

Implémentation de concepts de DESCRIPTION de IMGT-ONTOLOGY Sous l'éditeur d'ontologies Protégé

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World Wide Web

- Créé par Tim Berners Lee en 1990
- Langage HTML

=> Pour partager des connaissances et de relier les informations partagées.

IMGT Index - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://imgt.cines.fr/textes/IMGIndex/ontology.html

Getting Started Latest Headlines tomcat Outils linguistiques

ImMunoGeneTics Information system
http://imgt.cines.fr

Here you are: IMGT Web resources > IMGT Index

Ontology (IMGT-ONTOLOGY)

An ontology is a concise and non ambiguous description of the more significant and relevant concepts in a application domain. IMGT-ONTOLOGY [1], is the first ontology which allows the management of the immunogenetics knowledge for all vertebrate species.

Citing IMGT-ONTOLOGY:

- Giudicelli, V. and Lefranc, M.-P. "Ontology for Immunogenetics: IMGT-ONTOLOGY", *Bioinformatics*, 15, 1047-1054 (1999) PMID:10745995, LIGM:221, **ESB**
- Lefranc, M.-P. et al. "IMGT-ONTOLOGY for Immunogenetics and Immunoinformatics", *http://imgt.cines.fr*, *In Silico Biology*, 2004, 4, 17-29 Epub 2003, 4, 0004, LIGM:278, PMID: 15089751
- Lefranc, M.-P. et al. "IMGT-Choreography for Immunogenetics and Immunoinformatics", *In Silico Biology*, 2005, 5, 45-60, Epub 2005, 5, 0006, 24 Dec 2004, LIGM:294, PMID: 15972004

Introduction

The molecular synthesis and genetics of the immunoglobulin (IG) and T cell receptor (TR) chains and the polymorphism of the MHC are particularly complex, and therefore one of the first tasks of IMGT-ONTOLOGY comprises a formal specification of the terms to be used in the domain of immunogenetics and bioinformatics [2-8].

IMGT-ONTOLOGY includes a controlled vocabulary and annotation rules which are indispensable to ensure accuracy, consistency and coherence in IMGT® [5]. IMGT-ONTOLOGY allows scientists and clinicians to use identical terms with the same meaning. This provides a semantic repository to be included in more general molecular biology ontologies, and will be therefore of a great help to increase interoperability between specialist and generalist databases.

IMGT-ONTOLOGY axioms and concepts

Seven IMGT-ONTOLOGY axioms have been defined [1,6-8]: **'IDENTIFICATION'**, **'DESCRIPTION'**, **'CLASSIFICATION'**, **'NUMEROTATION'**, **'LOCALIZATION'**, **'ORIENTATION'**, and **'OBTENTION'**. They constitute the Formal IMGT-ONTOLOGY or IMGT-Kaleidoscope [9,10].

The IMGT-ONTOLOGY concepts of identification, description, classification, numerotation, localization, orientation and obtention were generated from these axioms and described in ref. [1,2,6-8].

Click here for:

- [Figures illustrating some of the IMGT-ONTOLOGY axioms and concepts](#) (IMGT Education).
- [Correspondence between the IMGT-ONTOLOGY concepts and the IMGT Scientific chart rules](#) (IMGT Scientific chart).
- [Scientific chart rules and ontologies report](#) **ESB**

Marie-Paule Lefranc, François Ehrenmann, Patrice Duroux and Véronique Giudicelli (D1.2 ImmunoGrid, The European Virtual Human Immune System Project, IST-2004-028069)
Describes the IMGT-ONTOLOGY concepts of identification, description and classification at the molecular level, generated from the IDENTIFICATION, DESCRIPTION and CLASSIFICATION axioms of the Formal IMGT-ONTOLOGY (IMGT-Kaleidoscope).

http://imgt.cines.fr/textes/PDF/D1.2_ImmunoGrid.pdf

World Wide Web

- Les ressources sous forme de page HTML
- Les relations entre ses pages se traduisent par des liens hypertextes

Limites

- Balises HTML:
 - la connaissance est encapsulée dans une couche de présentation
- Introduction de balises propriétaires (Microsoft, Netscape)
- Les liens hypertexte ne permettent pas de qualifier les relations entre les informations
- La qualité des pages est très hétérogène.

=> Ces informations ne sont pas exploitables automatiquement

World Wide Web Consortium (W3C) (créé en 1994)

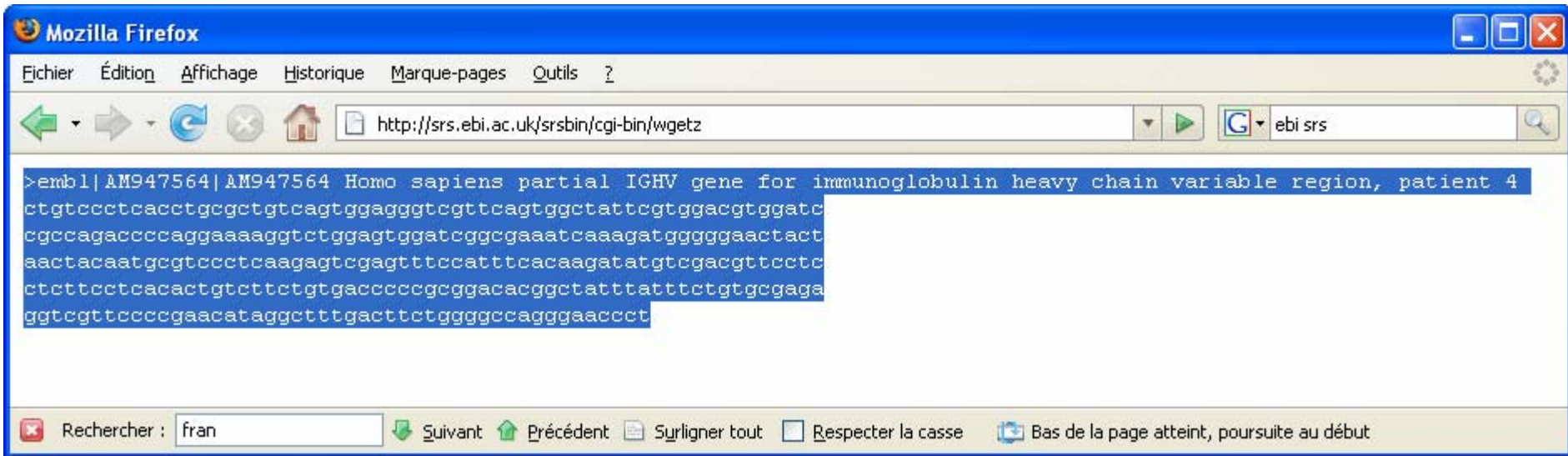
- Développement de technologies, (spécifications, guides, logiciels et outils)
- Proposition des standards, pour la croissance et l'exploitation du Web

En particulier, en 1998, le langage de balisage extensible
XML (Extensible Markup Language)
devient une recommandation du W3C

Objectifs

- XML devrait pouvoir être utilisé sans difficulté sur Internet
- Il devrait être facile d'écrire des programmes traitant les documents XML
- Les documents XML devraient être lisibles par l'homme et raisonnablement clairs
- Il devrait être facile de créer des documents XML

Séquence EMBL AM947564 en format FASTA (texte)



The screenshot shows a Mozilla Firefox browser window with the address bar containing `http://srs.ebi.ac.uk/srsbin/cgi-bin/wgetz` and a search engine dropdown set to 'ebi srs'. The main content area displays a FASTA sequence for EMBL AM947564, which is highlighted in blue. The sequence is as follows:

```
>embl|AM947564|AM947564 Homo sapiens partial IGHV gene for immunoglobulin heavy chain variable region, patient 4
ctgtccctcacctgcgctgtcagtgagggtcgttcagtggtattcgtggacgtggatc
cgccagaccccaggaaaaggtctggagtggtcggcgaatcaaagatggggaactact
aactacaatgcgtccctcaagagtcgagtttccatttcacaagatatgtcgacgttcctc
ctttctcactgtttctgtgacccccgggacaggtatttatttctgtgcgaga
ggtcgttccccgaacatagctttgacttctggggccagggaaacct
```

At the bottom of the browser window, there is a search bar with the text 'Rechercher : fran' and several navigation icons: 'Suivant', 'Précédent', 'Surligner tout', 'Respecter la casse', and 'Bas de la page atteint, poursuite au début'.

