopping some
- hasTopping some
- hasTopping some
- hasTopping some
- hasCountryOfOr
- hasTopping only
or Mo
or Ho
or Jal
or To

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)

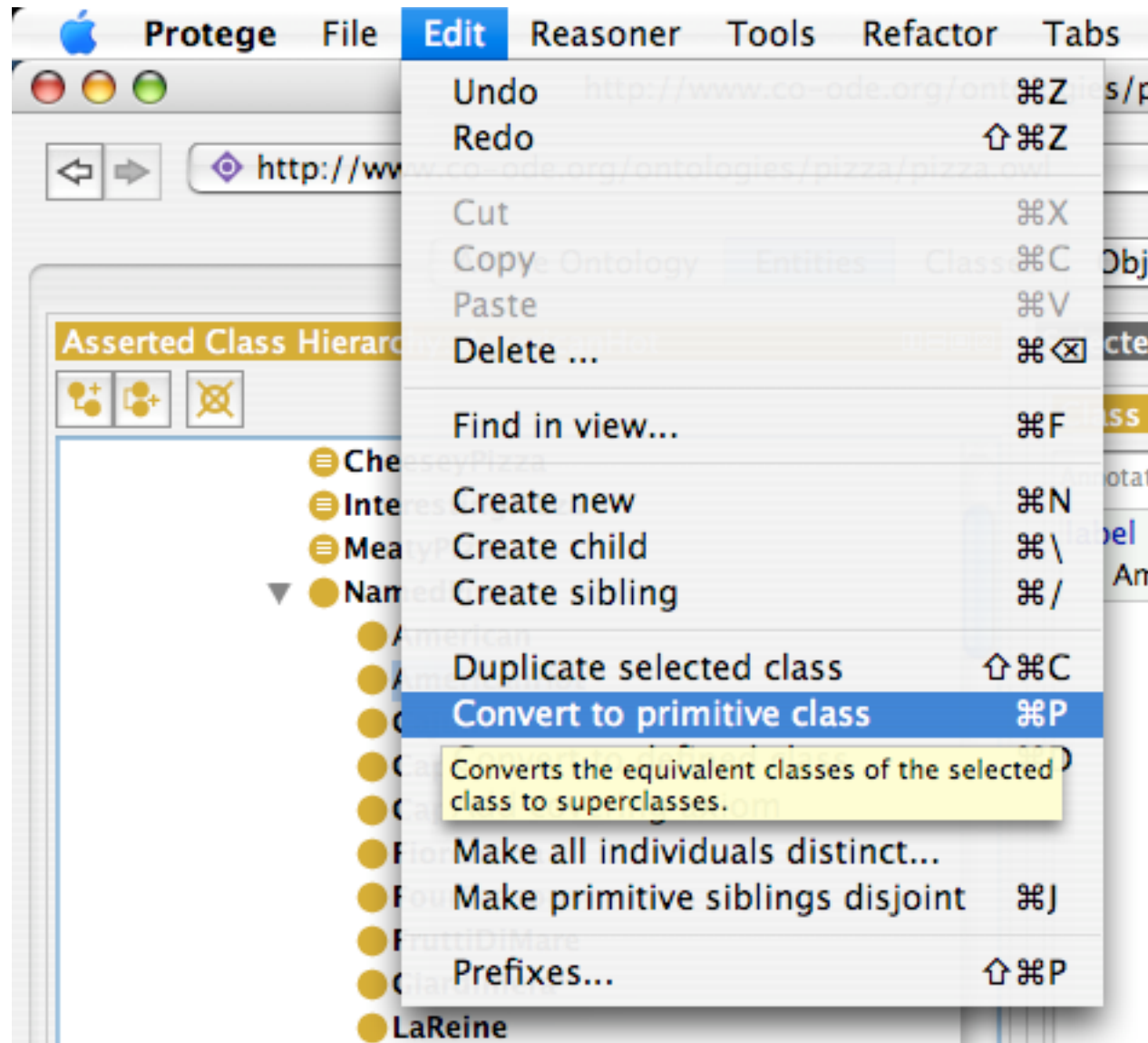
Object Property Usage: hasTopping

