Department of Computer Science
Technical University of Cluj-Napoca

UNIVERSITATEA TEHNICĂ
DIN CLUJ-NAPOCA

Knowledge-Based Systems

Laboratory activity: 2022-2023
Ontology title: Orbital Disease Ontology
Team name: Ontology Masters
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Chapter 1

Competency questions

1.1 Interogări

1. Care sunt bolile care au ca simptom X ?
2. Care sunt simptomele bolii X ?
3. Ce boala apare in locatia X ?
4. Este X o boala ?
5. Este X un simptom ?
6. Este X o locatie a unei boli ?
7. Are X baza materiala in Y ?
8. Este X adiacent lui Y ?
9. Este X o subcategorie a bolii Y?
10. Are boala X o locatie determinata?

Chapter 2

Reusing other ontologies

2.1 Reusing other Ontologies

1. Am folosit o ontologie cu tema asemanatoare cu cea dezvoltata de noi. Ontologia este preluata de pe site ul Bioportal (site asemnator cu Ontobee, dar am gasit ontologii mai usor de descarat in format owl) fiind accesibila la linkul acesta : `https://bioportal.bioontology.org/ontologies/FNS-H/?p=classes&conceptid=http`

2. Dupa descarcarea ontologiei in format owl am folosit site-ul acesta pentru a genera un rdf folosind EasyRdf converter

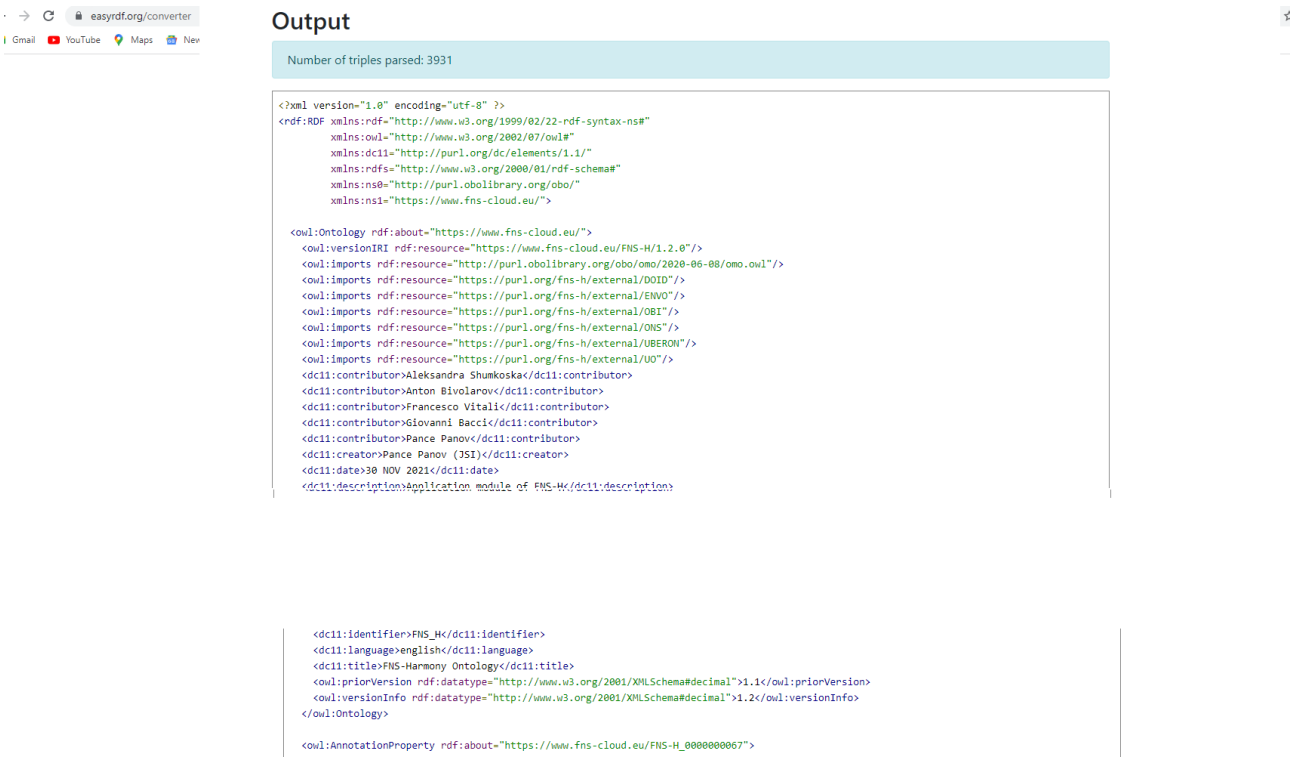


Figure 2.1: EasyRdf

si am salvat un fisier .rdf (selectati optiunea all files)
(Exista posibilitatea sa se poata incarca direct in Prodege cu extensia owl.
(Link catre Prodege: https://protege.stanford.edu/)

3. In prodege am facut urmatoarele (poze se pot gasi la capitolul FRED):

1. Am incarcarat ontologia .rdf
2. Am selectat start reasoner
3. Am dat export
4. Am selectat clase si subclase
5. Am selectat locatia si am denumit fisierul Ontologie.owl
6. Am salvat in formatul owl/xml

4. Am incarcat fiserul salvat cu owl/xml in racer: L-am salvat in OWL cu comanda (save-kb "Ontoreusing.owl" :syntax :owl) Dupa am adaugat continutul la ontlogia noastra deja exista in owl Cum arata taxologia :