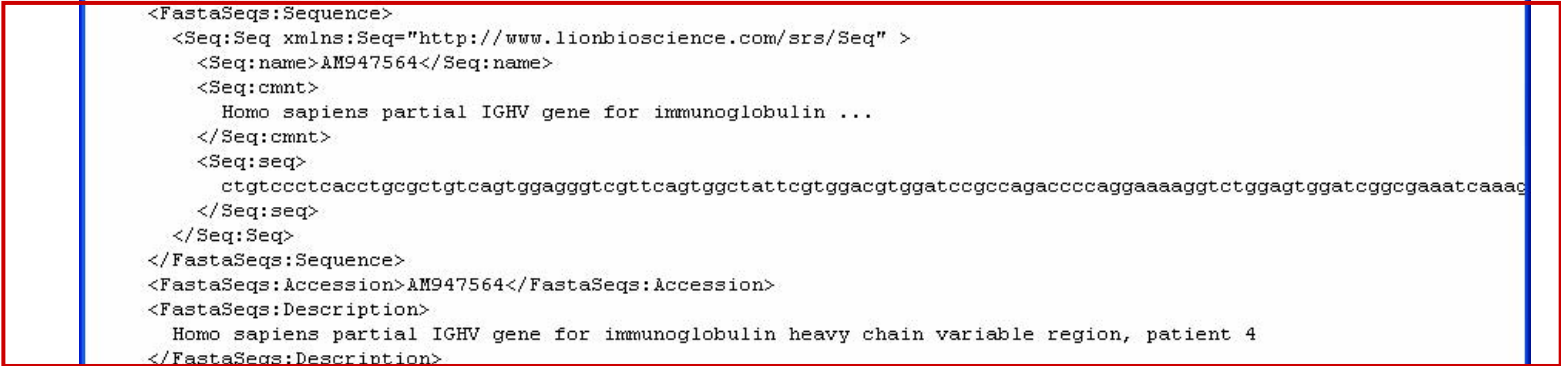
Séquence FASTA AM947564 en format XML

```
Mozilla Firefox
Fichier  Édition  Affichage  Historique  Marque-pages  Outils  ?
http://srs.ebi.ac.uk/srsbin/cgi-bin/wgetz  ebi srs

<?xml version="1.0" encoding="ISO-8859-1"?>

<!--
<!DOCTYPE LoadedSet [
<!ELEMENT LoadedSet (FastaSeqs:FastaSeqs*)>
<!ELEMENT FastaSeqs:FastaSeqs (FastaSeqs:Id, FastaSeqs:Sequence?, FastaSeqs:Accession?, FastaSeqs:Description?)>
<!ATTLIST FastaSeqs:FastaSeqs
  xmlns:FastaSeqs CDATA #FIXED "http://www.lionbioscience.com/srs/FastaSeqs"
>
<!ELEMENT FastaSeqs:Id (#PCDATA)>
<!ELEMENT FastaSeqs:Sequence (Seq:Seq)>
<!ELEMENT Seq:Seq (Seq:name?, Seq:dbName?, Seq:cmnt?, Seq:state?, Seq:seq?)>
<!ATTLIST Seq:Seq
  xmlns:Seq CDATA #FIXED "http://www.lionbioscience.com/srs/Seq"
>
<!ELEMENT Seq:name (#PCDATA)>
<!ELEMENT Seq:dbName (#PCDATA)>
<!ELEMENT Seq:cmnt (#PCDATA)>
<!ELEMENT Seq:state (#PCDATA)>
<!ELEMENT Seq:seq (#PCDATA)>
<!ELEMENT FastaSeqs:Accession (#PCDATA)>
<!ELEMENT FastaSeqs:Description (#PCDATA)>
]
-->

<LoadedSet>
  <FastaSeqs:FastaSeqs
    xmlns:FastaSeqs="http://www.lionbioscience.com/srs/FastaSeqs" >
    <FastaSeqs:Id>EMBL:AM947564</FastaSeqs:Id>
    <FastaSeqs:Sequence>
      <Seq:Seq xmlns:Seq="http://www.lionbioscience.com/srs/Seq" >
        <Seq:name>AM947564</Seq:name>
        <Seq:cmnt>
          Homo sapiens partial IGHV gene for immunoglobulin ...
        </Seq:cmnt>
        <Seq:seq>
          ctgtccctcacctgcgctgtcagtgagggtcgttcagtggtatcgtggacgtggatccgccagaccccaggaaaaggtctggagtggatcggcgaatcaaac
        </Seq:seq>
      </Seq:Seq>
    </FastaSeqs:Sequence>
    <FastaSeqs:Accession>AM947564</FastaSeqs:Accession>
    <FastaSeqs:Description>
      Homo sapiens partial IGHV gene for immunoglobulin heavy chain variable region, patient 4
    </FastaSeqs:Description>
  </FastaSeqs:FastaSeqs>
</LoadedSet>
```



RDF : Resource Description Framework

Créé en 1999 pour décrire les métadonnées
dans l'objectif de traiter l'information automatiquement,
de favoriser l'interopérabilité des connaissances et de structurer les informations.

Métadonnées: information permettant d'en décrire une autre

- Les métadonnées sont habituellement comprises comme des données à propos des données.
- Un catalogue de bibliothèque contient de l'information (métadonnée) à propos de publications (données)
- Un système de fichier informatique définit des droits de lecture, écriture, etc. (métadonnées) à propos des fichiers (données).

RDF

- Standard du W3C
- Basé sur XML
- Un début vers un Web structuré
- RDF emploie les URIs comme schéma de nommage (pour éviter la confusion, entre termes de sémantique différents).
- On peut décrire n'importe quoi... même une personne
- Grande souplesse quand à l'extensibilité

RDF se base sur une description des connaissances à l'aide de phrases simples :
C'est un moyen d'exprimer des relations.

Ces relations sont décrites sous forme de graphe.

Chaque nœud du graphe est une ressource ou une valeur.

Et chaque nœud est relié à un autre par un arc "nommé"

Sujet

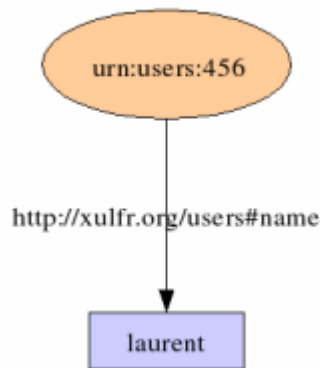
(source, ressource)

Prédicat

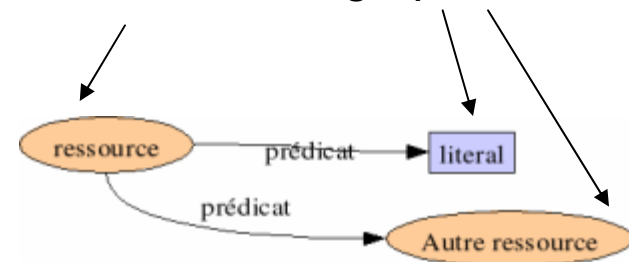
(propriété)

Objet

(cible, valeur)



nœuds du graphe



Shémas issus de <http://xulfr.org/wiki/FormatRdf/Introduction>

=> Ceci correspond à un lien qui comporte un sens : c'est du Web sémantique

Les objectifs du Web sémantique sont de partager les connaissances et de pouvoir les manipuler automatiquement. Pour ceci, il faut qualifier le savoir (à l'aide de métadonnées), le formaliser en utilisant une syntaxe extensible (par exemple avec XML) et le structurer pour éviter les duplications.

ONTOLOGIE

Une ontologie est un ensemble structuré de connaissances dans un domaine particulier comme l'immunogénétique.

Une ontologie cherche à représenter le sens des concepts et des relations qui les lient.

Elle comprend une partie terminologique: inventaire du vocabulaire pour les métadonnées, les concepts et la déclaration des instances (valeurs) et leurs propriétés particulières (relations entre elles).

Sur le plan informatique:

Les ressources sont définies les unes par rapport aux autres selon un graphe: cette structure permet une automatisation de la manipulation des données.

Différence entre un thésaurus et une ontologie :

un thésaurus relie des concepts entre eux selon des relations précises : synonyme, homonyme, hiérarchie, terme associé.

L'ontologie ajoute des règles et des outils de comparaison sur et entre les termes, groupes de termes et relations : équivalence, symétrie, contraire, cardinalité, transitivité..

=> Dans cet objectif RDF est trop limité, en particulier il ne permet pas de donner la nature des relations (transitive inverse, ..), il possède une logique trop limitée pour faire du raisonnement .

OWL (Web Ontology Language)

En 2004, OWL devient une recommandation du W3C

OWL découle de RDF et RDFS, possède des connecteurs logiques, d'exprimer des cardinalités sur les propriétés et d'en spécifier la nature

Une ontologie formalisée en OWL comprend

- Un espace de nom, :

- L'entête <owl :Ontology> pour décrire l'ontologie

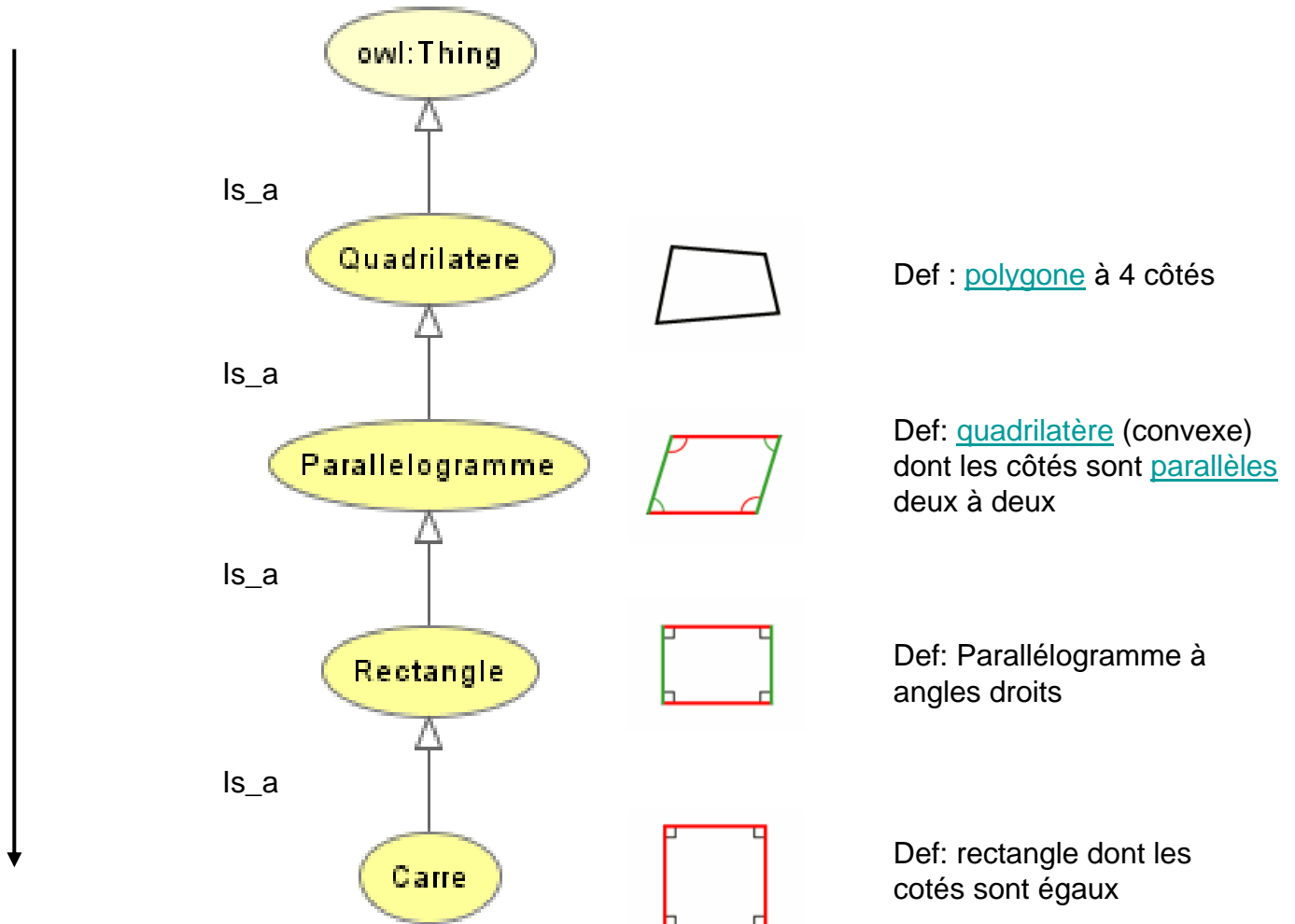
- La définition des classes, des propriétés et des instances

