

Part 5.6

Phase 4 - Knowledge Definition

- 1 KG Construction
- 2 iTelos
- 3 Phase 1 - Purpose Definition
- 4 Phase 2 - Information Gathering
- 5 Phase 3 - Language Definition
- 6 Phase 4 - Knowledge Definition (Practice)**
- 7 Phase 5 - Entity Definition

Phase 4 - Knowledge Definition (Practice)

- 1 Protégé
- 2 Schema Alignment in KGE

what is Protégé?

What is Protégé? (from their webpage)

A free, open-source ontology editor and framework for building intelligent systems

Protégé is supported by a strong community of academic, government, and corporate users, who use Protégé to build knowledge-based solutions in areas as diverse as biomedicine, e-commerce, and organisational modelling.

Where to get it: <http://protege.stanford.edu/>

Protégé Website

[SOFTWARE](#)[SUPPORT](#)[COMMUNITY](#)[ABOUT](#)

A free, open-source ontology editor and framework for building intelligent systems

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Active Ontology Tab

File Edit View Reasoner Tools Refactor Window Ontop Help

< > **untitled-ontology-684** (http://www.semanticweb.org/mbagc/ontologies/2024/10/untitled-ontology-684) Search...

Active ontology Entities × Individuals by class × DL Query × Individual Hierarchy Tab ×

Ontology header: ⌵ ⌶ ⌷ ⌸ **Ontology metrics:** ⌵ ⌶ ⌷ ⌸

Ontology IRI: <http://www.semanticweb.org/mbagc/ontologies/2024/10/untitled-ontology-684>

Ontology Version IRI: e.g. <http://www.semanticweb.org/mbagc/ontologies/2024/10/untitled-ontology-684/1.0.0>

Annotations +

Metrics	
Axiom	31
Logical axiom count	15
Declaration axioms count	8
Class count	3
Object property count	2
Data property count	3
Individual count	0
Annotation Property count	1
Class axioms	
SubClassOf	4
EquivalentClasses	0
DisjointClasses	1
GCI count	0
Hidden GCI Count	0

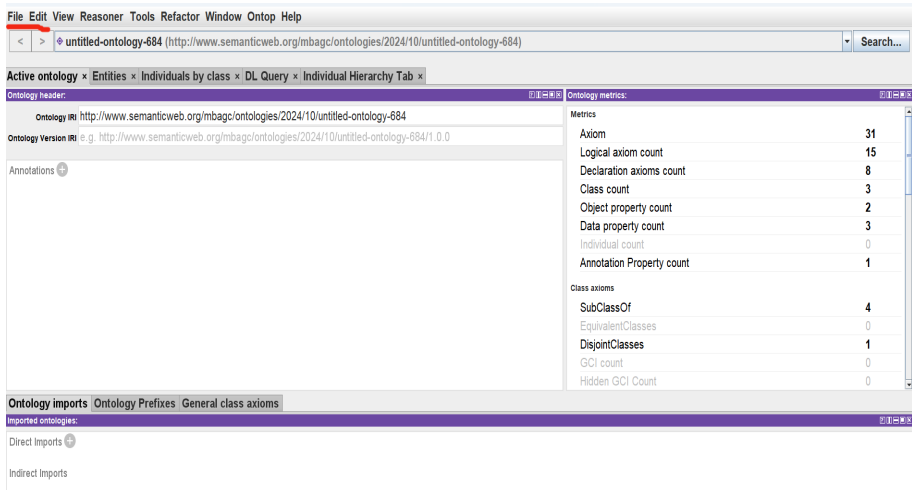
Ontology imports **Ontology Prefixes** **General class axioms**

Imported ontologies: ⌵ ⌶ ⌷ ⌸

Direct Imports +

Indirect Imports

Create/Edit Ontologies



The screenshot shows the Protégé ontology editor interface. The top menu bar includes File, Edit, View, Reasoner, Tools, Refactor, Window, and Ontop Help. The address bar shows the current ontology URI: `http://www.semanticweb.org/mbagc/ontologies/2024/10/untitled-ontology-684`. The main area is divided into several panes:

- Ontology header:** Displays the ontology IRI and version IRI.
- Ontology metrics:** A table showing various counts for the ontology.
- Ontology imports:** A section for managing imported ontologies.