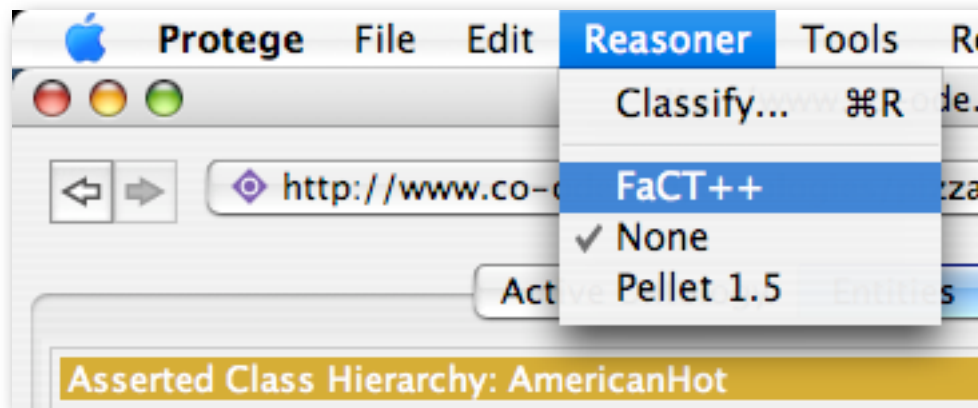
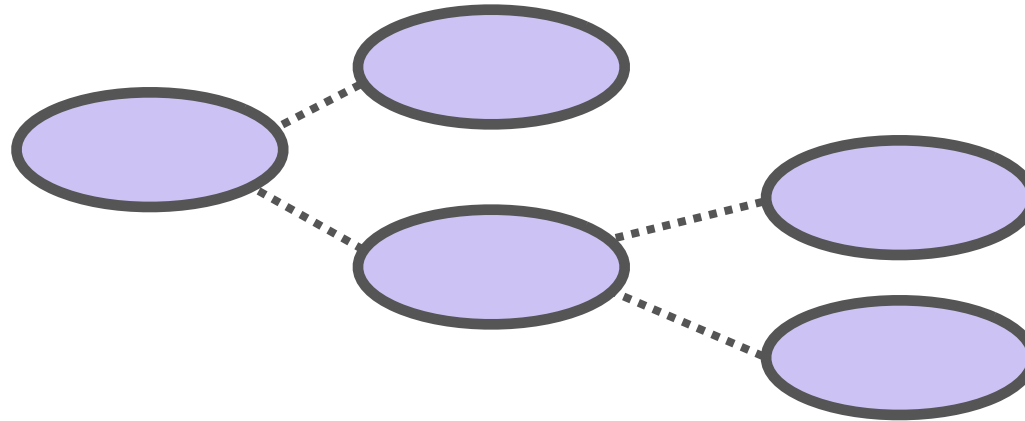
Usage for: hasTopping (146 usages)

- ▼ ● **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 o 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 +