Classes, sous-classes, héritage et spécialisation

Notion de Classe :

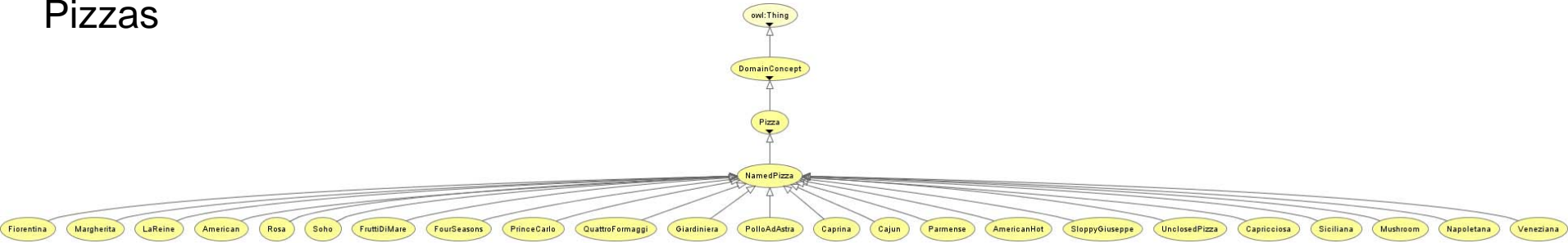
Définit un groupe d'individus possédant des propriétés similaires.
Thing est la classe mère.

spécialisation

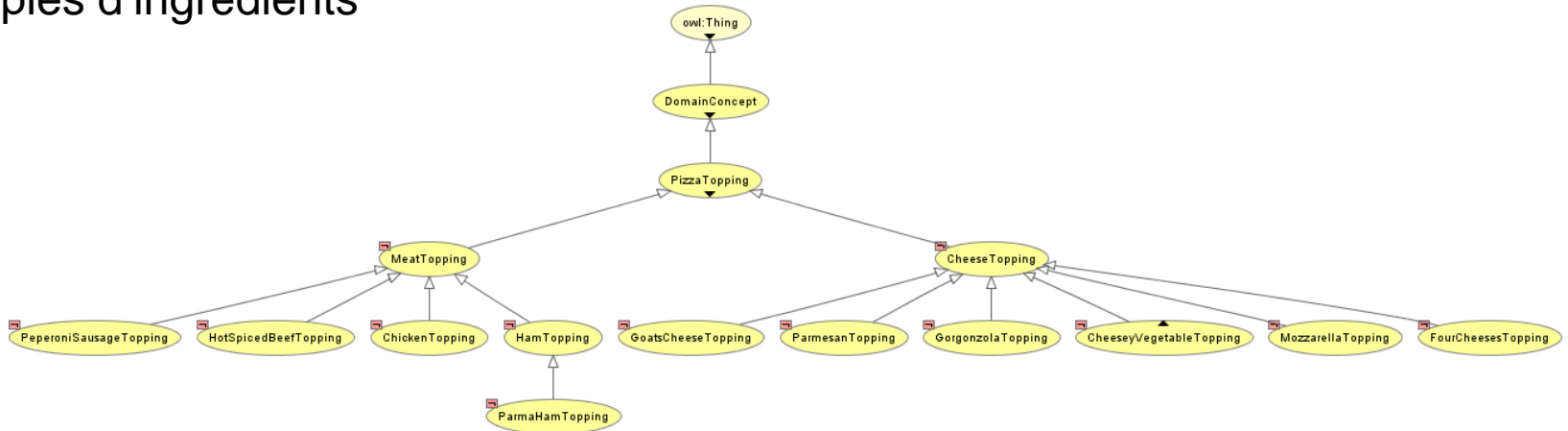


Exemples de hiérarchie : ontologie des pizzas (exemple fourni avec Protégé)

Pizzas



Exemples d'ingrédients

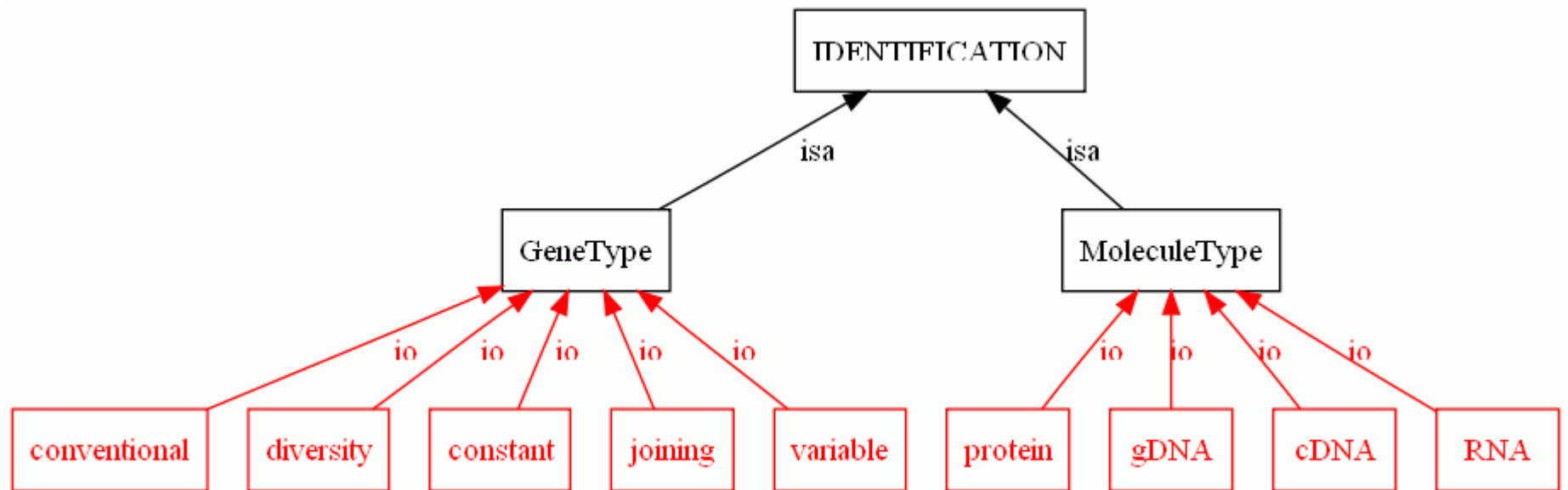


Exemples de hiérarchie : les concepts d'identification de IMGT-ONTOLOGY



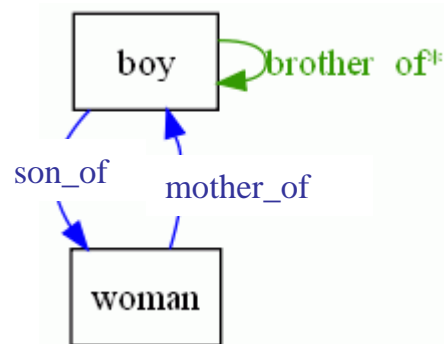
Instances

Ce sont les « individus » qui peuplent les classes
Exemple des instances des concepts « GeneType » et « MoleculeType »
de IMG-T-ONTOLOGY



Propriétés

- Propriété d'objet (Object property) : relie une instance à une autre instance



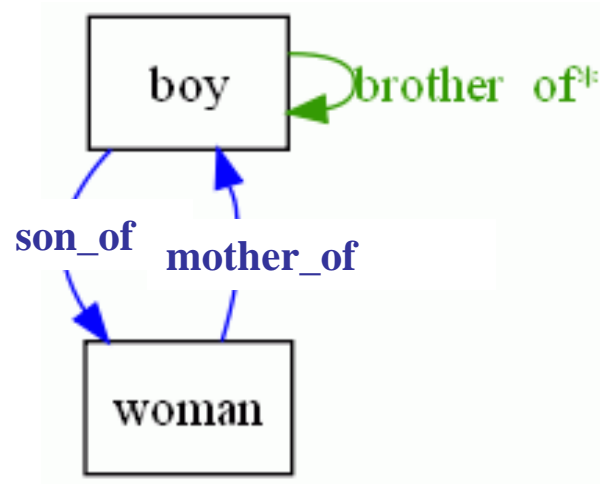
- Propriété de type de données (Datatype property): relie une instance à des valeurs. Owl propose un héritage des propriétés (à exploiter pour les relations entre les motifs).

| | | |
|------------|-----------------------|-------|
| boy | | |
| Son of | Instance | woman |
| brother of | Instance ⁺ | boy |
| age | Integer ⁺ | |

domain : classe pour laquelle est définie la propriété,
range : classe reliée par la propriété au domain.

Propriétés inverses et symétriques

Exemples de Restriction sur les Propriétés



Symétrie: brother_of

Inverse: son_of / mother_of

Cardinalités: Une femme peut avoir entre 0 et N fils
Un garçon peut avoir entre 0 et N frères
Un garçon a une et une seule mère

Les 3 sous-langages OWL

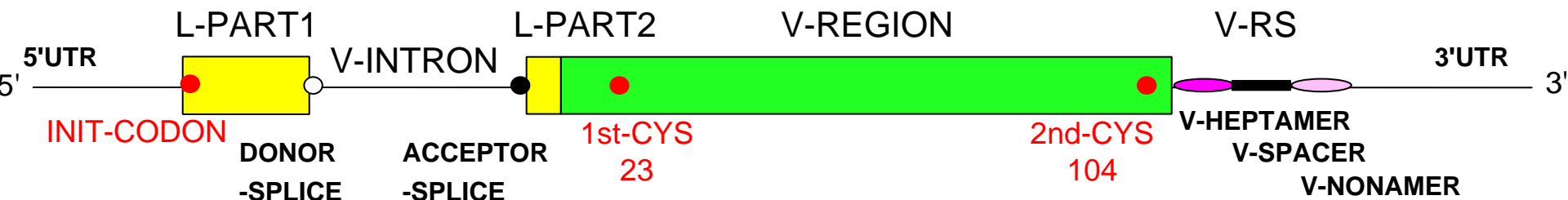
OWL LITE: permet d'établir une hiérarchie de concepts simples, contraintes simples: cardinalités 0 ou 1.

