

# Ontology building with Protégé

## PART I : Exploration

### 1. Installation of Protégé version 5.5

Download Protégé from <http://protegeproject.github.io/protege/installation/>

### 2. Launch Protégé and import the Pizza ontology

1. Execute the bin file: `>sh ./install_protege.bin`
2. Import the Pizza ontology (Direct Imports then choose « import an ontology contained in a document located on the web ») (cf. Figure 1)
3. Analyse the class hierarchy, the different options that appear on the boxes on the right of the main window. Try to understand the meaning of the different specifications.
4. Explore the tabs *Properties* and *Individual* and observe how they are used
5. Create some instances of Pizza, PizzaBase and PizzaTopping classes
6. Extend the example by creating a new type of pizza that does not exist. For this purpose,
  - o Create a new class representing the new pizza. Express how this new pizza is related to other pizzas using disjoint constraints
  - o Create a new kind of topping for your pizza
  - o Specify for example that your pizza is of French origin.

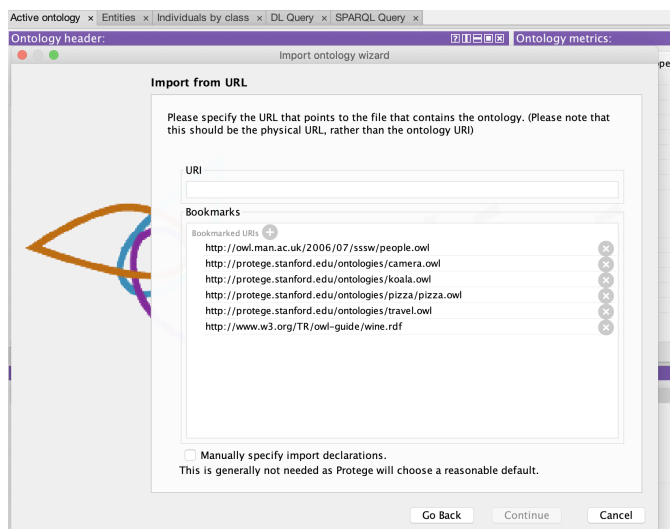


Figure 1 : The Pizza Ontology Import

## PART II : Family ontology design and development

The purpose of this *lab* is to give you with the basics of ontology modelling using Protégé tool. The main goal is to design the 'family' ontology, create individuals and infer new relations.

### 1- Classes and subclasses

The first step is to design classes and subclasses of family ontology according to the following figure (Fig.2):