Ontology header:	
Ontology IRI	<code>http://www.semanticweb.org/mbagc/ontologies/2024/10/untitled-ontology-684</code>
Ontology Version IRI	e.g. <code>http://www.semanticweb.org/mbagc/ontologies/2024/10/untitled-ontology-684/1.0.0</code>

Ontology metrics:	
Metrics	
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GCI count	0
Hidden GCI Count	0

Ontology imports:	
Direct Imports	
Indirect Imports	

Ontology Statistics

File Edit View Reasoner Tools Refactor Window Ontop Help

< > **untitled-ontology-684** (<http://www.semanticweb.org/mbagc/ontologies/2024/10/untitled-ontology-684>) Search...

Active ontology × Entities × Individuals by class × DL Query × Individual Hierarchy Tab ×

Ontology header: **Ontology metrics:**

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Ontology Version IRI: e.g. <http://www.semanticweb.org/mbagc/ontologies/2024/10/untitled-ontology-684/1.0.0>

Annotations +

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Ontology imports: **Ontology Prefixes** General class axioms

Imported ontologies:

Direct Imports +

Indirect Imports

Ontology IRI

File Edit View Reasoner Tools Refactor Window Ontop Help

< > **untitled-ontology-684** (<http://www.semanticweb.org/mbagc/ontologies/2024/10/untitled-ontology-684>) Search...

Active ontology × Entities × Individuals by class × DL Query × Individual Hierarchy Tab ×

Ontology header: ⌵ ⌵ ⌵ ⌵ **Ontology metrics:** ⌵ ⌵ ⌵ ⌵

Ontology IRI <http://www.semanticweb.org/mbagc/ontologies/2024/10/untitled-ontology-684> ✓

Ontology Version IRI e.g. <http://www.semanticweb.org/mbagc/ontologies/2024/10/untitled-ontology-684/1.0.0>

Annotations +

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Ontology imports **Ontology Prefixes** **General class axioms**

Imported ontologies: ⌵ ⌵ ⌵ ⌵

Direct Imports +

Indirect Imports

Ontology Import

File Edit View Reasoner Tools Refactor Window Ontop Help

< > **untitled-ontology-684** (<http://www.semanticweb.org/mbagc/ontologies/2024/10/untitled-ontology-684>) Search...

Active ontology × Entities × Individuals by class × DL Query × Individual Hierarchy Tab ×

Ontology header: ⌵ ⌵ ⌵ ⌵ **Ontology metrics:** ⌵ ⌵ ⌵ ⌵

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Annotations	+

Metrics	
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Ontology imports | **Ontology Prefixes** | **General class axioms**

Imported ontologies: ⌵ ⌵ ⌵ ⌵

Direct imports +



Indirect imports

Entities Tab


File Edit View Reasoner Tools Refactor Window Ontop Help

< > **untitled-ontology-684** (<http://www.semanticweb.org/mbagc/ontologies/2024/10/untitled-ontology-684>) Search...

Active ontology: **Entities** × individuals by class × DL Query × Individual Hierarchy Tab ×


Ontology header:  Ontology metrics: 


Ontology IRI	http://www.semanticweb.org/mbagc/ontologies/2024/10/untitled-ontology-684
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Annotations 