OWL DL (DL pour description logic): comprend toutes les structures de OWL, possède une expressivité plus importante

OWL FULL expressivité maximale, liberté syntaxique sans garantie de calcul, une classe peut aussi correspondre à l'instance d'une autre classe.

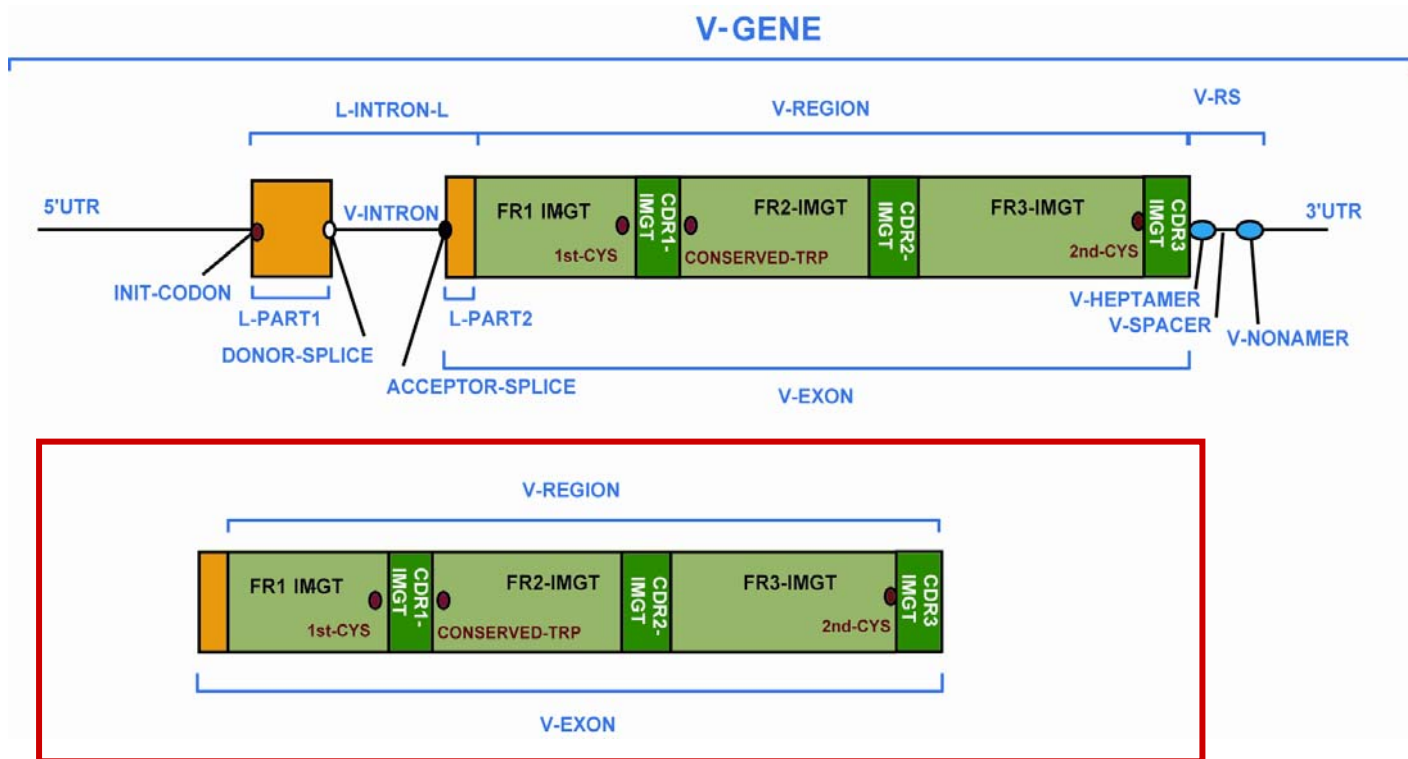
Les concepts de description de IMGT-ONTOLOGIE: La connaissance pour l'annotation des séquences

```
>X62106.0|HSV12|Homo sapiens VI-2 gene for immunoglobulin heavy chain
tgagagctcc gttcctcacc atggactgga cctggaggat cctcttcttg gtggcagcag      60
ccacagggaa gaggctccct agtcccagtg atgagaaaga gattgagtc agtccagggg      120
gatctcatcc acttctgtgt tctctccaca ggaggccact ccaggtgca gctggtgcag      180
tctggggctg aggtgaagaa gctgggggcc tcagtgaagg tctcctgcaa ggcttctgga      240
tacaccttca ccggctacta tatgcactgg gtgcgacagg ccctggaca agggcttgag      300
tggatgggat ggatcaacc taacagtggg ggcacaaact atgcacagaa gtttcagggc      360
agggtcacca tgaccagggg cacgtccatc agcacagcct acatggagct gagcaggctg      420
agatctgacg acacggccgt gtattactgt gcgagagaca cagtgtgaaa acccacatcc      480
tgagggtgtc agaaacccaa gggaggaggc ag
```



Application: formalisation dans Protégé des labels qui composent Le V-EXON et de leur relations

(Source d'information: les informations de l'article de Biochimie)



| Relation | Reciprocal relation (inverse) |
|----------------------------------|-------------------------------|
| "adjacent_at_its_5_prime_to" | "adjacent_at_its_3_prime_to" |
| "included_with_same_5_prime_in", | "includes_with_same_5_prime", |
| "included_with_same_3_prime_in", | "includes_with_same_3_prime", |
| "overlap_at_its_5_prime_with" | "overlap_at_its_3_prime_with" |
| "included_in" | "includes" |

Protégé

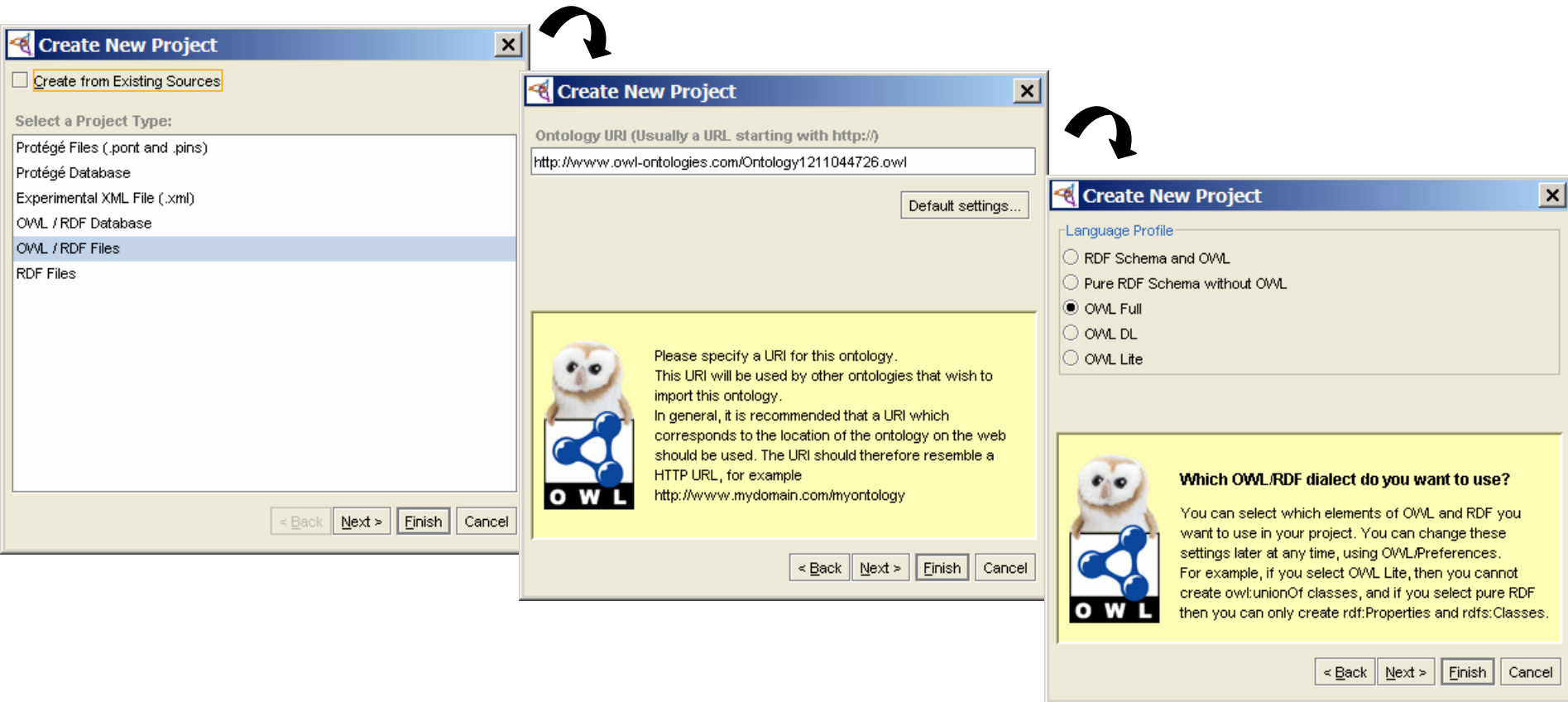
Protégé est un logiciel gratuit (JAVA), plate-forme open-source qui fournit une suite d'outils pour construire des bases de connaissances et de ontologies.

Protégé inclut de nombreux plugins pour la manipulation et la représentation d'ontologies dans différents formats.