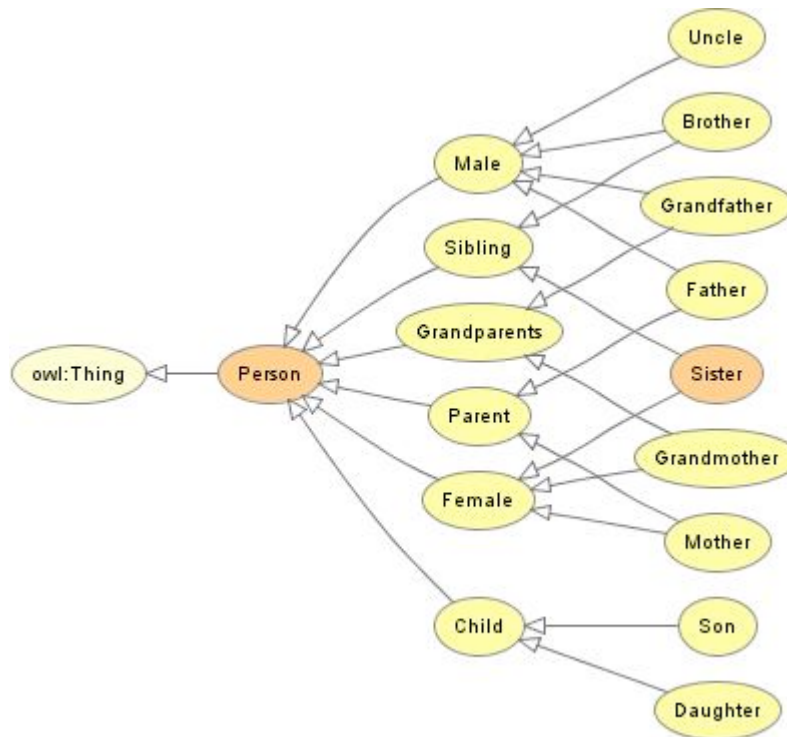


Figure 2 : Family ontology

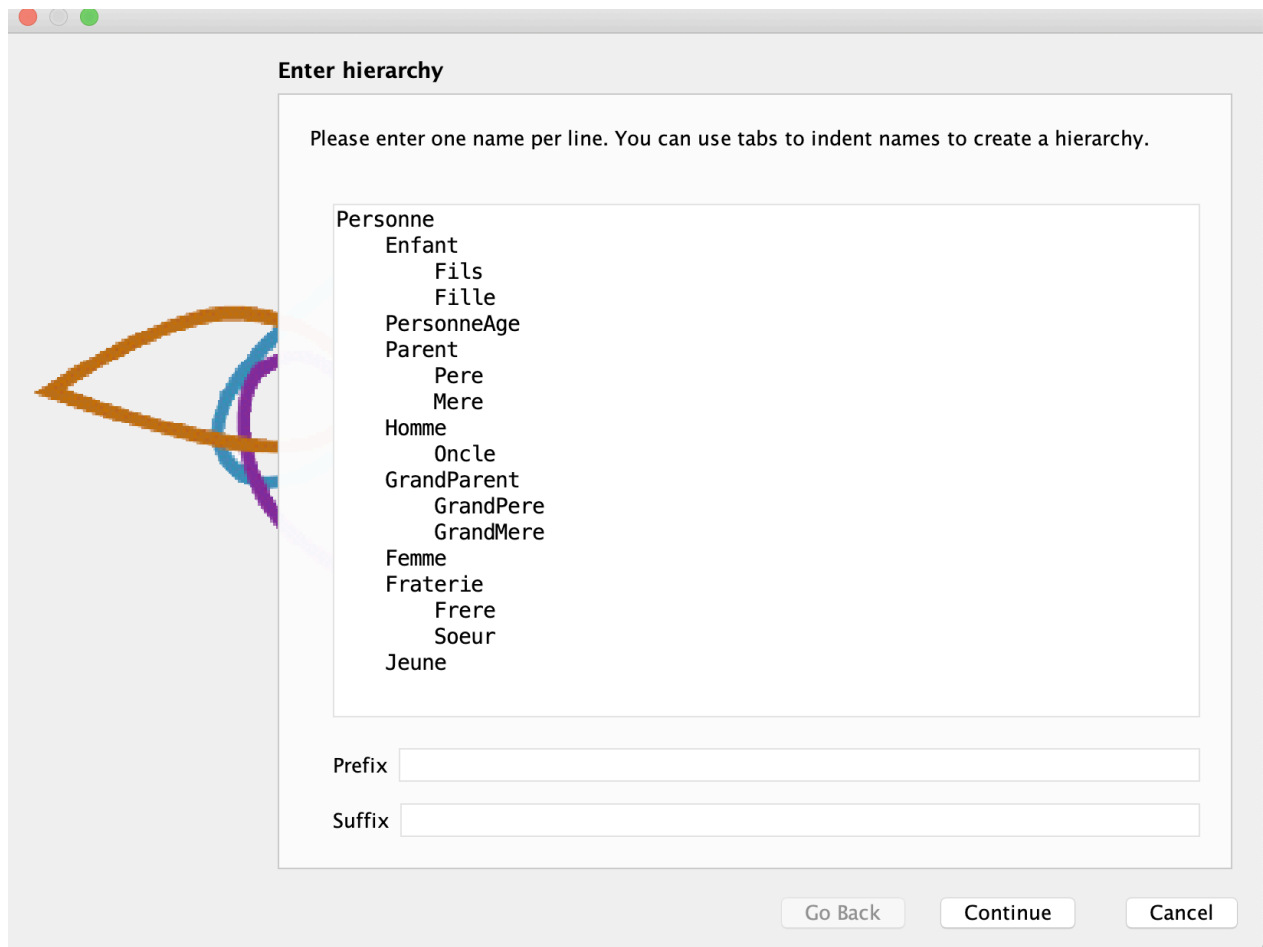


Figure 3 : Sub-classes

**Note:** It is possible to create a hierarchy of classes and subclasses (with `addSubClasses`) from a text area using indentations (see Figure 3), or by adding classes one by one with the + button at the top left of the `owl:Thing` class. Then, to express multiple inheritance, it is sufficient to mention that a class is a subclass of several classes (see Figure 5)