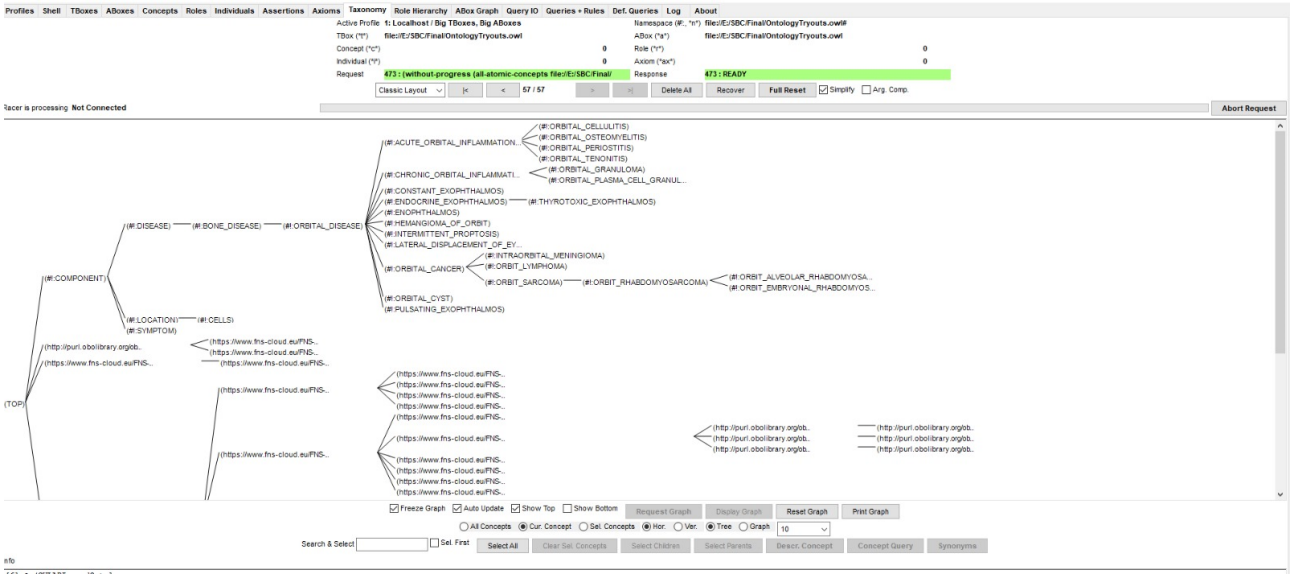


Figure 2.2: OntologyReusing

Chapter 3

Tboxes

TBox (Terminology Box) se refera la partea din ontologie ce defineste concepte, subconceptele si relatiile dintre ele. Reprezinta knowledge despre terminologia ontologiei si este de obicei folosita pentru a reprezenta structurile ierarhice dintre concepte (clase si subclase) si axiomele ce le guverneaza. De asemenea, Tbox-urile definesc caracteristicile si proprietatile entitatilor si ce categorii share-uiesc. Exemple de concepte pentru ontologii medicale includ : PatientDisease si Symtpthom.In plus , Cancer poate fi considerat subconcept al conceptului mai broad Disease. De asemenea, in Tbox sunt incluse rolurile (roles) si regulile (rules). Mai jos am atasat taxonomia ontologiei noastre. Pentru a vizualiza taxonomia ontologiei tale, slecteaza load , incarca fiserul .racer , iar la tabul de Taxonomy selecteaza tree 10.

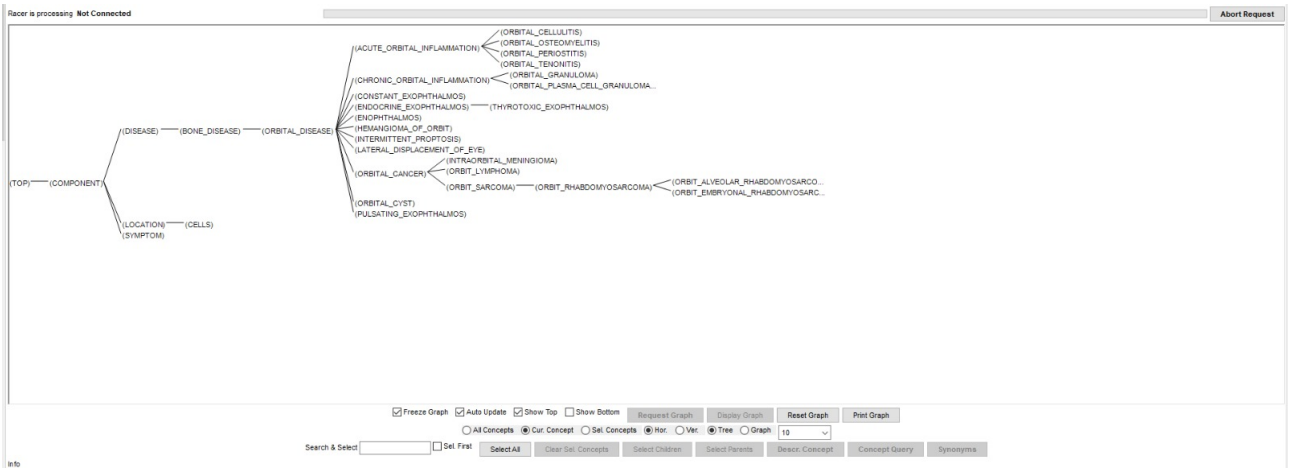


Figure 3.1: Tbox

```
(define-primitive-role has-symptom  :domain Disease  :range Symptom)
(define-primitive-role is-different  :domain Disease  :range Symptom)
(define-primitive-role has-location :domain Disease  :range Location)
(define-primitive-role adjacent-to  :domain Disease  :range Location)
(define-primitive-role has-material-basis-in  :domain Disease  :range Cells)
```

Figure 3.2: Roles

```
(implies Cells Location)

(implies Bone_disease Disease)
(implies Orbital_disease Bone_disease  )
(implies Endocrine_exophthalmos Orbital_disease )

(implies  Chronic_orbital_inflammation Orbital_disease)
(implies  Acute_orbital_inflammation Orbital_disease)
(implies  Orbital_cancer Orbital_disease)
(implies  Orbit_sarcoma Orbital_cancer)
(implies  Orbit_rhabdomyosarcoma Orbit_sarcoma )
```

Figure 3.3: Implies Conceps

Chapter 4

Aboxes

Abox contine informatii despre indivizi si attribute ale acestora .In general aici avem cuvinte cheie precum instance si related, attribute-filler, define-concrete-domain-attribute. La noi in ontologie indivizii sunt locatiile si simptomele ,iar toate bolile sunt definite ca si subconcepte ale conceptului disease.
Observatie: unii indivizi sunt considerati a fi si concepte de catre racer, apartinand ambelor categorii.