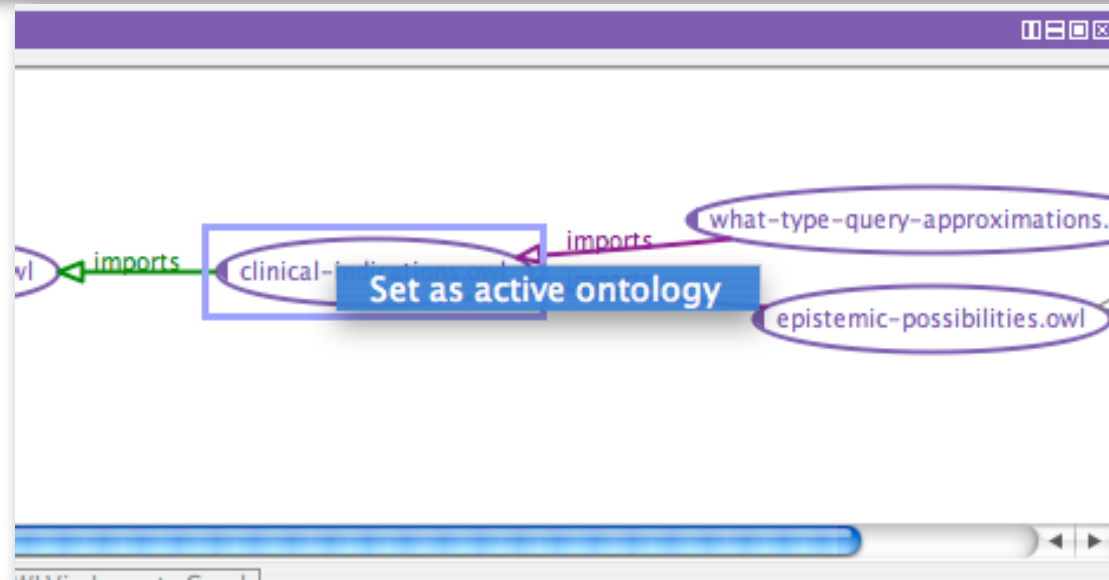
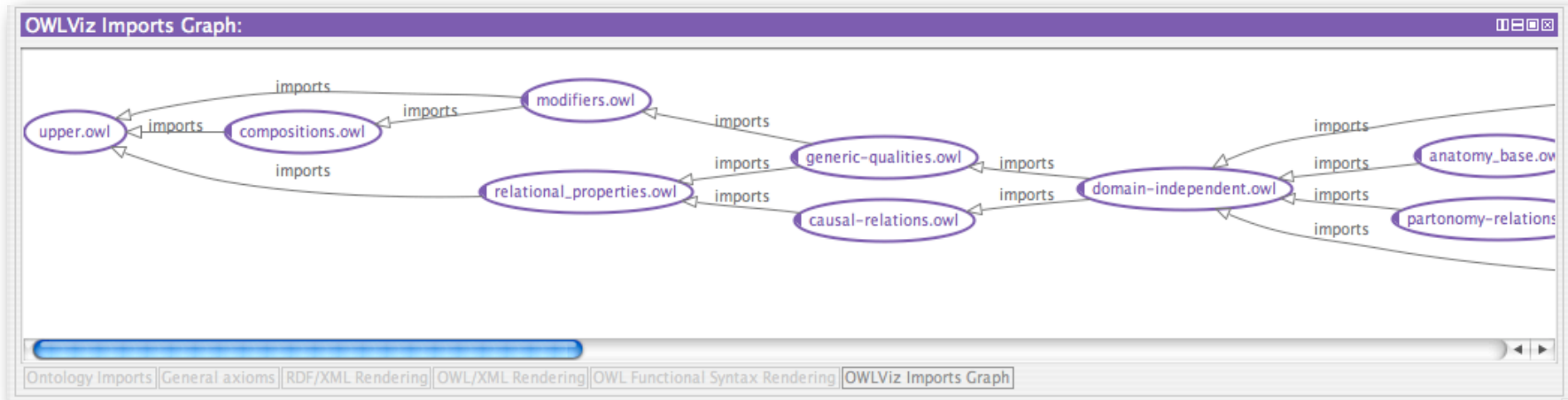
- Pizza
- ☰ CheeseyPizza
- ☰ MeatyPizza