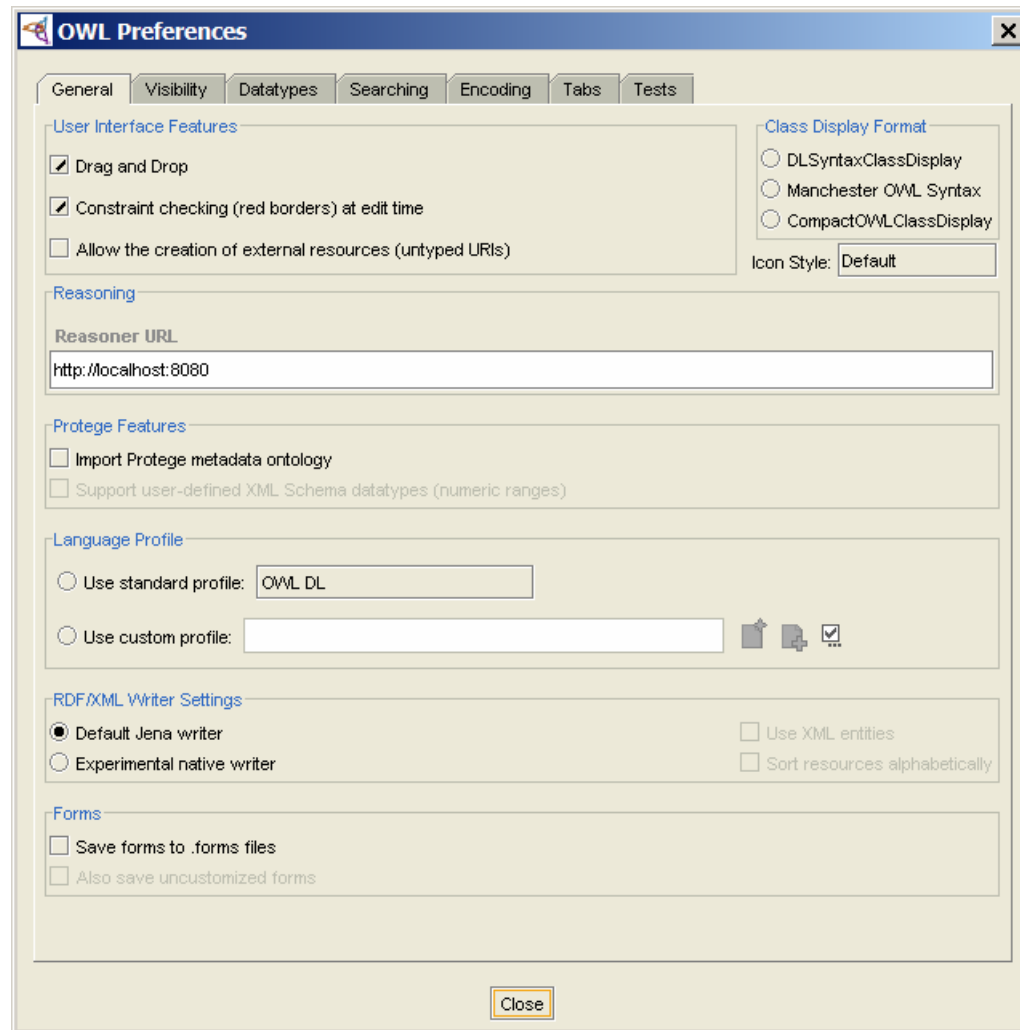
L'éditeur Protégé-OWL permet aux utilisateurs de construire des ontologies pour le Web sémantique en OWL.

- Dans IMGT-ONTOLOGY, créer le concept des régions codantes de l'axiome DESCRIPTION et définir ses relations à l'aide de Protégé.
- Créer les instances qui permettent de décrire le V-GENE et les relations qui les lient,
- Représenter graphiquement concepts, instances et relations.
- Générer le code RDF/XML.

Creation d'une nouvelle ontologie avec Protege_3.4_beta



Pour redéfinir le langage: onglet OWL => Preferences



Espace de noms

Chaque ontologie éditée avec Protégé a son propre espace de noms:
C'est le « default namespace »

C'est une chaîne de caractères qui préfixe les noms des classes, des propriétés, des instances afin d'assurer leur unicité (Unique Resource Identifiers URI) le préfixe n'est pas visible sous Protégé.

-Evite la confusion de termes identiques avec des significations différentes en fonction du domaine de connaissances de l'ontologie

The screenshot shows the Protégé 3.4 beta interface. The 'INDIVIDUAL EDITOR' window is active, showing the 'Ontology URI' field set to 'http://imgt.igh.cnrs.fr/IMG-ONTOLOGY'. The 'Default Namespace' field is also set to 'http://imgt.igh.cnrs.fr/IMG-ONTOLOGY#'. Below, the 'Namespace Prefixes' table lists various prefixes and their corresponding URIs.

| Prefix | Namespace |
|---------|---|
| p1 | http://www.owl-ontologies.com/assert.owl# |
| xsd | http://www.w3.org/2001/XMLSchema# |
| xsp | http://www.owl-ontologies.com/2005/08/07/xsp.owl# |
| protege | http://protege.stanford.edu/plugins/owl/protege# |
| rdfs | http://www.w3.org/2000/01/rdf-schema# |
| rdf | http://www.w3.org/1999/02/22-rdf-syntax-ns# |
| owl | http://www.w3.org/2002/07/owl# |

Création de nouvelles classes avec Protégé (1)

The screenshot displays the Protégé 3.4 beta interface for editing an ontology. The main window is titled "IMG-T-ONTOLOGY Protégé 3.4 beta". The interface is divided into several panes:

- SUBCLASS EXPLORER:** Located on the left, it shows a tree view of the ontology's class hierarchy. The root class is `owl:Thing`. Underneath, there are two main categories: `CLASSIFICATION` and `IDENTIFICATION`. The `IDENTIFICATION` category is expanded, showing subclasses like `ChainType`, `ConfigurationType`, `DomainType`, `EntityType`, `Function`, `Functionality`, `GeneType`, `MoleculeType`, `ReceptorType`, `Specificity`, `StructureType`, and `Taxon`. A red box highlights the `owl:Thing` class and a "Create subclass" button next to it.
- CLASS EDITOR:** The main workspace on the right. It shows the selected class `owl:Thing` (an instance of `owl:Class`). Below this, there is a table for defining class properties and values. The table has columns for "Property", "Value", and "Lang". One property, `rdfs:comment`, is listed. Below the table, there is a section for "Asserted Conditions" with a list of conditions: "NECESSARY & SUFFICIENT" and "NECESSARY".

The bottom of the interface features a toolbar with various icons and a status bar at the very bottom with radio buttons for "Logic View" (selected) and "Properties View".

Création de nouvelles classes avec Protégé (2)

The screenshot displays the Protégé 3.4 beta interface for editing the 'DESCRIPTION' class. The window title is 'IMGT-ONTOLOGY Protégé 3.4 beta'. The main menu includes File, Edit, Project, OWL, Reasoning, Code, Tools, Window, and Help. The toolbar contains various icons for file operations and editing.

The interface is divided into several panels:

- SUBCLASS EXPLORER:** Located on the left, it shows the 'Asserted Hierarchy' for the project 'IMGT-ONTOLOGY'. The hierarchy includes 'owl:Thing' as the root, with several subclasses like 'CLASSIFICATION', 'IDENTIFICATION', 'ChainType', 'ConfigurationType', 'DomainType', 'EntityType', 'Function', 'Functionality', 'GeneType', 'MoleculeType', 'ReceptorType', 'Specificity', 'StructureType', 'Taxon', and 'DESCRIPTION' (which is currently selected).
- CLASS EDITOR:** The central panel, titled 'CLASS EDITOR', shows the 'DESCRIPTION' class. It includes a 'For class:' field set to 'DESCRIPTION' and a '(instance of owl:Class)' checkbox. Below this is a table with columns 'Property', 'Value', and 'Lang'. A single row is visible with the property 'rdfs:comment' and the value 'definition'. A red box highlights this table area.
- ASSERTED CONDITIONS:** Located at the bottom, this panel shows 'Asserted Conditions' for the class. It includes a legend for 'NECESSARY & SUFFICIENT' and 'NECESSARY' conditions. A red box highlights this panel.

The bottom status bar shows 'Logic View' selected and 'Properties View' unselected.

Classes disjointes

Exprime que les instances d'une classe ne peuvent instances d'une autre Classe.

Exemple: le cercle ne fait pas partie des parallogrammes.

les sites d'épissage ne font pas partie des régions codantes

On peut soit exprimer que les sous classe d'une classe sont toutes disjointes

Click droit =>

The screenshot shows the Protégé 3.4 beta interface. The main window is titled "IMGT-ONTOLOGY Protégé 3.4 beta". The interface is divided into several panes:

- SUBCLASS EXPLORER:** Shows a tree view of classes under "IMGT-ONTOLOGY". The "IDENTIFICATION" class is selected, and a context menu is open over it. The menu options include "Create subclass", "Create individuals...", "Create sibling class", "Create subclasses...", "Delete class", "Edit class description...", "Check concept consistency", "Compute individuals belonging to class", "Get inferred subclasses", "Get inferred superclasses", "Create clone", "Hide class", "Extract", "Show Neighbourhood (Jambalaya)...", "Show Subclass Tree (Jambalaya)...", "Show Superclass Tree (Jambalaya)...", "Refactor", "Rename across files...", "Set all subclasses disjoint", "Set deprecation flag", "Search and View", "Sort", "Collapse", and "Expand".
- SUPERCLASS EXPLORER:** Shows the "IDENTIFICATION" class selected.
- CLASS EDITOR:** Shows the "CLASSIFICATION" class selected. The "Properties and Restrictions" tab is active, showing a table with columns "Property", "Value", and "Lang". The table contains one row: "rdfs:comment". Below the table, there are several restrictions listed: "_for_" (multiple CLASSIFICATION or IDENTIFICATION), "_has_" (multiple IDENTIFICATION or CLASSIFICATION), "defines" (multiple CLASSIFICATION or IDENTIFICATION), and "is_defined_by" (multiple IDENTIFICATION or CLASSIFICATION).
- Properties and Restrictions:** Shows a list of properties and restrictions for the selected class.
- Disjoints:** Shows a list of disjoint classes, including "IDENTIFICATION" and "rdfs:Property".