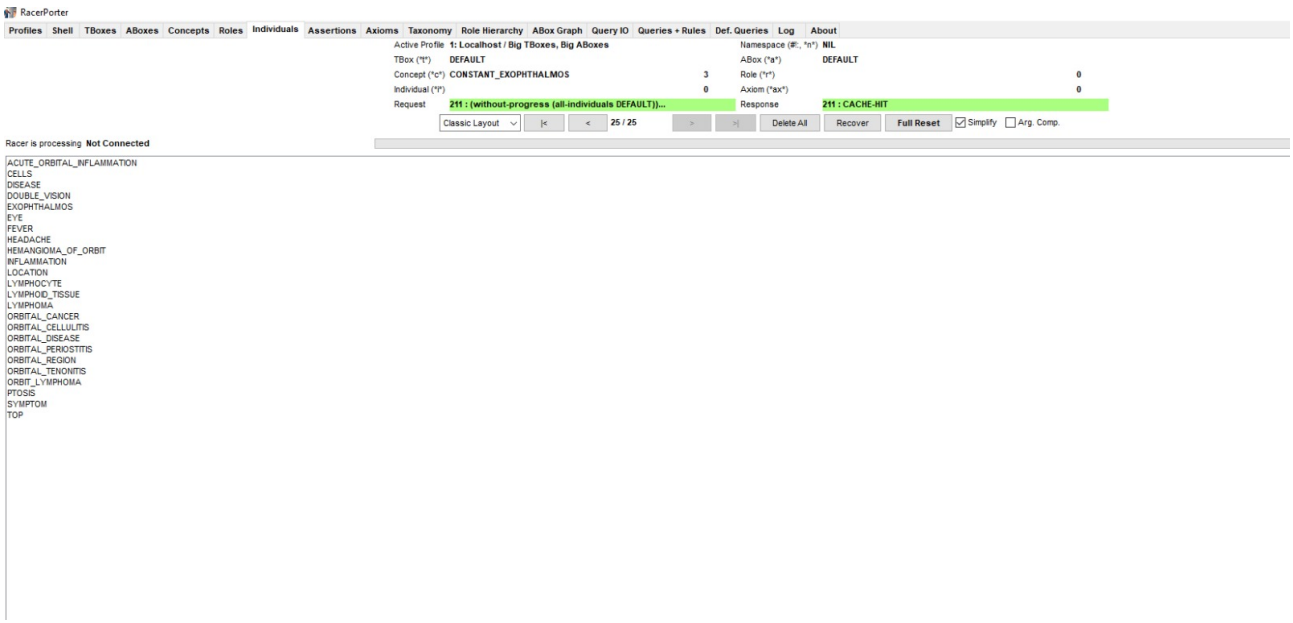


Figure 4.1: Indivizi

```
(related  Orbital_cellulitis fever has-symptom)
(related  Orbital_cellulitis ptosis has-symptom)
(related  Orbital_cellulitis headache has-symptom)
(related  Orbital_cellulitis double_vision has-symptom)
(related  Orbital_cellulitis inflammation has-symptom)
(related  Orbital_cancer ptosis has-symptom)
(related  Orbital_cancer exophthalmos has-symptom)
(related  Orbital_tenonitis inflammation has-symptom)
(related  Orbital_periostitis inflammation has-symptom)
(related  Acute_orbital_inflammation inflammation has-symptom)

(related  Hemangioma_of_orbit orbital_region has-location)
(related  Lymphoma lymphoid_tissue has-location)

(related  Orbital_disease eye  adjacent-to)

(related  Orbit_lymphoma lymphocyte  has-material-basis-in)
```

Figure 4.2: Related

```
(instance fever Symptom)
(instance ptosis Symptom)
(instance headache Symptom)
(instance double_vision Symptom)
(instance inflammation Symptom)
(instance exophthalmos Symptom)

(instance orbital_region Location)
(instance lymphoid_tissue Location)
(instance eye Location)
(instance lymphocyte Cells)
```

Figure 4.3: Instance

Chapter 5

Queries

5.1 Interogari Nrql

1. Care sunt bolile care au ca simptom febra ?

```
(retrieve (?x)
 (and (?x Disease)
 (?x fever has-symptom))
)
```

2. Care sunt bolile care au ca simptom dureri de cap ?

```
 (retrieve (?x)
  (and (?x Disease)
  (?x headache has-symptom))
 )
```

3. Ce boala apare in tesutul limfoid?

```
(retrieve (?x)
 (and (?x Disease)
 (?x lymphoid_tissue has-location))
)
```

4. Care sunt bolile care au ca simptom durerile de cap ?

```
(retrieve (?x)
 (and (?x Disease)
 (?x inflammation has-symptom))
)
```

5.2 Interogari Racer

1. Care sunt bolile care au ca simptom febra ?

```
(individual-fillers fever (inv has-symptom) )
```

2. Care sunt simptomele bolii orbital cellulitis ?

```
(individual-fillers orbital_cellulitis has-symptom )
```

5.3 Evaluare ontologie

1. Cod pentru determinarea si evaluarea diferitilor factori ai ontologiei

```
(all-atomic-concepts)
(all-individuals)

(abox-consistent?)
(tbox-cyclic?)
(tbox-coherent?)

(realize-abox)
(classify-tbox)

(evaluate (length (all-individuals)))
(evaluate (length (all-atomic-concepts)))
(evaluate (length (all-roles)))
(evaluate (length (all-rules)))
```

5.4 Rezultate query-uri

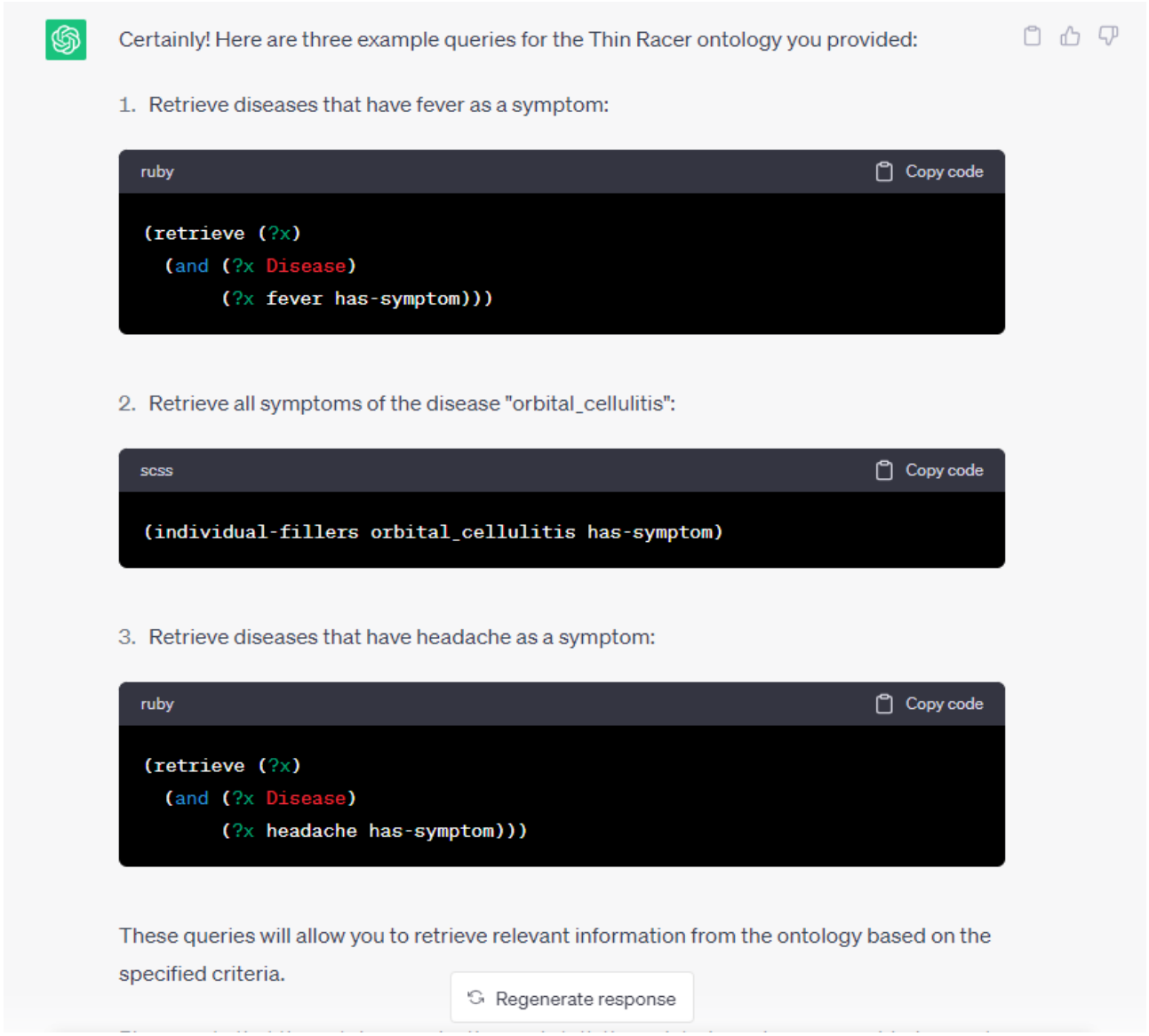
```
[1] ? (RACER-READ-FILE "D:/Faculta/SBC/OrbitalDiseaseOntology.racer")
(FULL-RESET) --> :OKAY-FULL-RESET
(DISABLE-NRQL-WARNINGS) --> :OKAY-WARNINGS-DISABLED
Redundant definition ORBITAL_CANCER for ORBIT_LYMPHOMA ignored.
(RETRIEVE (?X) (AND (?X DISEASE) (?X FEVER HAS-SYMPTOM))) --> (((?X ORBITAL_CELLULITIS)))
(INDIVIDUAL-FILLERS FEVER (INV HAS-SYMPTOM)) --> (ORBITAL_CELLULITIS)
(INDIVIDUAL-FILLERS ORBITAL_CELLULITIS HAS-SYMPTOM) --> (INFLAMMATION DOUBLE_VISION HEADACHE PTOSIS FEVER)
(RETRIEVE (?X) (AND (?X DISEASE) (?X HEADACHE HAS-SYMPTOM))) --> (((?X ORBITAL_CELLULITIS)))
(RETRIEVE (?X) (AND (?X DISEASE) (?X LYMPHOID_TISSUE HAS-LOCATION))) --> (((?X LYMPHOMA)))
(RETRIEVE (?X) (AND (?X DISEASE) (?X INFLAMMATION HAS-SYMPTOM))) --> (((?X ORBITAL_CELLULITIS)) ((?X ORBITAL_TENONITIS)) ((?X ORBITAL_PERIOSTITIS)) ((?X ACUTE_ORBITAL_INFLAMMATION)))
(ALL-ATOMIC-CONCEPTS) --> (TOP BOTTOM ORBITAL_GRANULOMA CHRONIC_ORBITAL_INFLAMMATION ORBITAL_PLASMA_CELL_GRANULOMA ORBIT_SARCOMA ENDOCRINE_EXOPHTHALMOS BONE_DISEASE ORBIT_EMBRYONAL_RHABDOMYOSARCOMA THYROTOXIC_EXOPHTHALMOS HEMANGIOMA_OF_ORBIT ORBIT_RHABDOMYOSARCOMA LATERAL_DISPLACEMENT_OF_EYE ORBIT_ALVEOLAR_RHABDOMYOSARCOMA CONSTANT_EXOPHTHALMOS ORBIT_LYMPHOMA SYMPTOM ENOPHTHALMOS ORBITAL_CANCER PULSATING_EXOPHTHALMOS LOCATION INTRAORBITAL_MENINGIOMA DISEASE ORBITAL_CYST ORBITAL_PERIOSTITIS ORBITAL_DISEASE ORBITAL_OSTEOMYELITIS INTERMITTENT_PROPTOSIS ORBITAL_TENONITIS CELLS COMPONENT ACUTE_ORBITAL_INFLAMMATION ORBITAL_CELLULITIS)
(ALL-INDIVIDUALS) --> (ORBIT_LYMPHOMA LYMPHOCYTE ORBITAL_DISEASE EYE LYMPHOMA LYMPHOID_TISSUE HEMANGIOMA_OF_ORBIT ORBITAL_REGION ACUTE_ORBITAL_INFLAMMATION INFLAMMATION ORBITAL_PERIOSTITIS ORBITAL_TENONITIS ORBITAL_CANCER EXOPHTHALMOS PTOSIS ORBITAL_CELLULITIS DOUBLE_VISION HEADACHE FEVER CELLS LOCATION TOP SYMPTOM DISEASE)
(ABOX-CONSISTENT?) --> T
(TBOX-CYCLIC?) --> NIL
(TBOX-COHERENT?) --> T
(EVALUATE (LENGTH (ALL-INDIVIDUALS))) --> 24
(EVALUATE (LENGTH (ALL-ATOMIC-CONCEPTS))) --> 33
(EVALUATE (LENGTH (ALL-ROLES))) --> 18
(EVALUATE (LENGTH (ALL-RULES))) --> 0

[1] > :OKAY
```