Metrics	
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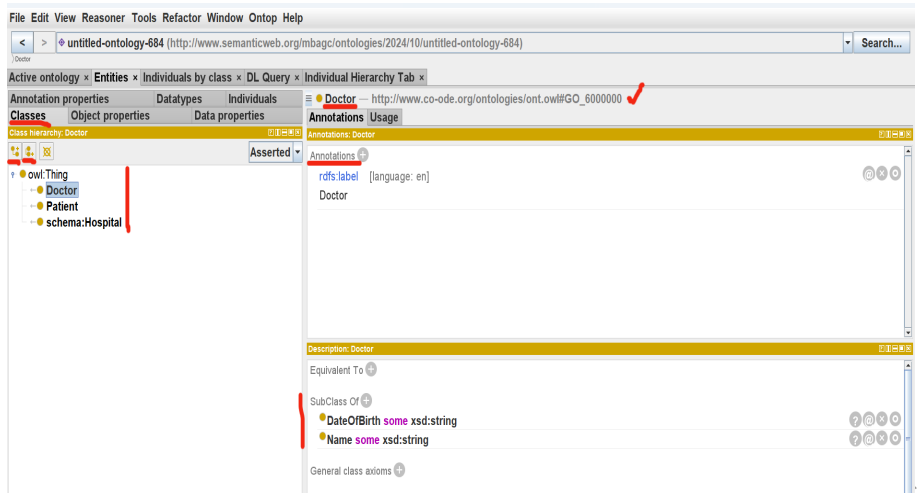
Ontology imports | **Ontology Prefixes** | General class axioms

Imported ontologies: 

Direct Imports 

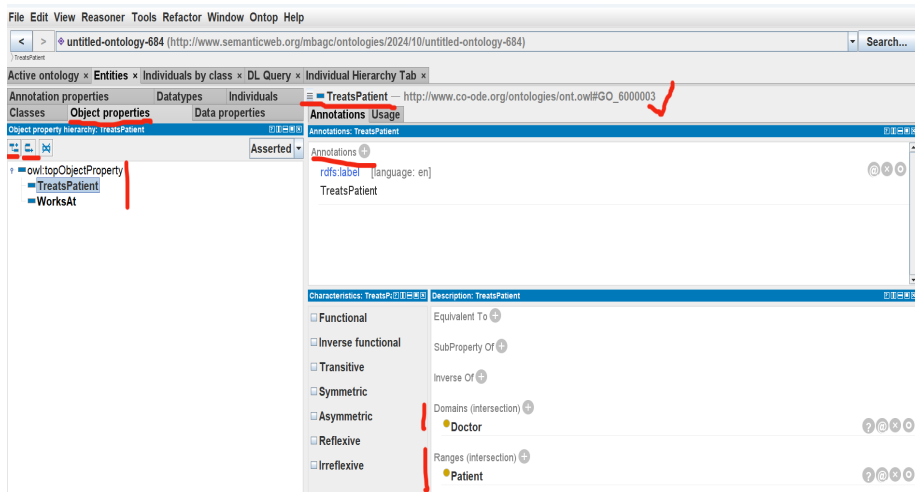
Indirect Imports

Class Hierarchy View



The screenshot displays the 'Class Hierarchy View' for the 'Doctor' class in an ontology editor. The interface includes a menu bar (File, Edit, View, Reasoner, Tools, Refactor, Window, Ontop, Help) and a search bar. The active ontology is 'untitled-ontology-684'. The 'Doctor' class is selected, and its URI is 'http://www.co-ode.org/ontologies/ont.owl#GO_6000000'. The 'Class Hierarchy' panel on the left shows a tree structure under 'owl:Thing', with 'Doctor' as a child, and 'Patient' and 'schema:Hospital' as siblings. The 'Annotations' panel shows the 'rdfs:label' property with the value 'Doctor'. The 'Description' panel shows the 'Doctor' class is a 'SubClass Of' 'DateOfBirth some xsd:string' and 'Name some xsd:string'. The 'General class axioms' panel is currently empty.