Soit expliciter quelles sont les classes disjointes

The screenshot displays the Protégé 3.4 beta interface for the IMG-T ONTOLOGY. The main window is titled "IMG-T ONTOLOGY Protégé 3.4 beta" and shows the following components:

- Subclass Explorer:** Shows the hierarchy of classes under "owl:Thing", including CLASSIFICATION, IDENTIFICATION, and Taxon.
- Superclass Explorer:** Shows the hierarchy of classes under "IDENTIFICATION", including ChainType, ConfigurationType, DomainType, EntityType, Function, Functionality, GeneType, MoleculeType, ReceptorType, and Taxon.
- Class Editor:** Shows the "Taxon" class with its properties and restrictions. The "rdfs:comment" property is visible, describing the Taxon concept. The "NCBITaxon" restriction is also shown.
- Disjoint Classes:** A pane (highlighted with a red box) showing a list of disjoint classes: ChainType, ConfigurationType, DomainType, EntityType, Function, Functionality, GeneType, MoleculeType, and ReceptorType.

The "Disjoint Classes" pane is currently in "Properties View" mode, as indicated by the radio buttons at the bottom right.

Création de sous-classes avec Protégé

The screenshot displays the Protégé 3.4 beta software interface. The title bar indicates the project is 'IMGT-ONTOLOGY' and the file path is 'C:\Documents%20and%20Settings\veronique\Mes%20documents\protege\IMGT-ONTOLOGY\IMGT-ONTOLOGY.pprj, OWL ...'. The main menu includes File, Edit, Project, OWL, Reasoning, Code, Tools, Window, and Help. The toolbar contains various icons for file operations and navigation.

The interface is divided into several panes:

- SUBCLASS EXPLORER:** Shows the ontology hierarchy for 'IMGT-ONTOLOGY'. The 'DESCRIPTION' class is expanded, showing 'CodingRegion' as a subclass.
- CLASS EDITOR:** The active pane for editing the 'CodingRegion' class. It shows the class name in a text field and a table for properties and values.
- Table:** A table with columns 'Property', 'Value', and 'Lang'. One row is visible with 'Property' as 'rdfs:comment'.
- Asserted Conditions:** A section for defining logical constraints, currently showing 'NECESSARY & SUFFICIENT' and 'NECESSARY'.
- Disjoints:** A section for defining disjoint classes, currently empty.

A tooltip labeled 'Create subclass' is visible over the 'CodingRegion' class in the hierarchy. The bottom status bar shows 'Logic View' selected and 'Properties View' unselected.

Création d'une nouvelle propriété avec Protégé de type ObjectProperty

The screenshot displays the Protégé 3.4 beta interface for editing an ontology. The main window is titled "IMGT-ONTOLOGY Protégé 3.4 beta". The interface is divided into several panes:

- PROPERTY BROWSER:** Located on the left, it shows a list of object properties for the project "IMGT-ONTOLOGY". The properties listed are:
 - is_defined_by ↔ defines
 - _has_ ↔ _for_
 - defines ↔ is_defined_by
 - _for_ ↔ _has_
- PROPERTY EDITOR:** The central pane is titled "PROPERTY EDITOR" and is currently editing the property "is_defined_by". It shows a table with the following content:

| Property | Value | Lang |
|--------------|-------|------|
| rdfs:comment | | |
- Domain and Range:** Below the table, there are two sections: "Domain" and "Range". Both sections have a dropdown menu set to "CLASSIFICATION".
- Property Characteristics:** On the right side, there are several checkboxes for property characteristics:
 - Functional
 - InverseFunctional
 - Symmetric
 - Transitive
- Inverse:** At the bottom right, there is an "Inverse" section with a dropdown menu set to "defines".

Création d'une nouvelle propriété avec Protégé de type ObjectProperty

The screenshot displays the Protégé 3.4 beta interface for creating a new property. The main window is titled "PROPERTY EDITOR" and shows the configuration for a property named "is_consecutive_to".

Property Editor Details:

- For Property:** is_consecutive_to (instance of owl:ObjectProperty)
- Annotations Table:**

| Property | Value | Lang |
|--------------|------------------|------|
| rdfs:comment | definition | |

Property Configuration:

- Domain:** owl:Thing
- Range:** (empty)
- Characteristics:**
 - Functional
 - InverseFunctional
 - Symmetric
 - Transitive
- Inverse:** (empty)

Left Panel (PROPERTY BROWSER):

- For Project: MGT-ONTOLOGY
- Object properties list:
 - is_consecutive_to
 - is_defined_by ↔ defines
 - _has_ ↔ _for_
 - defines ↔ is_defined_by
 - _for_ ↔ _has_

Création d'une nouvelle propriété avec Protégé de type ObjectProperty

The screenshot displays the Protégé 3.4 beta interface for creating a new property. The main window is titled "IMGT-ONTOLOGY Protégé 3.4 beta" and shows the "PROPERTY EDITOR" for the property "inverse_of_is_consecutive_to_". The interface includes a "PROPERTY BROWSER" on the left, a "PROPERTY EDITOR" in the center, and a "PROPERTY EDITOR" in a floating window. The floating window shows the "PROPERTY EDITOR" for the property "inverse_of_is_consecutive_to_" with the following details:

- For Property: `inverse_of_is_consecutive_to_` (instance of `owl:ObjectProperty`)
- Annotations table:

| Property | Value | Lang |
|---------------------------|------------------|------|
| <code>rdfs:comment</code> | definition | |
- Domain: `DESCRIPTION`
- Range: `DESCRIPTION`
- Properties: Functional, InverseFunctional, Symmetric, Transitive
- Inverse: `is_consecutive_to`

The main window also shows the "PROPERTY EDITOR" for the property "is_consecutive_to" with the following details:

- For Property: `is_consecutive_to` (instance of `owl:ObjectProperty`)
- Annotations table:

| Property | Value | Lang |
|---------------------------|------------------|------|
| <code>rdfs:comment</code> | definition | |

The "PROPERTY BROWSER" on the left shows the following properties:

- `inverse_of_is_consecutive_to_ ↔ is_consecutive_to`
- `inverse_of_is_consecutive_to`
- `is_consecutive_to ↔ inverse_of_is_consecutive_to`
- `is_defined_by ↔ defines`
- `_has_ ↔ _for_`
- `defines ↔ is_defined_by`
- `_for_ ↔ _has_`

The "Super Properties" section at the bottom left is empty.

Création d'une nouvelle propriété avec Protégé de type DatatypeProperty

The screenshot shows the Protégé 3.4 beta interface. The title bar indicates the project is 'IMGT-ONTOLOGY' and the file path is 'file:\C:\Documents%20and%20Settings\veronique\Mes%20documents\protege\IMGT-ONTOLOGY\IMGT-ONTOLOGY.pprj, OWL ...'. The main window is divided into several panes:

- PROPERTY BROWSER:** Located on the left, it shows a tree view of the ontology. Under 'Datatype Properties', the property 'NCBITaxon' is highlighted with a red box.
- PROPERTY EDITOR:** The main central pane, titled 'PROPERTY EDITOR' for 'NCBITaxon'. It shows a table with the following data:

| Property | Value | Lang |
|--------------|---------------------------------------|------|
| rdfs:comment | taxonomic rank from the NCBI taxonomy | |
- Domain:** A dropdown menu below the table, currently set to 'Taxon', is highlighted with a red box.
- Range:** A dropdown menu below the domain, currently set to 'int', is highlighted with a red box.
- Allowed values:** A list box below the range, currently empty.
- Functional:** A checkbox labeled 'Functional' is present and unchecked.

At the bottom of the interface, there are sections for 'Super Properties' and a status bar with icons for saving, undo, and redo.

Création d'instances avec Protégé (1)

The screenshot displays the Protégé 3.4 beta interface for editing an ontology. The window title is "IMG-T-ONTOLOGY Protégé 3.4 beta (file:\C:\Documents%20and%20Settings\veronique\Mes%20documents\protege\IMG-T-ONTOLOGY\IMG-T-ONTOLOGY.pprj, OWL ...)". The menu bar includes File, Edit, Project, OWL, Reasoning, Code, Tools, Window, and Help. The toolbar contains various icons for file operations and editing.

The interface is divided into several panes:

- CLASS BROWSER:** Shows the class hierarchy for the project "IMG-T-ONTOLOGY". The hierarchy is: owl:Thing (parent) -> CLASSIFICATION (parent) -> IDENTIFICATION (parent) -> DESCRIPTION (parent) -> CodingRegion (1) (selected).
- INSTANCE BROWSER:** Shows the "Asserted Instances" for the class "CodingRegion". The instance "V-REGION" is listed.
- INDIVIDUAL EDITOR:** Shows the editor for the instance "V-REGION" (instance of CodingRegion). It features a table for properties and values:

| Property | Value | Lang |
|--------------|------------|------|
| rdfs:comment | definition | |

Below the table, there are two property editors:

- inverse_of_is_consecutive_to_:** A text input field.
- is_consecutive_to:** A text input field.

At the bottom of the interface, the "Asserted Types" pane shows "CodingRegion" as the type for the selected instance.

Création d'instances avec Protégé (2)

The screenshot displays the Protégé 3.4 beta interface for the IMGT-ONTOLOGY project. The main window is divided into several panes:

- CLASS BROWSER:** Shows the class hierarchy for the project. The 'CodingRegion' class is highlighted under the 'DESCRIPTION' category.
- INSTANCE BROWSER:** Shows the 'Asserted Instances' for the 'CodingRegion' class. The instances listed are CDR1-IMGT, FR1-IMGT, and V-REGION.
- INDIVIDUAL EDITOR:** Shows the editor for the individual 'CDR1-IMGT'. It includes a table for properties and values, and a section for adding new properties.

The **INDIVIDUAL EDITOR** pane contains the following table:

| Property | Value | Lang |
|--------------|-------|------|
| rdfs:comment | | |

Below the table, there are two sections for adding properties:

- inverse_of_is_consecutive_to_:** A section with a text input field and a button.
- is_consecutive_to:** A section with a text input field, a button, and an 'Add...' button.

The interface also shows a menu bar (File, Edit, Project, OWL, Reasoning, Code, Tools, Window, Help) and a toolbar with various icons for file operations and navigation.

Création d'instances avec Protégé (3)

The screenshot displays the Protégé 3.4 beta interface for the IMGT-ONTOLOGY project. The main workspace is divided into three panes: CLASS BROWSER, INSTANCE BROWSER, and INDIVIDUAL EDITOR.

- CLASS BROWSER:** Shows the class hierarchy for the project. The 'CodingRegion' class is highlighted under the 'DESCRIPTION' category.
- INSTANCE BROWSER:** Shows the asserted instances for the 'CodingRegion' class. The instances listed are CDR1-IMGT, FR1-IMGT, and V-REGION.
- INDIVIDUAL EDITOR:** Shows the editor for the individual 'CDR1-IMGT'. The editor displays a table of properties and values, and a list of asserted types.