Figure 5.1: Rezultate query

Chapter 6

Query-uri pentru ontologie in limbaj natural

1. Urmatoarele query-uri folosite in ontologie au fost generate prin intermediul ChatGPT. Acestea au fost formulate in limbaj natural, dupa care au fost incarcate impreuna cu ontologia in chat, urmand ca acesta sa creeze codul necesar.



Certainly! Here are three example queries for the Thin Racer ontology you provided:

1. Retrieve diseases that have fever as a symptom:

ruby — Copy code

```
(retrieve (?x)
  (and (?x Disease)
       (?x fever has-symptom)))
```

2. Retrieve all symptoms of the disease "orbital_cellulitis":

scss — Copy code

```
(individual-fillers orbital_cellulitis has-symptom)
```

3. Retrieve diseases that have headache as a symptom:

ruby — Copy code

```
(retrieve (?x)
  (and (?x Disease)
       (?x headache has-symptom)))
```

These queries will allow you to retrieve relevant information from the ontology based on the specified criteria.

Regenerate response

Figure 6.1: Generare query-uri cu ChatGPT

Chapter 7

Design patterns

Ontology design patterns sunt soluții de modelare care rezolvă diverse probleme în proiectarea ontologiei. Există șase tipuri de astfel de modele: structurale, corespondență, conținut, raționament, prezentare și lexico-sintactice. In ontologia noastra, am folosit doua patternuri structurale un pattern de continut si unul de presentare :

Pattern-uri structurale:

1. N-arry relation design pattern. Pentru conceptul de Disease am definit urmatoarele relatii.

```
(define-primitive-role has-symptom  :domain Disease  :range Symptom)
(define-primitive-role has-location :domain Disease  :range Location)
(define-primitive-role adjacent-to  :domain Disease  :range Location)
(define-primitive-role has-material-basis-in  :domain Disease  :range Cells)
```

2. Partition design pattern. Pentru demonstrarea acestui pattern am considerat un concept numit Component care este impartit in subconcepte diferite intre ele care compun ontologia noastra (Disease, Symptom, Location).

```
(equivalent Component (or Disease Symptom Location))
(disjoint Disease Symptom Location)
```

Pattern de continut:

1. PartOf design pattern. Pentru demonstrarea acestui pattern am considerat entitatea Component si am definit partile ei componente.

```
(define-primitive-role subNodeOf :transitive t :inverse superNodeOf)
(define-primitive-role directSubNodeOf :parent subNodeOf)
(related Disease top directSubNodeOf)
(related Symptom top directSubNodeOf)
(related Location top directSubNodeOf)
```

Pattern de prezentare:

1. Pentru realizarea acestui pattern, am incercat sa respectam anumite conventii de scriere pentru a realiza un cod cat mai usor de citit indiferent de expertiza celui care vizualizeaza. Rolurile si instantele existente incep cu litera mica, iar conceptele cu litera mare. In cazul in care acestea sunt compuse din mai multe cuvinte aceste sunt separate pintr-o linie, in cazul rolurilor, si printr-un underline in cazul conceptelor si instantelor pentru a fi mai usor de citit.