Class hierarchy: owl:Thing

- owl:Thing
  - Personne
    - Enfant
    - Femme
    - Fraterie
      - Frere
      - Soeur
    - GrandParent
      - GrandMere
      - GrandPere
    - Homme
    - Jeune
    - Parent
      - Mere
      - Pere
    - PersonneAge

Annotations: owl:Thing

Annotations +

SPARQL query:

```

PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
SELECT ?subject ?object
WHERE { ?subject rdfs:subClassOf ?object }

```

Execute

Description: owl:Thing

Equivalent To +

SubClass Of +

General class axioms +

SubClass Of (Anonymous Ancestor)

No Reasoner set. Select a reasoner from the Reasoner menu  Show Inferences

Figure 4 : Family classes

Class hierarchy: Soeur

- owl:Thing
  - Personne
    - Enfant
    - Femme
      - Soeur
    - Fraterie
      - Frere
      - Soeur
    - GrandParent
      - GrandMere
      - GrandPere
    - Homme
    - Jeune
    - Parent
      - Mere
      - Pere
    - PersonneAge

Annotations: Soeur

Annotations +

SPARQL query:

```

PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
SELECT ?subject ?object
WHERE { ?subject rdfs:subClassOf ?object }

```

Execute

Description: Soeur

Equivalent To +

SubClass Of +

- Femme
- Fraterie

General class axioms +

Figure 5 : Multiple Heritage

### 3. Class properties

#### a. Data Properties (cf. Figure 6)

1. A person has a name, an age and a nationality.
  - a. Create a datatype property *name* with domain **Person** and range `xsd:String`
  - b. Create a datatype property *age* with domain **Person** and range `xsd:int`
  - c. Create a datatype property *nationality* with domain **Person** and range `xsd:String`