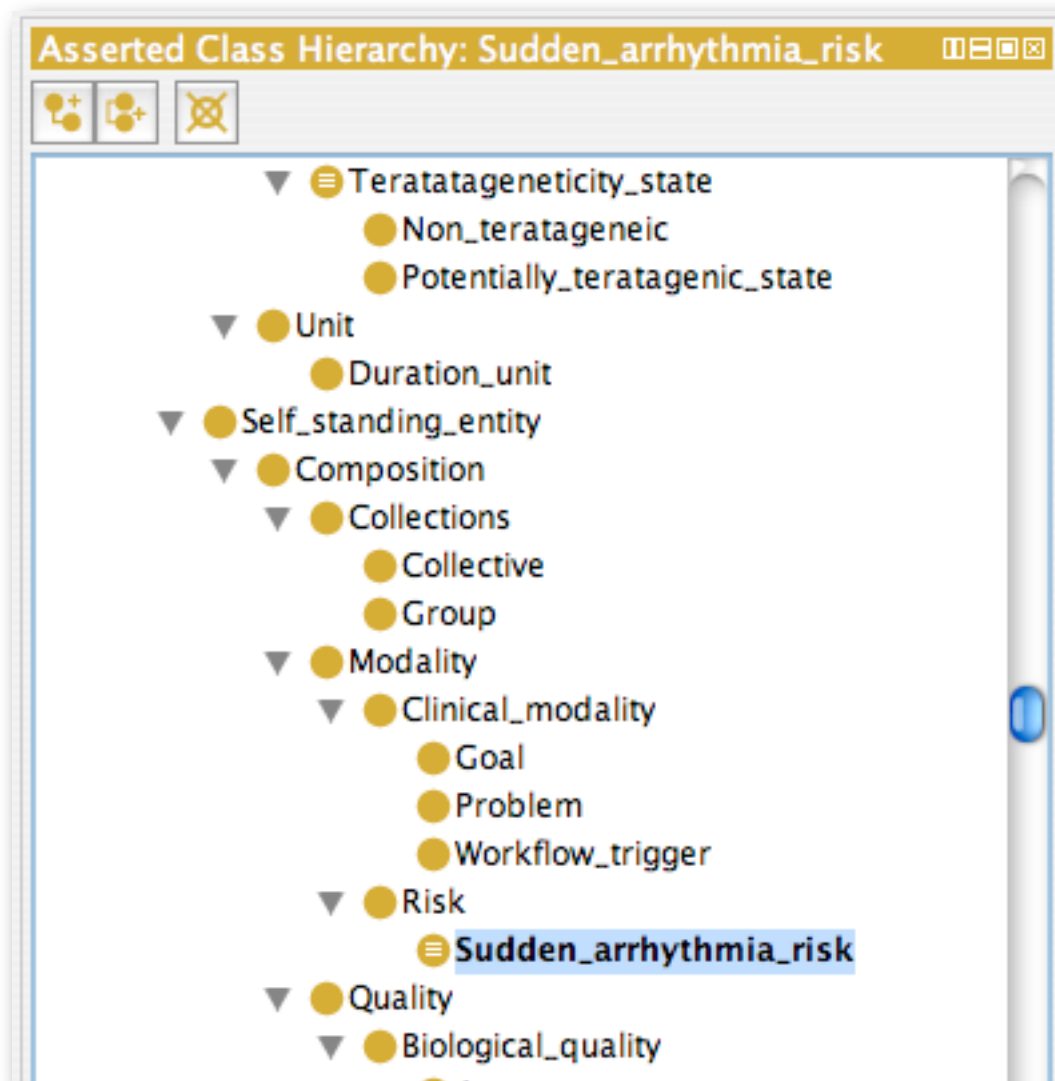
Property assertions: myPizza

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 ✕ ○
● is_functional_part_of_directly some Cardiovascular_system ✕ ○