Chapter 8

Fred

Pasul 1: Traducerea în DL folosind Fred

1. Accesați http://wit.istc.cnr.it/stlab-tools/fred/demo/
2. Obțineți reprezentarea grafică a sentence-ului si salvați-o ca nume.png
3. Obțineți formalizarea textului în sintaxa turtle si salvați-o ca nume.ttl

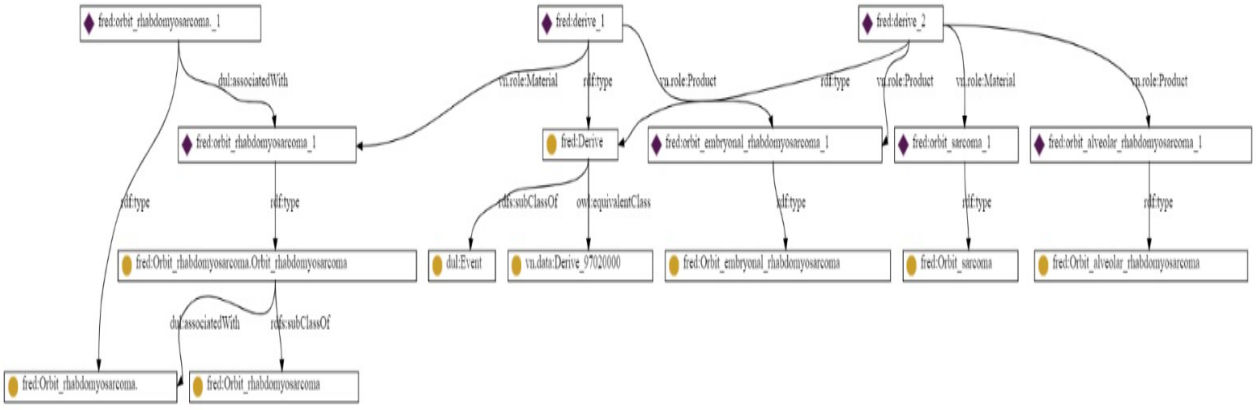
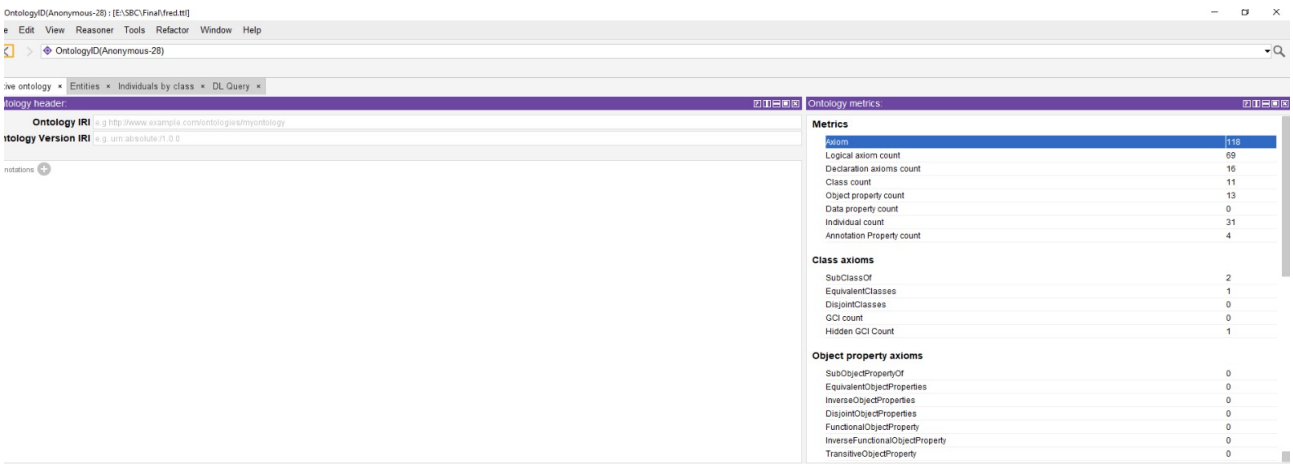
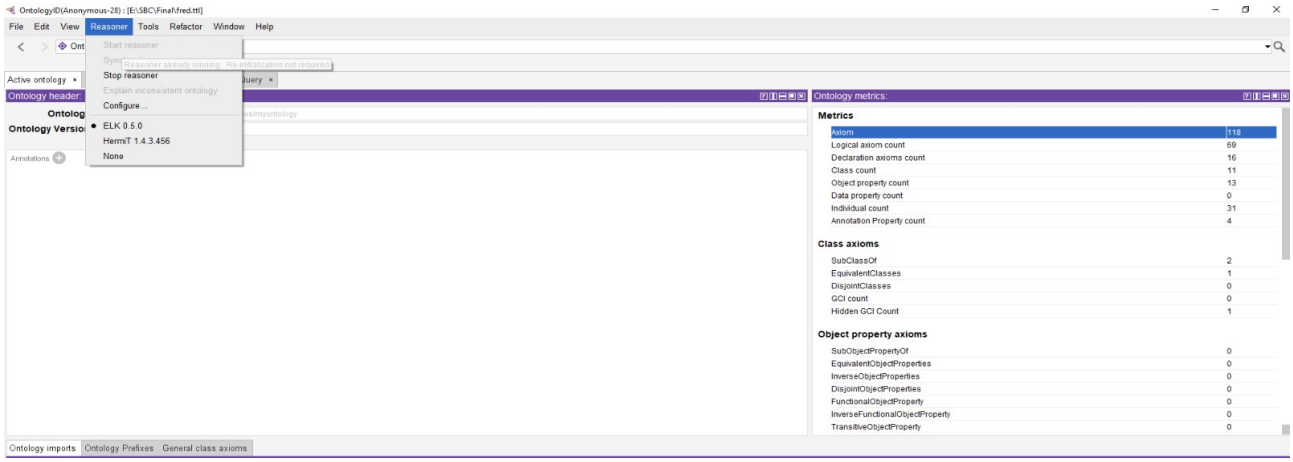
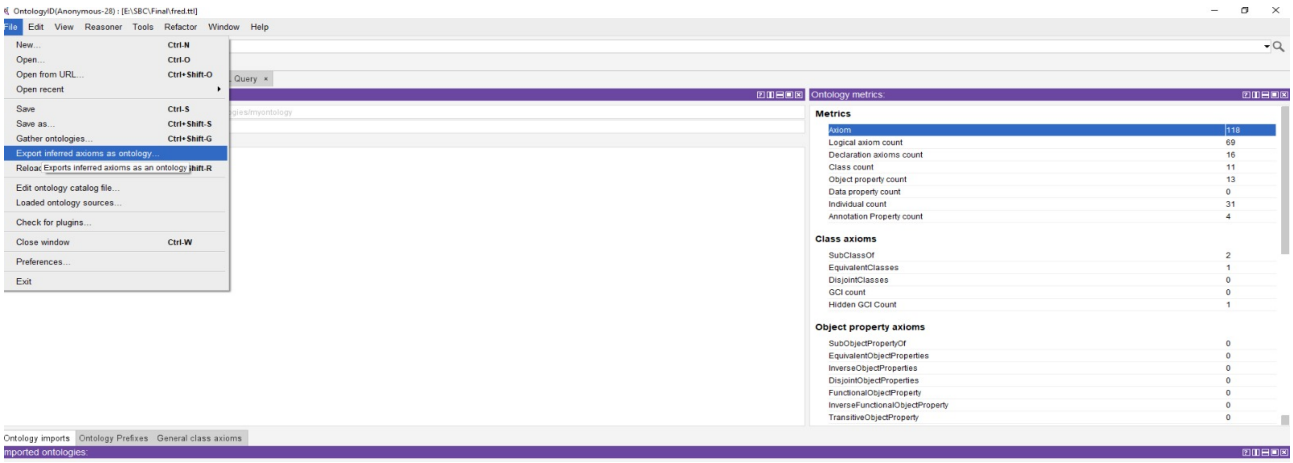