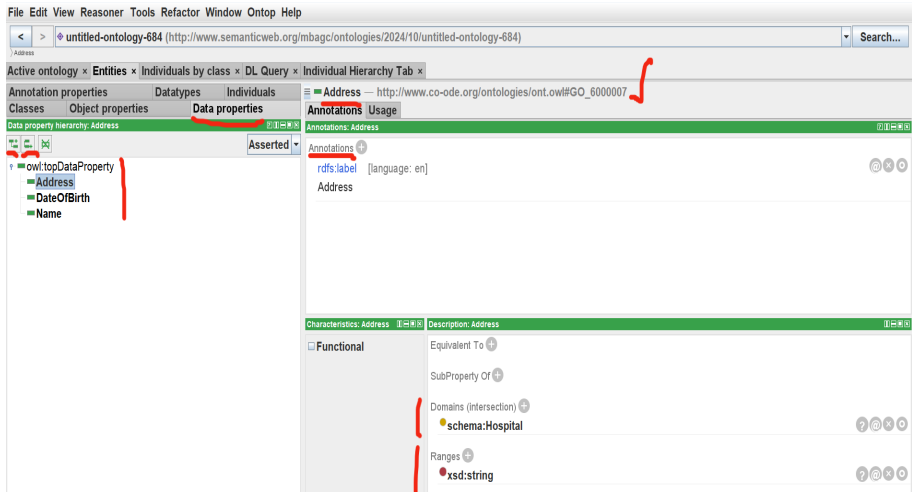
Object Property View



The screenshot shows the Protégé software interface with the following components:

- Menu Bar:** File, Edit, View, Reasoner, Tools, Refactor, Window, Ontop, Help.
- Address Bar:** < > untitle-ontology-684 (http://www.semanticweb.org/mbagc/ontologies/2024/10/untitle-ontology-684) Search...
- Active ontology:** untitle-ontology-684
- Navigation Tabs:** Active ontology, Entities, Individuals by class, DL Query, Individual Hierarchy Tab.
- Property View:**
 - Annotation properties, Datatypes, Individuals, **TreatsPatient** (http://www.co-ode.org/ontologies/ont.owl#GO_6000003)
 - Classes, **Object properties**, Data properties, Annotations, Usage
- Object property hierarchy:** TreatsPatient
 - owl:topObjectProperty
 - TreatsPatient**
 - WorksAt
- Annotations:**
 - rdfs:label [language: en]
 - TreatsPatient
- Characteristics:**
 - Functional
 - Inverse functional
 - Transitive
 - Symmetric
 - Asymmetric
 - Reflexive
 - Irreflexive
- Description:**
 - Equivalent To +
 - SubProperty Of +
 - Inverse Of +
 - Domains (intersection) +
 - Doctor
 - Ranges (intersection) +
 - Patient

Data Property View



File Edit View Reasoner Tools Refactor Window Ontop Help

< > ♦ untitle-ontology-684 (http://www.semanticweb.org/mbagc/ontologies/2024/10/untitle-ontology-684) Search...

Active ontology × Entities × Individuals by class × DL Query × Individual Hierarchy Tab ×

Annotation properties Datatypes Individuals

Classes Object properties **Data properties** Annotations Usage

Data property hierarchy: Address Annotations: Address

Asserted

- owl:topDataProperty
 - Address
 - DateOfBirth
 - Name

Annotations +

rdfs:label [language: en]
Address

Characteristics: Address Description: Address

Functional

Equivalent To +

SubProperty Of +

Domains (intersection) +

- schema:Hospital

Ranges +

- xsd:string

Phase 4 - Knowledge Definition (Practice)