Asserted in: http://www.co-ode.org/siemens-exp3/anatomy_base.owl

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 C ✕ ○

Asserted in: http://www.co-ode.org/siemens-exp3/anatomy_base.owl

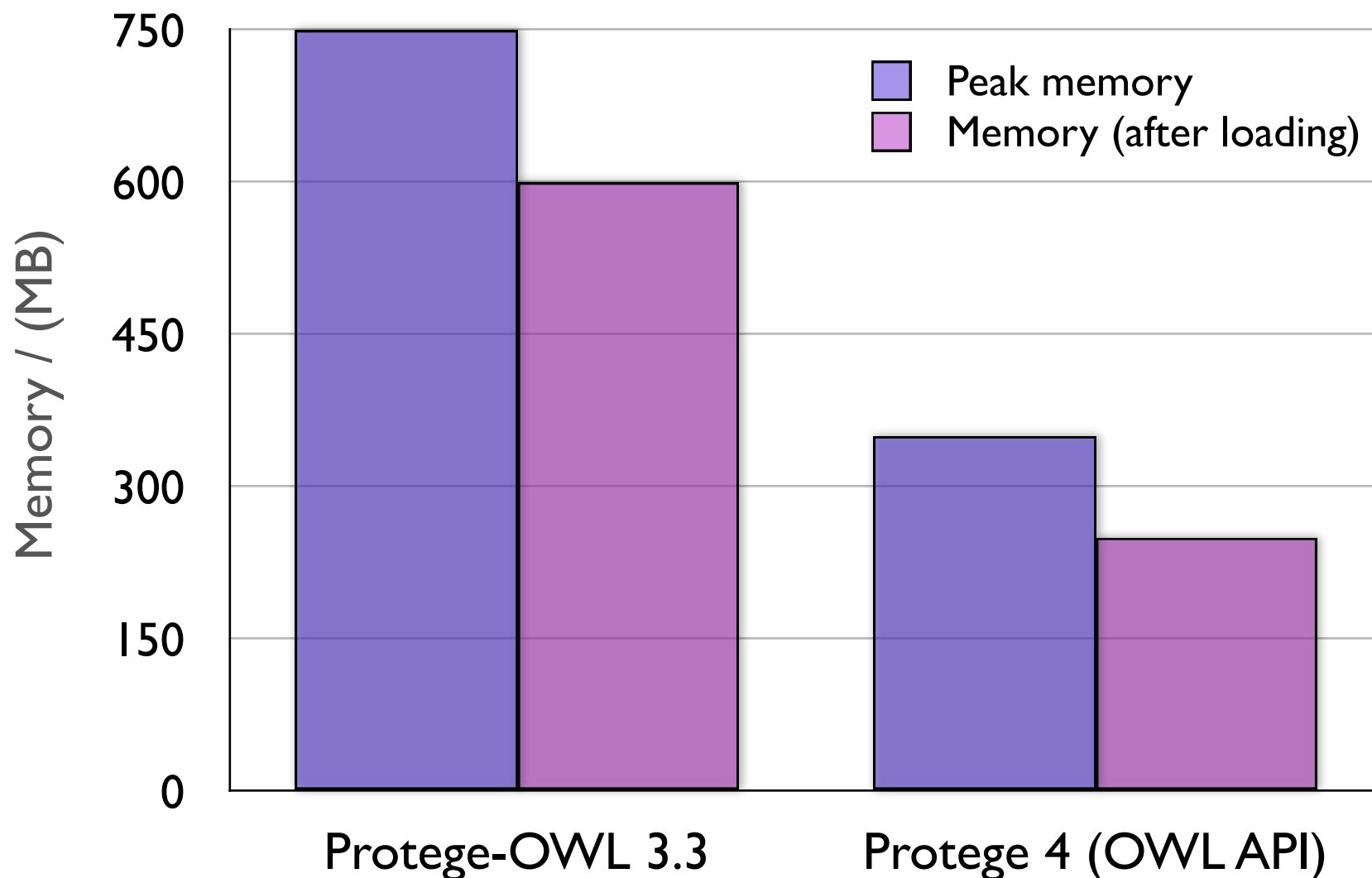
Inherited anonymous classes