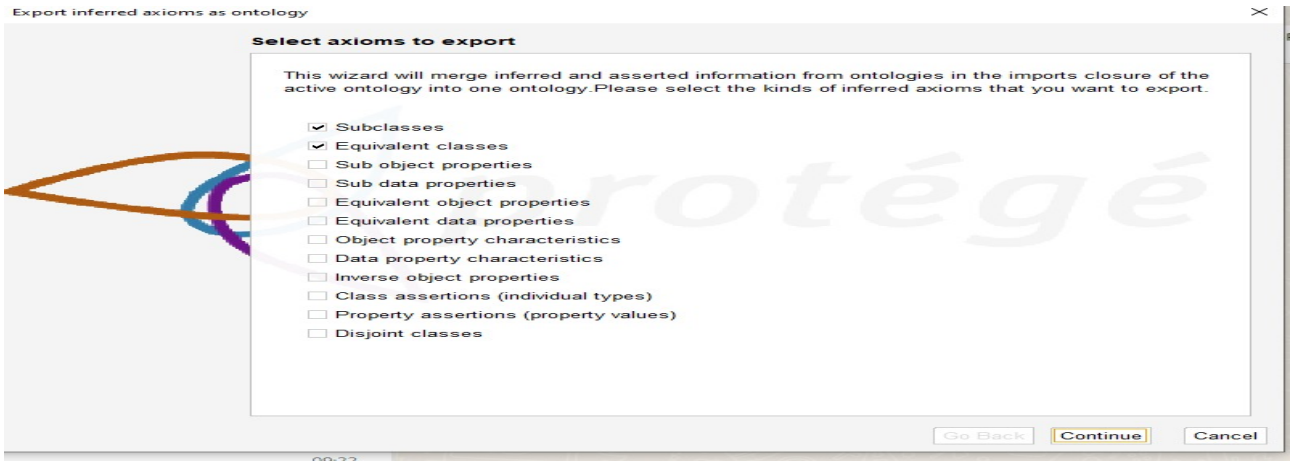
Figure 8.1: Reprezentarea grafica a propozitiei

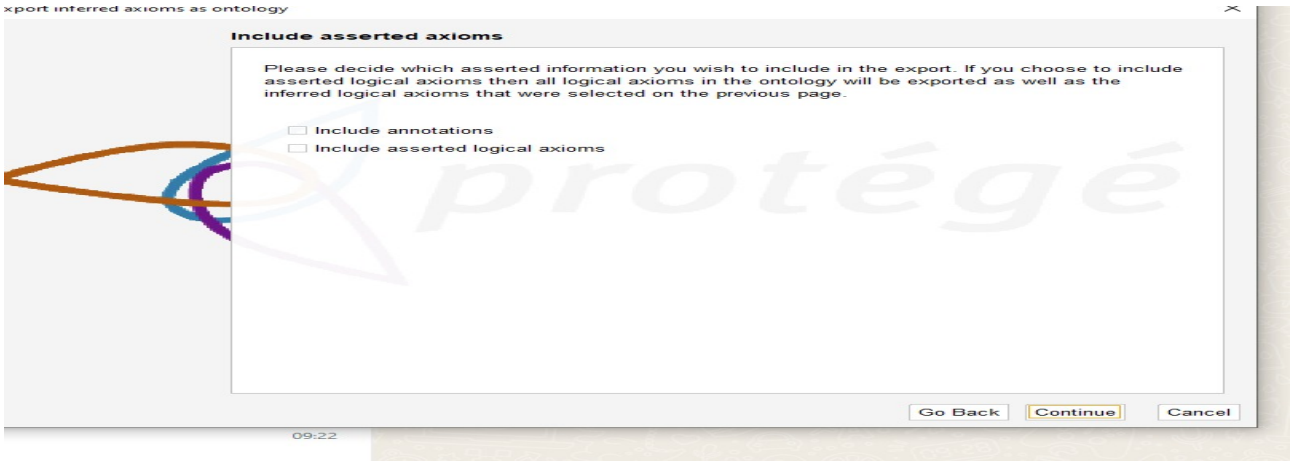
Step 2: Protege

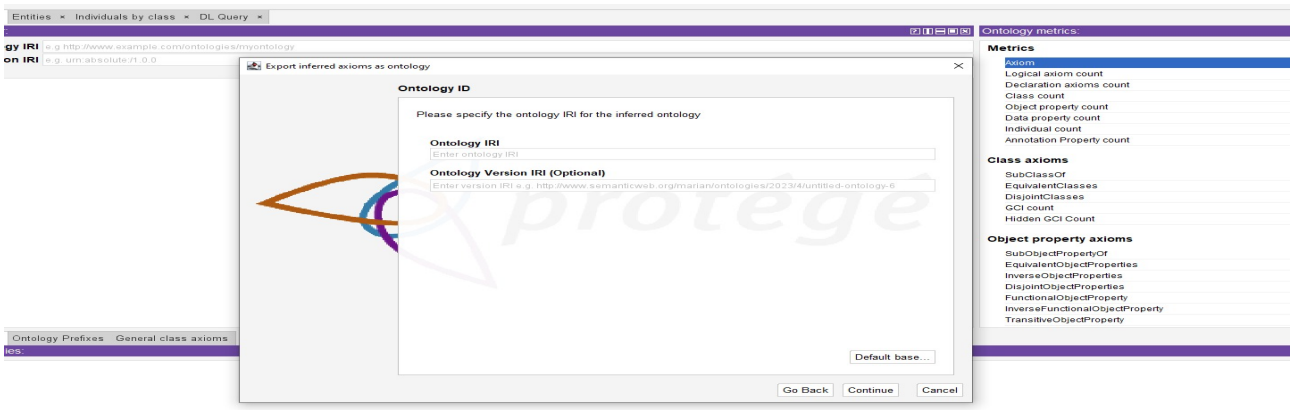



File Edit View Reasoner Tools Refactor Window Help
Start reasoner
Stop reasoner
Explain inconsistent ontology
Configure...
ELK 0.5.0
HermiT 1.4.3.456
None
Ontology header:
Ontology metrics:
Metrics
Axiom 118
Logical axiom count 69
Declaration axioms count 16
Class count 11
Object property count 13
Data property count 0
Individual count 31
Annotation Property count 4
Class axioms
SubClassOf 2
EquivalentClasses 1
DisjointClasses 0
GCI count 0
Hidden GCI Count 1
Object property axioms
SubObjectPropertyOf 0
EquivalentObjectProperties 0
InverseObjectProperties 0
DisjointObjectProperties 0
FunctionalObjectProperty 0
InverseFunctionalObjectProperty 0
TransitiveObjectProperty 0
Ontology imports
Ontology Prefixes
General class axioms