The table in the INDIVIDUAL EDITOR shows the following data:

| Property | Value | Lang |
|--------------|-------|------|
| rdfs:comment | | |

The 'Asserted Types' section shows the following data:

| Asserted Types |
|----------------|
| CodingRegion |

Création d'instances avec Protégé (4)

The screenshot displays the Protégé 3.4 beta interface for editing an ontology. The main window is titled "IMGT-ONTOLOGY Protégé 3.4 beta" and shows the file path: "file:\C:\Documents%20and%20Settings\veronique\Mes%20documents\protege\IMGT-ONTOLOGY\IMGT-ONTOLOGY.pprj, OWL ...".

The interface is divided into several panes:

- CLASS BROWSER:** Shows the class hierarchy for the project "IMGT-ONTOLOGY". The hierarchy is: owl:Thing > CLASSIFICATION > IDENTIFICATION > DESCRIPTION > CodingRegion (3).
- INSTANCE BROWSER:** Shows the asserted instances for the class "CodingRegion". The instances listed are CDR1-IMGT, FR1-IMGT (highlighted), and V-REGION.
- INDIVIDUAL EDITOR:** Shows the editor for the instance "FR1-IMGT" (instance of CodingRegion). It features a table for properties and values, and a section for assertions.

The **INDIVIDUAL EDITOR** pane contains the following table:

| Property | Value | Lang |
|--------------|-------|------|
| rdfs:comment | | |

Below the table, there are two assertion sections:

- inverse_of_is_consecutive_to:** A text box containing "CDR1-IMGT".
- is_consecutive_to:** An empty text box.

The bottom of the interface shows the "Asserted Types" pane, which lists "CodingRegion".

Représentation graphique de l'ontologie

The screenshot shows the Protégé 3.4 beta interface. The title bar reads "IMGT-ONTOLOGY Protégé 3.4 beta (file: \\C:\\Documents%20and%20Settings\\veronique\\Mes%20documents\\protege\\IMGT-ONTOLOGY\\IMGT-O...". The menu bar includes File, Edit, Project, OWL, Reasoning, Code, Tools, Window, and Help. The toolbar contains various icons for file operations and editing. The main workspace is divided into several panes:

- ONTOLGY BROWSER**: Shows the project "IMGT-ONTOLOGY" and a list of ontologies, including "Ontology(http://imgt.igh.cnrs.fr/IMGT-ONTOLOGY)".
- INDIVIDUAL EDITOR**: The active pane, showing the "Ontology URI" as "http://imgt.igh.cnrs.fr/IMGT-ONTOLOGY". It features a table for annotations with columns for Property, Value, and Lang. The table currently contains one row: "rdfs:comment".
- Default Namespace**: Set to "http://imgt.igh.cnrs.fr/IMGT-ONTOLOGY#".
- Namespace Prefixes**: A table listing various prefixes and their corresponding namespaces.

A red box highlights the "Ontoviz" and "OWL Viz" buttons in the top toolbar, which are used for visualizing the ontology.

| Property | Value | Lang |
|--------------|-------|------|
| rdfs:comment | | |

| Prefix | Namespace |
|---------|---|
| p1 | http://www.owl-ontologies.com/assert.owl# |
| xsd | http://www.w3.org/2001/XMLSchema# |
| xsp | http://www.owl-ontologies.com/2005/08/07/xsp.owl# |
| protege | http://protege.stanford.edu/plugins/owl/protege# |
| rdfs | http://www.w3.org/2000/01/rdf-schema# |
| rdf | http://www.w3.org/1999/02/22-rdf-syntax-ns# |
| koala | http://www.domain3.com# |
| owl | http://www.w3.org/2002/07/owl# |

Représentation graphique de l'ontologie

The screenshot displays the Protégé 3.4 beta interface for the 'IMG-T-ONTOLOGY' project. The main window is titled 'IMG-T-ONTOLOGY Protégé 3.4 beta (file: C:\Documents%20and%20Settings\veronique\Mes%20documents\protege\IMG-T-ONTOLOGY\IMG-T-ONTOLOGY.pprj, OWL ...)'. The interface is divided into several panes:

- Class Browser:** Shows the class hierarchy for 'owl:Thing', including 'CLASSIFICATION', 'IDENTIFICATION', and 'DESCRIPTION'. The 'CodingRegion' class is highlighted under 'DESCRIPTION' with a count of 3 instances.
- Instance Browser:** Shows 'Asserted Instances' for the selected class 'CodingRegion'. The instances listed are 'CDR1-IMGT', 'FR1-IMGT', and 'V-REGION'.
- Individual Editor:** Shows the editor for the individual 'FR1-IMGT' (instance of 'CodingRegion'). It includes a table for properties and values, and a section for relationships.

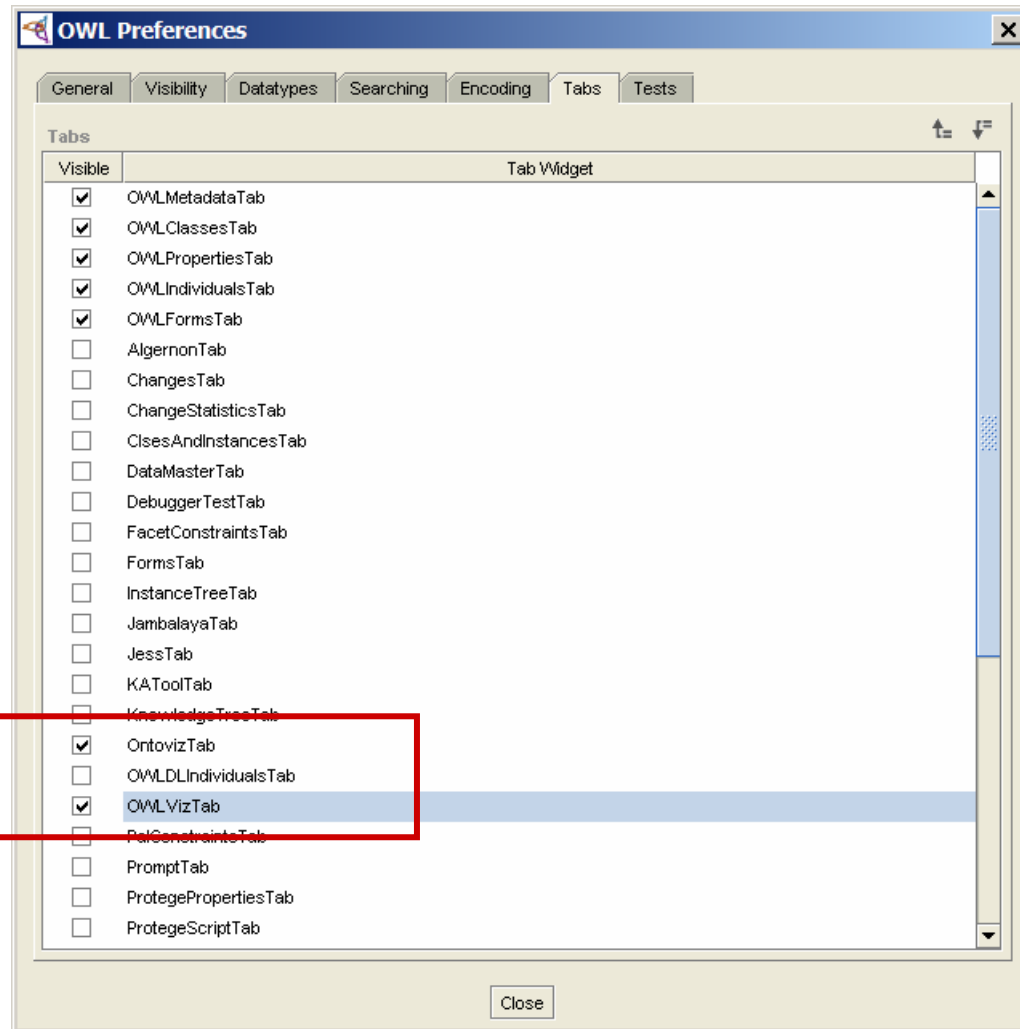
| Property | Value | Lang |
|--------------|-------|------|
| rdfs:comment | | |

Relationships shown in the Individual Editor:

- inverse_of_is_consecutive_to_:** CDR1-IMGT
- is_consecutive_to:**

At the bottom, the 'Asserted Types' pane shows 'CodingRegion'.

Représentation graphique de l'ontologie



Représentation graphique de l'ontologie

The screenshot shows the Protégé 3.4 beta interface for the IMGT-ONTOLOGY. The 'OWL Viz' tab is active, displaying a hierarchical graph of classes. The class 'IDENTIFICATION' is highlighted with a blue box. The graph shows 'owl:Thing' as the root, with 'IDENTIFICATION' as a child. 'IDENTIFICATION' is further divided into several subclasses: Function, Specificity, ChainType, Taxon, DomainType, MoleculeType, StructureType, GeneType, Functionality, ReceptorType, ConfigurationType, and EntityType. 'Taxon' has further subclasses: Strain, species, Breed, and EthnicGroup. 'species' has a subclass 'subspecies'. 'ReceptorType' has a subclass 'Molecule_ReceptorType'. 'EntityType' has a subclass 'Molecule_EntityType'. The class browser on the left shows the 'IDENTIFICATION' class selected. A legend in the bottom right corner explains the graph symbols: a yellow circle for 'Show class', a cluster of yellow circles for 'Show children', a cluster of yellow circles with arrows for 'Show parents', a white circle for 'Hide class', a cluster of white circles for 'Hide children', a cluster of white circles with a blue border for 'Hide all classes', and a magnifying glass for 'Show Info'.

Représentation graphique de l'ontologie

The screenshot displays the Protégé 3.4 beta interface for the IGMT-ONTOLOGY. The main window shows the 'Ontoviz' tab, which is used for visualizing the ontology. The 'Ontoviz Global Options' dialog is open, showing various settings for the visualization. The 'Ontoviz Slot Configuration' dialog is also open, showing a table of slot configurations.