- 1 Protégé
- 2 Schema Alignment in KGE - Practical

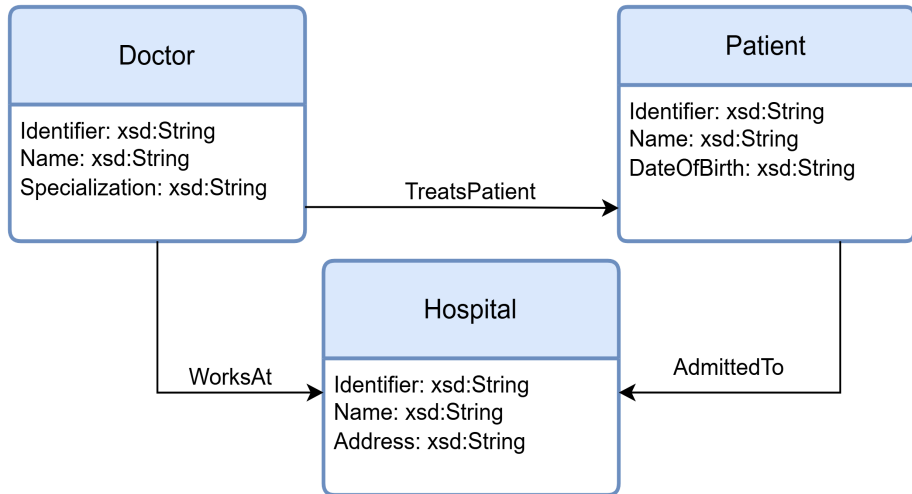
Schema Alignment in KGE

- We have the purpose already specified as an informal ER model.
- We formalize the informal ER model as an OWL file.
- We align the entity types of the above formal OWL file to their general entity types in the chosen knowledge teleontology (also in OWL) for the KGE purpose. This is a formalization of the EER model for the KGE purpose.

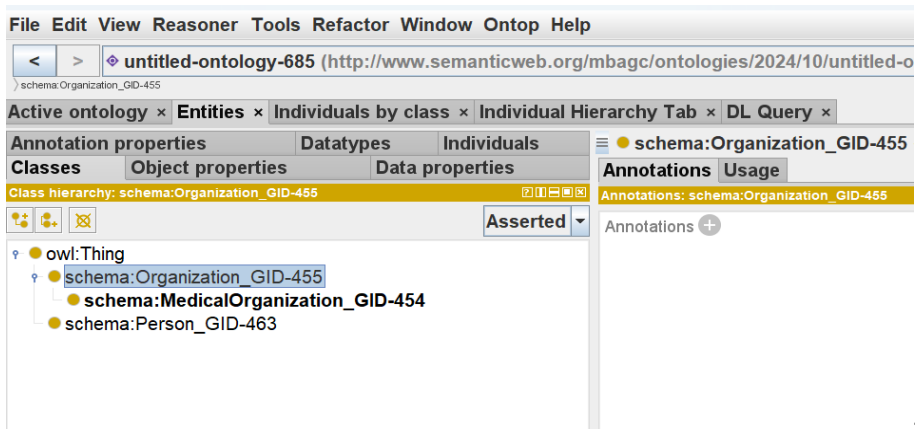
Schema Alignment in KGE (contd.)

- Finally, the **teleology** is produced as an OWL file by:
 - first, identifying only the leaf entity types for which we have data
 - second, dropping all the entity types more general to the leaf entity types
 - third, adding all the purpose-specific object and data properties of the general entity types to the leaf entity types (if applicable)
- **Revisiting and rechecking language definition:** In case any entity type, object property or data property are left without a unique UKC identifier, such a definition is achieved here.
- Next, we define the notion of a teleology in more detail and provide illustrations of an example schema alignment.

Schema Alignment Input: ER Model



Alignment Input: Knowledge Teleontology



The screenshot shows a web-based ontology editor interface. At the top, there is a menu bar with options: File, Edit, View, Reasoner, Tools, Refactor, Window, Ontop, Help. Below the menu is a browser-like address bar showing the URL: `untitled-ontology-685 (http://www.semanticweb.org/mbagc/ontologies/2024/10/untitled-o`. Below the address bar, there are tabs for `Active ontology`, `Entities`, `Individuals by class`, `Individual Hierarchy Tab`, and `DL Query`. The main interface is divided into several panels. On the left, there are tabs for `Annotation properties`, `Datatypes`, and `Individuals`. Below these are `Classes`, `Object properties`, and `Data properties`. A yellow bar indicates the current view: `Class hierarchy: schema:Organization_GID-455`. Below this, there are icons for class operations and a dropdown menu set to `Asserted`. The main area shows a class hierarchy tree starting with `owl:Thing`, which has three children: `schema:Organization_GID-455` (highlighted), `schema:MedicalOrganization_GID-454`, and `schema:Person_GID-463`. On the right side, there are tabs for `Annotations` and `Usage`. A yellow bar indicates the current view: `Annotations: schema:Organization_GID-455`. Below this, there is a section for `Annotations` with a plus sign icon.