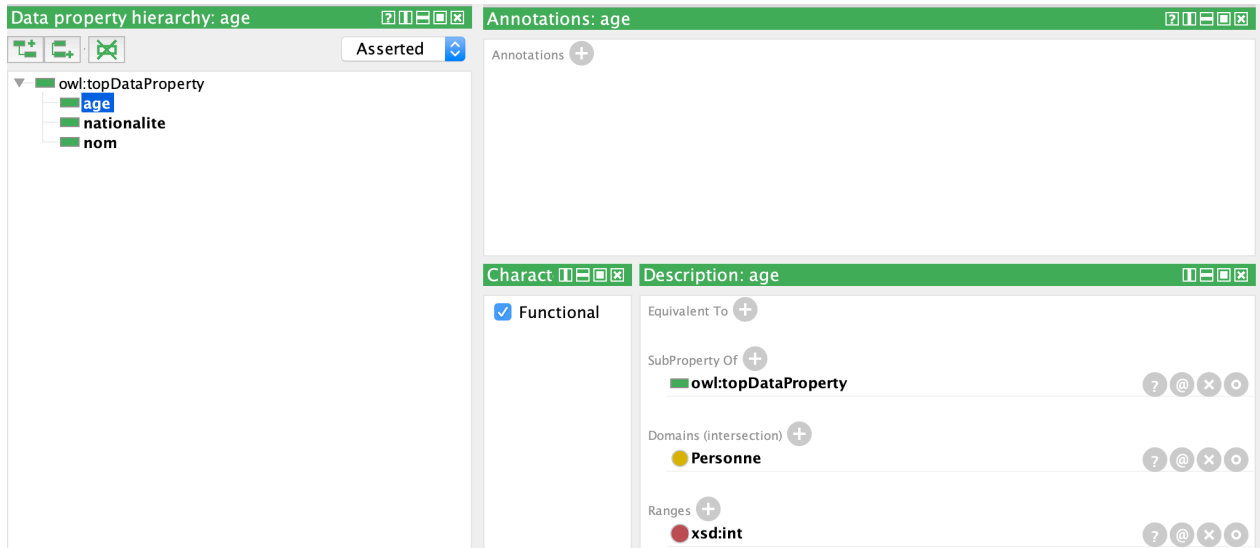


Figure 6 : Data Properties

#### b. Object Properties (cf. Figure 7)

2. Two people can get married

Create an object property *isMarriedWith* with **Person** as domain and range

3. A person is parent of another person

Create the object property *isParentOf* with **Person** as domain and range

4. A Male is father of person

Create the object property *isFatherOf* which is sub property of *isParentOf* with domain **Male** and range **Person**

5. A Female is mother of person

Create the object property *isMotherOf* which is sub property of *isParentOf* with domain **Female** and range **Person**

6. A person belongs to another person's siblings

Create the object property *isSiblingOf* with domain **Person** and range **Person**

7. A man is the brother of a person

Create the object property *isBrotherOf* which is sub property of *isSiblingOf* with domain **Male** and range **Person**

8. A Female is the sister of a person

Create the object property *isSisterOf* which is sub property of *isSiblingOf* with domain **Female** and range **Person**

9. A person is a child of another person

Create the object property *isChildOf* with domain **Person** and range **Person**

10. A Male is the son of a person

Create the object property *isSonOf* which is sub property of *isChildOf* with domain **Male** and range **Person**

11. A woman is the daughter of a person

Create the object property *isDaughterOf* which is sub property of *isChildOf* with domain **Female** and range **Person**

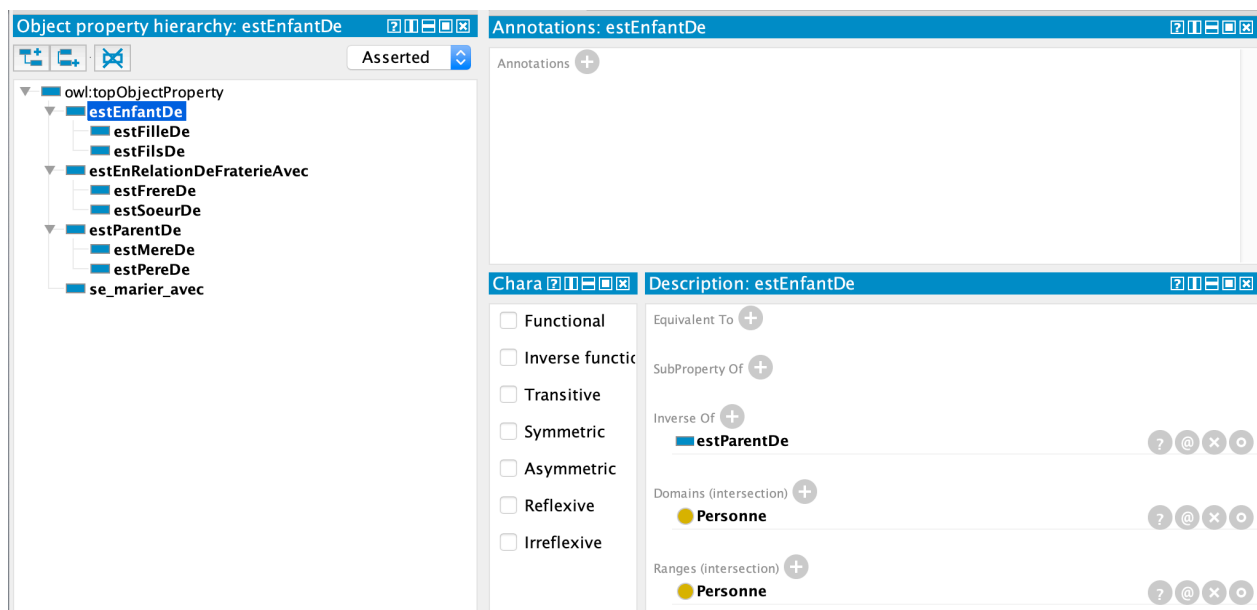


Figure 7 : Object Properties

### 3. Class and properties restrictions

#### NECESSARY AND SUFFICIENT CONDITION (Equivalent To):

- An uncle has the restriction : *is brother of one parent*
- A grandfather has the restriction : *is father of a parent*
- A grandmother has the restriction : *is mother of a parent*
- A father has the restriction : *isFatherOf* property has at least one instance
- A mother has the restriction : *isMotherOf* property has at least one instance
- A son has the restriction : *isSonOf* property has at least one instance