Ontoviz Global Options

general colors

- save as gif
- show io :STANDARD-CLASS edges
- show system own slots
- slot edges dashed
- show instances only
- 3 maximum depth for slot extension (instances)
- 1 maximum depth for slot extension (classes)
- 3 maximum displayed values per slot
- 5 maximum displayed slots per node

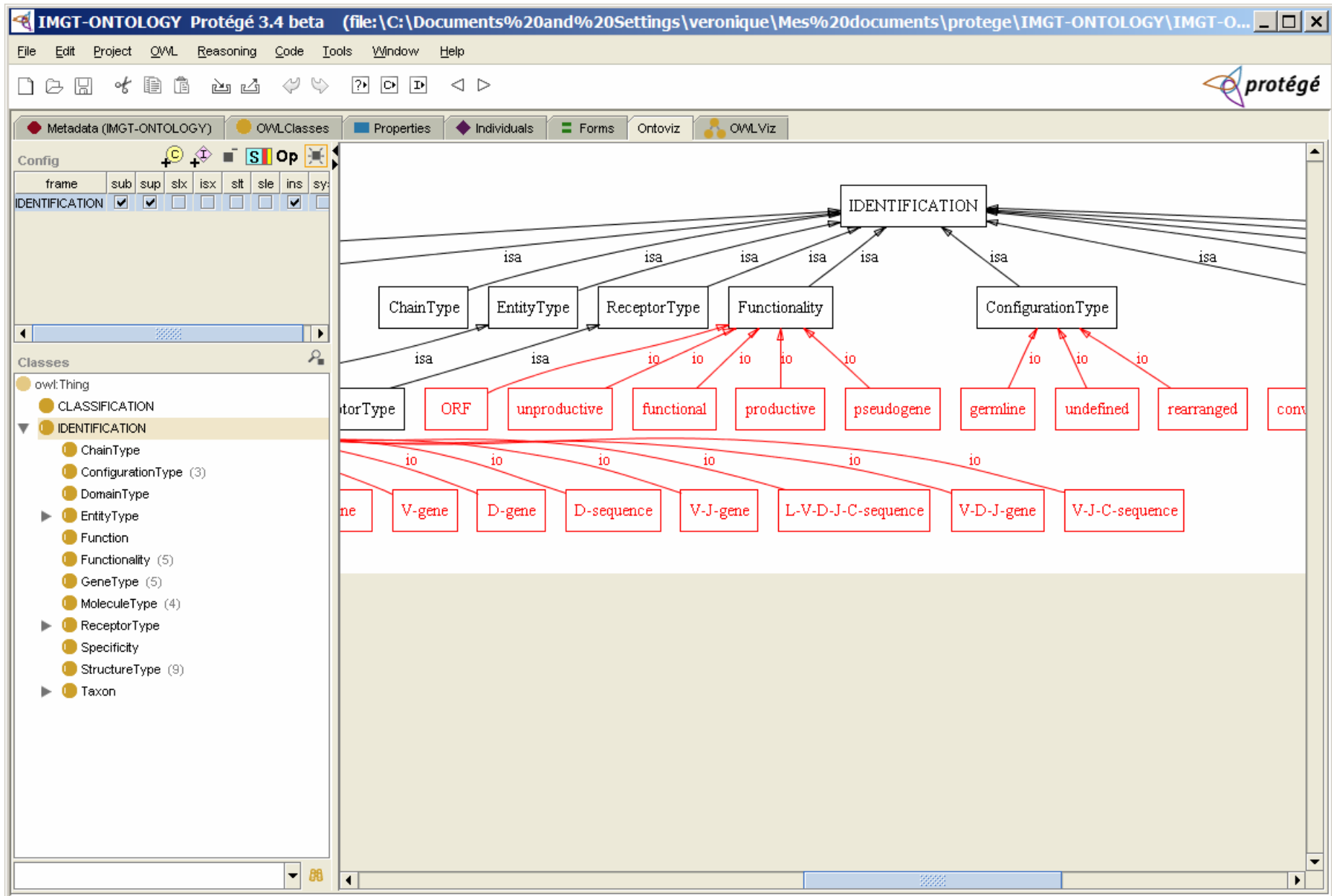
Ontoviz Slot Configuration

| slot | config |
|-------------------------|---------|
| _for_ | default |
| _has_ | default |
| defines | default |
| is_defined_by | default |
| NCBITaxon | default |
| protege:abstract | default |
| protege:allowedParent | default |
| protege:defaultLanguage | default |
| protege:excludedTest | default |
| protege:isCommentedOut | default |
| protege:probeClass | default |

hide slots as default

default close

Représentation graphique de l'ontologie



Restriction sur les cardinalités Properties View

The screenshot displays the Protégé 3.4 beta interface. The main window is titled "IMGT-ONTOLOGY Protégé 3.4 beta" and shows the "CLASS EDITOR" for the class "Molecule_EntityType". The "SUBCLASS EXPLORER" on the left shows a hierarchy of classes, with "Molecule_EntityType" selected under "EntityType". The "CLASS EDITOR" shows the class's properties, including "protege:subclassesDisjoint" (true) and "rdfs:comment" (If the object is a molecule, the "EntityType" concept is "MoleculeType", "GeneType" and "ConfigurationType", "Functionality" and "StructureType" concepts.). The "is_defined_by" property is highlighted, showing its cardinality and domain. The "Create Restriction" dialog box is open, showing the "Restricted Property" list with "is_defined_by" selected. The "Restriction" list includes "allValuesFrom", "someValuesFrom", "hasValue", "cardinality", "minCardinality", and "maxCardinality". The "Filler" field is empty, and an error message "Error: Please enter a filler. at "" is displayed. The "OK" and "Cancel" buttons are visible at the bottom of the dialog box.

IMGT-ONTOLOGY Protégé 3.4 beta (file:\C:\Documents%20and%20Settings\veronique\Mes%20documents\protege\IMGT-ONTOLOGY\IMGT-O...

File Edit Project OWL Reasoning Code Tools Window Help

Subclass Explorer: For Project: IMGT-ONTOLOGY

Asserted Hierarchy: owl:Thing, CLASSIFICATION, IDENTIFICATION, ChainType, ConfigurationType, DomainType, EntityType, Molecule_EntityType, Function, Functionality, GeneType, MoleculeType, ReceptorType, Molecule_ReceptorType, Specificity, StructureType, Taxon

Class Editor: For Class: Molecule_EntityType (instance of owl:Class) Inferred View Annotations

Property Table:

| Property | Value |
|----------------------------|--|
| protege:subclassesDisjoint | true |
| rdfs:comment | If the object is a molecule, the "EntityType" concept is "MoleculeType", "GeneType" and "ConfigurationType", "Functionality" and "StructureType" concepts. |

is_defined_by (multiple IDENTIFICATION or CLASSIFICATION) (cardinality 1 ConfigurationType)

is_defined_by Restriction: someValuesFrom

Filler: Error: Please enter a filler. at ""

OK Cancel

Logic View Properties View

Restriction sur les cardinalités Logic View

The screenshot shows the Protégé 3.4 beta interface in Logic View. The main window title is "IMGT-ONTOLOGY Protégé 3.4 beta (file:\C:\Documents%20and%20Settings\veronique\Mes%20documents\protege\IMGT-ONTOLOGY\IMGT-O...". The menu bar includes File, Edit, Project, OWL, Reasoning, Code, Tools, Window, and Help. The toolbar contains various icons for file operations and navigation.

The interface is divided into several panes:

- SUBCLASS EXPLORER:** Shows the ontology hierarchy for "IMGT-ONTOLOGY". The "IDENTIFICATION" class is expanded, showing subclasses like ChainType, ConfigurationType, DomainType, EntityType, Molecule_EntityType, Function, Functionality, GeneType, MoleculeType, ReceptorType (with Molecule_ReceptorType), Specificity, StructureType, and Taxon.
- CLASS EDITOR:** Shows the "Molecule_EntityType" class. The "For Class:" field is set to "Molecule_EntityType". The "Annotations" table is visible:

| Property | Value | Lang |
|----------------------------|--|------|
| protege:subclassesDisjoint | true | |
| rdfs:comment | If the object is a molecule, the "EntityType" concept is designated as "Molecule_EntityType", which is defined by the "MoleculeType", "GeneType" and "ConfigurationType" concepts of identification and has properties identified in the "Functionality" and "StructureType" concepts. | |

- Asserted Conditions:** A list of restrictions for the "Molecule_EntityType" class, categorized as "NECESSARY & SUFFICIENT" and "NECESSARY". Each restriction has a button to edit it:

- EntityType
- _has_max 1 Functionality
- _has_max 1 StructureType
- is_defined_by some GeneType
- is_defined_by some MoleculeType
- is_defined_by exactly 1 ConfigurationType

At the bottom right, there are radio buttons for "Logic View" (selected) and "Properties View".

Importation d'ontologies

Il est alors possible d'utiliser les classes, les propriétés et les instances de L'ontologie importée, d'en étendre la description

⇒ Attention, la référence aux classes, propriétés et individus d'une autre Ontologie en utilisant l'espace de nom est différente de l'importation complète d'ontologies.

The screenshot shows the Protégé 3.4 beta interface. The 'ONTLOGY BROWSER' on the left is highlighted with a red box, showing the project 'IMGT-ONTOLOGY' and a list of ontologies. The 'INDIVIDUAL EDITOR' on the right shows the 'Ontology URI' field set to 'http://imgt.igh.cnrs.fr/IMGT-ONTOLOGY'. Below this, there is a table for 'Property' and 'Value' with a column for 'Lang'. The 'Default Namespace' is 'http://imgt.igh.cnrs.fr/IMGT-ONTOLOGY#'. At the bottom, there is a table for 'Namespace Prefixes'.

| Property | Value | Lang |
|--------------|-------|------|
| rdfs:comment | | |

| Prefix | Namespace |
|---------|---|
| p1 | http://www.owl-ontologies.com/assert.owl# |
| xsd | http://www.w3.org/2001/XMLSchema# |
| xsp | http://www.owl-ontologies.com/2005/08/07/xsp.owl# |
| protege | http://protege.stanford.edu/plugins/owl/protege# |
| rdfs | http://www.w3.org/2000/01/rdf-schema# |
| rdf | http://www.w3.org/1999/02/22-rdf-syntax-ns# |
| koala | http://www.domain3.com# |
| owl | http://www.w3.org/2002/07/owl# |