Schema Alignment Process: formalize ER Model

Active ontology × Entities × Individuals by class × Individual Hierarchy Tab × DL Query ×

Annotation properties Datatypes Individuals

Classes Object properties Data properties

Class hierarchy: Doctor_GID-451

Annotations Usage

Annotations: Doctor_GID-451

Asserted

- owl:Thing
 - Doctor_GID-451
 - Patient_GID-452
 - schema:Hospital_GID-453

Annotations +

rdfs:label [language: en]
Doctor_GID-451

rdfs:comment
A person who is qualified to treat people who are ill.

Description: Doctor_GID-451

Equivalent To +

SubClass Of +

DateOfBirth_GID-461 some xsd:string

Schema Alignment Step

Active ontology x Entities x Individuals by class x DL Query x Individual Hierarchy Tab x

Annotation properties Datatypes Individuals

Classes Object properties Data properties

Class hierarchy: Doctor_GID-451

Annotations Usage

Annotations: Doctor_GID-451

Annotations +

rdfs:label [language: en]
Doctor_GID-451

rdfs:comment
A person who is qualified to treat people who are ill.

owl:Thing

- schema:Person_GID-463
- schema:Organization_GID-455
 - schema:MedicalOrganization_GID-454
 - Doctor_GID-451
 - Patient_GID-452
 - schema:Hospital_GID-453

Description: Doctor_GID-451

Equivalent To +

SubClass Of +

- DateOfBirth_GID-461 some xsd:string
- Name_GID-462 some xsd:string

General class axioms +

SubClass Of (Anonymous Ancestor)

Instances +

Doctor_GID-451

Data restriction creator Object restriction creator

Class expression editor Class hierarchy

Annotations +

owl:Thing

- Doctor_GID-451
- Patient_GID-452
- schema:Hospital_GID-453
- schema:Organization_GID-455
- schema:Person_GID-463

Schema aligned to Knowledge Teleontology

Active ontology × Entities × Individuals by class × DL Query × Individual Hierarchy Tab ×

Annotation properties Datatypes Individuals

Classes Object properties Data properties

Class hierarchy: Doctor_GID-451

- owl:Thing
 - schema:Person_GID-463
 - Patient_GID-452
 - Doctor_GID-451**
 - schema:Organization_GID-455
 - schema:MedicalOrganization_GID-454
 - schema:Hospital_GID-453

Annotations Usage

Annotations: Doctor_GID-451

Annotations +

- rdfs:label [language: en]
Doctor_GID-451
- rdfs:comment
A person who is qualified to treat people who are ill.

Description: Doctor_GID-451

Equivalent To +

SubClass Of +

- DateOfBirth_GID-461 some xsd:string
- Name_GID-462 some xsd:string

Teleology

Active ontology × Entities × Individuals by class × Individual Hierarchy Tab × DL Query ×

Annotation properties Datatypes Individuals

Classes Object properties Data properties

Class hierarchy: Doctor_GID-451

- owl:Thing
 - Doctor_GID-451
 - Patient_GID-452
 - schema:Hospital_GID-453

Annotations Usage

Annotations: Doctor_GID-451

Annotations +

rdfs:label [language: en]
Doctor_GID-451

rdfs:comment
A person who is qualified to treat people who are ill.

Description: Doctor_GID-451

Equivalent To +

SubClass Of +

- DateOfBirth_GID-461 some xsd:string
- Name_GID-462 some xsd:string

Revisit Language Definition

- Finally, each teleology concept: {entity type, object property and data property}, one at a time, is checked with the language resource sheet whether its UKC Global Identifier (GID) exist.
- There can be two cases:
 - 1 if the UKC GID exists in the language resource sheet, then check whether it is written in the teleology OWL file. If not, rewrite the GID as, e.g., **conceptname_GID-theactualGID**, e.g., **doctor_GID-451**, OR,
 - 2 if the UKC GID does not exist in the language resource sheet, then perform language definition for the concept and do the rewriting in the OWL file.