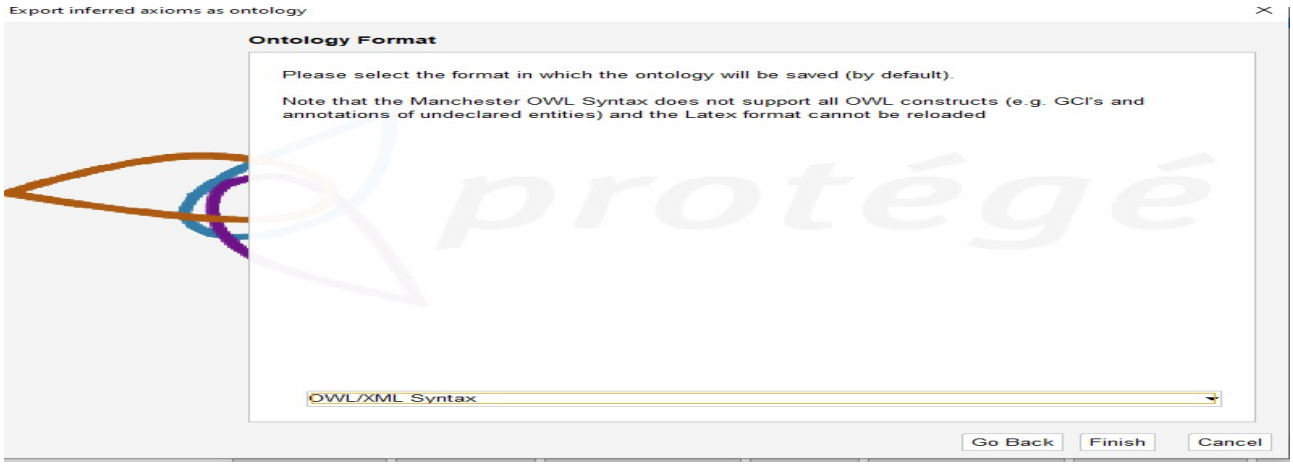

File Edit View Reasoner Tools Refactor Window Help
New... Ctrl-N
Open... Ctrl-O
Open from URL... Ctrl+Shift-O
Open recent
Save Ctrl-S
Save as... Ctrl+Shift-S
Gather ontologies... Ctrl+Shift-G
Export inferred axioms as ontology...
Exports inferred axioms as an ontology
Edit ontology catalog file...
Loaded ontology sources...
Check for plugins...
Close window Ctrl-W
Preferences...
Exit
Ontology metrics:
Metrics
Axiom 118
Logical axiom count 69
Declaration axioms count 16
Class count 11
Object property count 13
Data property count 0
Individual count 31
Annotation Property count 4
Class axioms
SubClassOf 2
EquivalentClasses 1
DisjointClasses 0
GCI count 0
Hidden GCI Count 1
Object property axioms
SubObjectPropertyOf 0
EquivalentObjectProperties 0
InverseObjectProperties 0
DisjointObjectProperties 0
FunctionalObjectProperty 0
InverseFunctionalObjectProperty 0
TransitiveObjectProperty 0
Ontology imports
Ontology Prefixes
General class axioms


Export inferred axioms as ontology
Select axioms to export
This wizard will merge inferred and asserted information from ontologies in the imports closure of the active ontology into one ontology.Please select the kinds of inferred axioms that you want to export.
Subclasses
Equivalent classes
Sub object properties
Sub data properties
Equivalent object properties
Equivalent data properties
Object property characteristics
Data property characteristics
Inverse object properties
Class assertions (individual types)
Property assertions (property values)
Disjoint classes
Go Back
Continue
Cancel


Include asserted axioms
Please decide which asserted information you wish to include in the export. If you choose to include asserted logical axioms then all logical axioms in the ontology will be exported as well as the inferred logical axioms that were selected on the previous page.
Include annotations
Include asserted logical axioms
Go Back
Continue
Cancel


Entities
Individuals by class
DL Query
Ontology metrics:
Export inferred axioms as ontology
Ontology ID
Please specify the ontology IRI for the inferred ontology
Ontology IRI
Ontology Version IRI (Optional)
Default base...
Go Back
Continue
Cancel
Metrics
Axiom
Logical axiom count
Declaration axioms count
Class count
Object property count
Data property count
Individual count
Annotation Property count
Class axioms
SubClassOf
EquivalentClasses
DisjointClasses
GCI count
Hidden GCI Count
Object property axioms
SubObjectPropertyOf
EquivalentObjectProperties
InverseObjectProperties
DisjointObjectProperties
FunctionalObjectProperty
InverseFunctionalObjectProperty
TransitiveObjectProperty
Ontology Prefixes
General class axioms


Export inferred axioms as ontology
Physical Location
Please specify the file path that points to the location where your ontology will be saved to. (Click on a location in the 'recent locations' list to automatically select that location).
E:\SBC\Final\fred.owl
Browse...
RecentLocations
Default base...


Export inferred axioms as ontology
Ontology Format
Please select the format in which the ontology will be saved (by default).
Note that the Manchester OWL Syntax does not support all OWL constructs (e.g. GCI's and annotations of undeclared entities) and the Latex format cannot be reloaded
OWL/XML Syntax
Go Back
Finish
Cancel

Step 3: From OWL/XML syntax to OWL

1. Am incarcat fiserul salvat cu owl/xml in racer
2. L-am salvat in OWL cu comanda (save-kb “fred.owl” :syntax :owl)
3. Dupa am adaugat continutul la ontlogia noastra deja existenta in owl

Chapter 9

Verbaliser

Urmam aceeasi pasi ca si in Fred:

Pasul 1: Traducerea în DL folosind Fred

1. Accesați http://wit.istc.cnr.it/stlab-tools/fred/demo/
2. Obțineți reprezentarea grafică a sentence-ului si salvați-o ca nume.png
3. Obțineți formalizarea textului în sintaxa turtle si salvați-o ca nume.ttl

2. In prodege am facut urmatoarele (poze se pot gasi la capitolul FRED):

1. Am incarcarat ontologia .ttl
2. Am selectat start reasoner
3. Am dat export
4. Am selectat clase si subclase
5. Am selectatlocatia si am denumit fisierul Ontologie.owl
6. Am salvat in OWL/XML

Am pus formatul RDF/XML in : `http://attempto.ifi.uzh.ch/site/docs/owl_to_ace.html` si a generat varianta finala in natural language:

```
Every LymphocyteOrbital is an Orbit.
Every LymphocyteOrbital is an Orbital.
Every LymphocyteOrbitalCancer is an OrbitalCancer.
Every Material is a Quality.
Every MaterialBasis is a Basis.
Every Orbit is a Quality.
Every OrbitAlveolar is an Alveolar.
Every OrbitAlveolarRhabdomyosarcoma is an Alveolar_rhabdomyosarcoma.
Every OrbitAlveolarRhabdomyosarcoma is an AlveolarRhabdomyosarcoma.
Every OrbitEmbryonalRhabdomyosarcoma is an Embryonal_rhabdomyosarcoma.
Every OrbitEmbryonalRhabdomyosarcoma is an EmbryonalRhabdomyosarcoma.
Every OrbitLymphoma is a Lymphoma.
Every OrbitLymphoma is a Lymphoma.
Every OrbitRhabdomyosarcoma is a Rhabdomyosarcoma.
Every OrbitRhabdomyosarcoma is a Rhabdomyosarcoma.
Every OrbitRhabdomyosarcoma. is a Rhabdomyosarcoma..
Every OrbitRhabdomyosarcoma.Orbit is a Rhabdomyosarcoma.Orbit.
Every OrbitRhabdomyosarcoma.OrbitRhabdomyosarcoma is a Rhabdomyosarcoma.OrbitRhabdomyosarcoma.
Every OrbitSarcoma is a Sarcoma.
Every Orbital is a Quality.
Every OrbitalCancer is a Cancer.
Every OrbitalCancer is a Cancer.
Every OrbitalMeningioma is a Meningioma.
Every OrbitalMeningioma is a Meningioma.
Every Rhabdomyosarcoma.Orbit is an Orbit_(anatomy).
Every Rhabdomyosarcoma.Orbit is an Orbit.
Every Rhabdomyosarcoma.Orbit is an Orbital.
Every Rhabdomyosarcoma.OrbitRhabdomyosarcoma is an OrbitRhabdomyosarcoma.
Every SymptomExophthalmo is an Exophthalmo.
```