- A daughter has the restriction : *isDaughterOf* property has at least one instance
- A brother has the restriction : *isBrotherOf* property has at least one instance
- A sister has the restriction : *isSisterOf* property has at least one instance (cf. Figure 8)

The screenshot displays two panels from a software application. The left panel, titled 'Class hierarchy: Soeur', shows a tree structure of classes. Under 'owl:Thing', there are several classes including 'Personne', 'Enfant', 'Femme', 'GrandMere', 'Mere', 'Soeur', 'Fraterie', 'GrandParent', 'Homme', 'Frere', 'GrandPere', 'Oncle', 'Pere', 'Jeune', 'Parent', and 'PersonneAge'. The 'Soeur' class is highlighted. The right panel, titled 'Annotations: Soeur', is currently empty. Below it is a 'SPARQL query' section with an 'Execute' button. The bottom panel, titled 'Description: Soeur', shows the following information:
 

- Equivalent To: **estSoeurDe min 1 Personne**
- SubClass Of: **Femme** and **Fraterie**
- General class axioms: +
- SubClass Of (Anonymous Ancestor):
- Instances: +
- Target for Key: +
- Disjoint With: **Frere**

Figure 8 : Restriction on Sœur class

#### DISJOINTS CLASSES :

- Male and Female are disjoint
- Father and Mother are disjoint
- Son and Daughter are disjoint
- GandFather and GrandMother are disjoint

#### 4. Assign types to properties

1. *iMarriedWith* and *isSiblingOf* are symmetric properties
2. *isSiblingOf* property is transitive
3. *isChildOf* property is the inverse property of *isParentOf*
4. name, age and nationality are functional properties

#### 5. Individuals

1. create individuals to Male class :
  - a. Peter, 70, *isMarriedWith* Marie. He is French
  - b. Thomas, 40, *isSonOf* Peter. He is French
  - c. Paul, 38 *isSonOf* Peter

- d. John, 45, is italian
  - e. Pedro, 10, *isSonOf* John
  - f. Tom, 10, *isSonOf* Thomas and Alex
  - g. Michael, 5, *isSonOf* Thomas and Alex
2. create individuals to Female class :
- a. Marie, 69, french
  - b. Sylvie, 30, *isDaughterOf* Marie and Peter
  - c. Chloé, 18, *isDaughterOf* Marie and Peter
  - d. Sylvie *isMarriedWith* John
  - e. Claude, 5, *isDaughterOf* Sylvie, french
  - f. Alex, 25, *isMarriedWith* Thomas

## 6. Ontology checking using an inference engine and basic reasoning (OWL)

1. Configure the inference engine, menu : **Reasoner/Pellet or Reasoner/Hermit**
2. Check the consistency by running the reasoner : start reasoner
3. By going through the different instances, you can see the inferences made (yellow background).  
What do you observe?
- 4.
5. Instances of the Male and Female classes are automatically associated to the Person class. In version 3 of Protégé these are visible directly from the Person class but since version 4 this is no longer the case. One way to view them is to run a DL Query by typing the class name.
6. No instances are generated in the Brother, Sister and Uncle classes. Why ? How can we infer, for example, the relationships *isBrotherOf* or *isSisterOf* from *isChildOf*?

The next lab (Jena) will allow you to express these kinds of restrictions using a rule language. Indeed, inference rules will solve this problem

## SPARQL

1. In the SPARQL Queries window, test some queries
  - a. Provide the instances of Male class?
  - b. How old is John?
  - c. Provide Peter's children names?