● Biological_entity ✕ ○
--

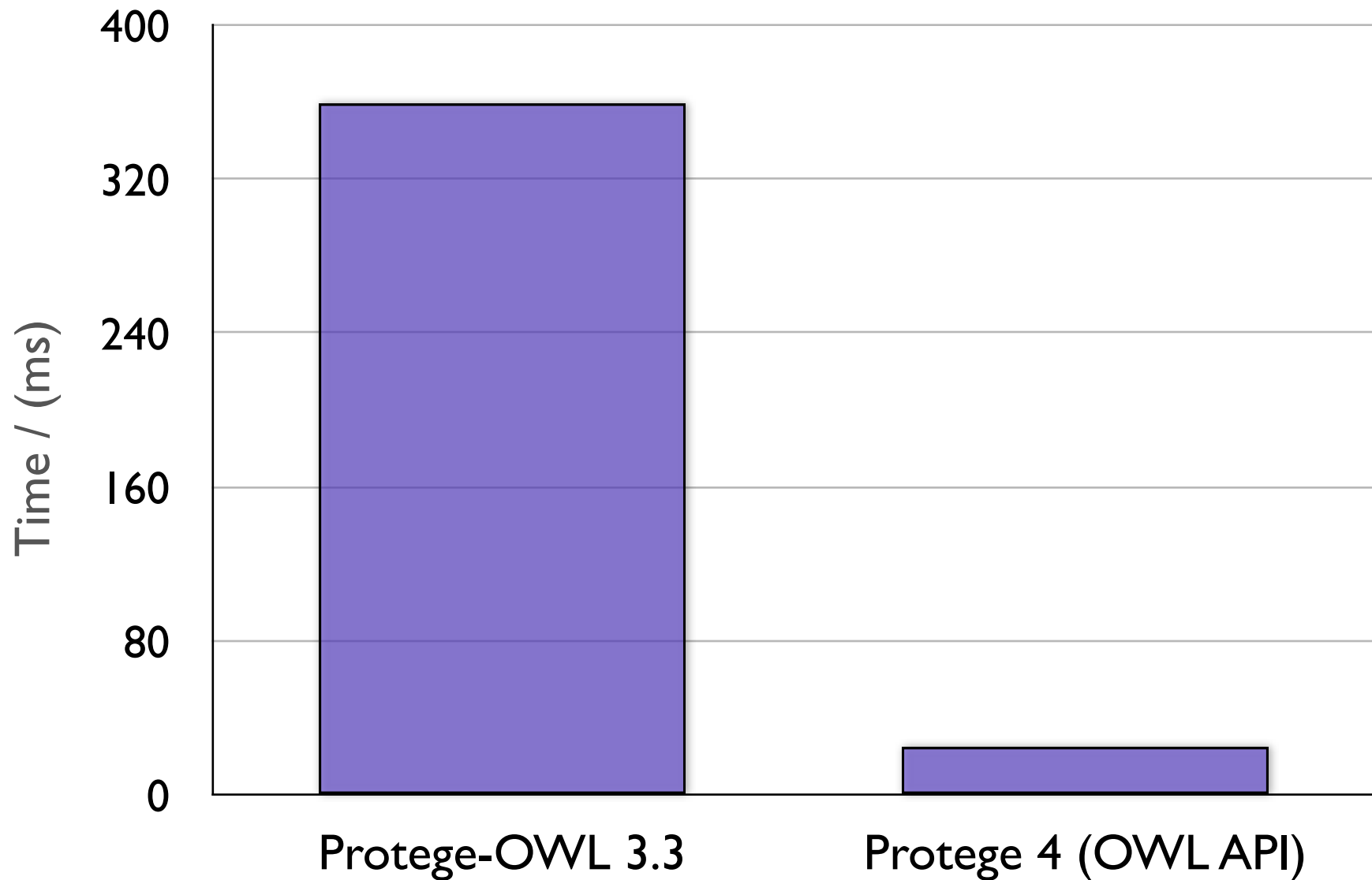
- Switch to defining ontology
- Pull into active ontology
- Move axiom to ontology...
- Convert selected rows to defined class

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/>