Chapter 10

Anexa

.1 Racer code

```
(full-reset)
(disable-nrql-warnings)


;;;;;;;;;;;;;;N-arry relation Design pattern;;;;;;;;;;;;;;
(define-primitive-role has-symptom  :domain Disease  :range Symptom)
(define-primitive-role is-different  :domain Disease  :range Symptom)
(define-primitive-role has-location :domain Disease  :range Location)
(define-primitive-role adjacent-to  :domain Disease  :range Location)
(define-primitive-role has-material-basis-in  :domain Disease  :range Cells)
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;



;;;;;;;;;;;;;;PartOf Design pattern;;;;;;;;;;;;;;
(define-primitive-role subNodeOf :transitive t :inverse superNodeOf)
(define-primitive-role directSubNodeOf :parent subNodeOf)
(related Disease top directSubNodeOf)
(related Symptom top directSubNodeOf)
(related Location top directSubNodeOf)
(related Cells Location directSubNodeOf)
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;


;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;Presentation Design pattern;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

(instance fever Symptom)
(instance ptosis Symptom)
(instance headache Symptom)
(instance double_vision Symptom)
(instance inflammation Symptom)
(instance exophthalmos Symptom)

(instance orbital_region Location)
(instance lymphoid_tissue Location)
(instance eye Location)
(instance lymphocyte Cells)


;;;;;;;;;;;;;;Partition Design pattern;;;;;;;;;;;;;;
(equivalent Component (or Disease Symptom Location))
```

```
(disjoint Disease Symptom Location)
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;


(implies Intermittent_proptosis Orbital_disease)
(implies Orbital_cyst Orbital_disease)
(implies Pulsating_exophthalmos Orbital_disease)
(implies Enophthalmos Orbital_disease)
(implies Constant_exophthalmos Orbital_disease)
(implies Lateral_displacement_of_eye Orbital_disease)
(implies Hemangioma_of_orbit Orbital_disease)

(implies Thyrotoxic_exophthalmos Endocrine_exophthalmos)
(implies Orbital_plasma_cell_granuloma Chronic_orbital_inflammation)
(implies Orbital_granuloma Chronic_orbital_inflammation)

(implies Orbital_cellulitis Acute_orbital_inflammation)
(implies Orbital_tenonitis Acute_orbital_inflammation)
(implies Orbital_osteomyelitis Acute_orbital_inflammation)
(implies Orbital_periostitis Acute_orbital_inflammation)

(implies Intraorbital_meningioma Orbital_cancer)
(implies Orbit_lymphoma Orbital_cancer)
(implies Orbit_lymphoma Orbital_cancer)
(implies Orbit_alveolar_rhabdomyosarcoma Orbit_rhabdomyosarcoma)
(implies Orbit_embryonal_rhabdomyosarcoma Orbit_rhabdomyosarcoma)

(implies Cells Location)

(implies Bone_disease Disease)
(implies Orbital_disease Bone_disease  )
(implies Endocrine_exophthalmos Orbital_disease )

(implies  Chronic_orbital_inflammation Orbital_disease)
(implies  Acute_orbital_inflammation Orbital_disease)
(implies  Orbital_cancer Orbital_disease)
(implies  Orbit_sarcoma Orbital_cancer)
(implies  Orbit_rhabdomyosarcoma Orbit_sarcoma )


(related  Orbital_cellulitis fever has-symptom)
(related  Orbital_cellulitis ptosis has-symptom)
(related  Orbital_cellulitis headache has-symptom)
(related  Orbital_cellulitis double_vision has-symptom)
(related  Orbital_cellulitis inflammation has-symptom)
(related  Orbital_cancer ptosis has-symptom)
(related  Orbital_cancer exophthalmos has-symptom)
(related  Orbital_tenonitis inflammation has-symptom)
(related  Orbital_periostitis inflammation has-symptom)
(related  Acute_orbital_inflammation inflammation has-symptom)

(related  Hemangioma_of_orbit orbital_region has-location)
(related  Lymphoma lymphoid_tissue has-location)

(related  Orbital_disease eye  adjacent-to)

(related  Orbit_lymphoma lymphocyte  has-material-basis-in)
```

```
;;;;;;;;;;;;;;;Queries;;;;;;;;;;;;;;;


;1_______Returneaza bolile care au ca simptom febra
(retrieve (?x)
 (and (?x Disease)
 (?x fever has-symptom)))

(individual-fillers fever (inv has-symptom) )

;2_______Returneaza toate simptomele bolii orbital_cellulitis
(individual-fillers orbital_cellulitis has-symptom )


;3_______Returneaza bolile care au ca simptom dureri de cap
(retrieve (?x)
 (and (?x Disease)
 (?x headache has-symptom)))

;4_______Ce boala apare in tesutul limfoid?
(retrieve (?x)
(and (?x Disease)
(?x lymphoid_tissue has-location)))

;5_______Returneaza toate bolile care au ca simptom inflamatia
(retrieve (?x)
(and (?x Disease)
(?x inflammation has-symptom)))

;;;;;;;;;;;;;;;Ontology evaluation;;;;;;;;;;;;;;;

(all-atomic-concepts)
(all-individuals)

(abox-consistent?)
(tbox-cyclic?)
(tbox-coherent?)

(realize-abox)
(classify-tbox)

(evaluate (length (all-individuals)))
(evaluate (length (all-atomic-concepts)))
(evaluate (length (all-roles)))
(evaluate (length (all-rules)))
```

Listing 1: Orbital Disease Ontology

.2 Competency questions Racer and Nrql and evaluation

```

;1_______Returneaza bolile care au ca simptom febra
(retrieve (?x)
 (and (?x Disease)
 (?x fever has-symptom)))

(individual-fillers fever (inv has-symptom) )

;2_______Returneaza toate simptomele bolii orbital_cellulitis
(individual-fillers orbital_cellulitis has-symptom )
```

```
11
12
13 ;3_______Returneaza bolile care au ca simptom dureri de cap
14 (retrieve (?x)
15  (and (?x Disease)
16  (?x headache has-symptom)))
17
18 ;4_______Ce boala apare in tesutul limfoid?
19 (retrieve (?x)
20 (and (?x Disease)
21 (?x lymphoid_tissue has-location)))
22
23 ;5_______Returneaza toate bolile care au ca simptom inflamatia
24 (retrieve (?x)
25 (and (?x Disease)
26 (?x inflammation has-symptom)))
27
28
29 (all-atomic-concepts)
30 (all-individuals)
31
32 (abox-consistent?)
33 (tbox-cyclic?)
34 (tbox-coherent?)
35
36 (realize-abox)
37 (classify-tbox)
38
39 (evaluate (length (all-individuals)))
40 (evaluate (length (all-atomic-concepts)))
41 (evaluate (length (all-roles)))
42 (evaluate (length (all-rules)))
```

Listing 2: Competency questions Racer and Nrql and evaluation