

AMIA 2008 Washington, DC

FMA-RadLex:
An Application Ontology of Radiological Anatomy
derived from the
Foundational Model of Anatomy Reference Ontology

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and James F. Brinkley, MD, PhD^{1,2}

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Motivation

Ontological interoperability in biomedicine

-Derive *application ontologies*
from *reference ontologies*

RSNA

RadLex®

A Lexicon for Uniform Indexing and Retrieval of Radiology Information

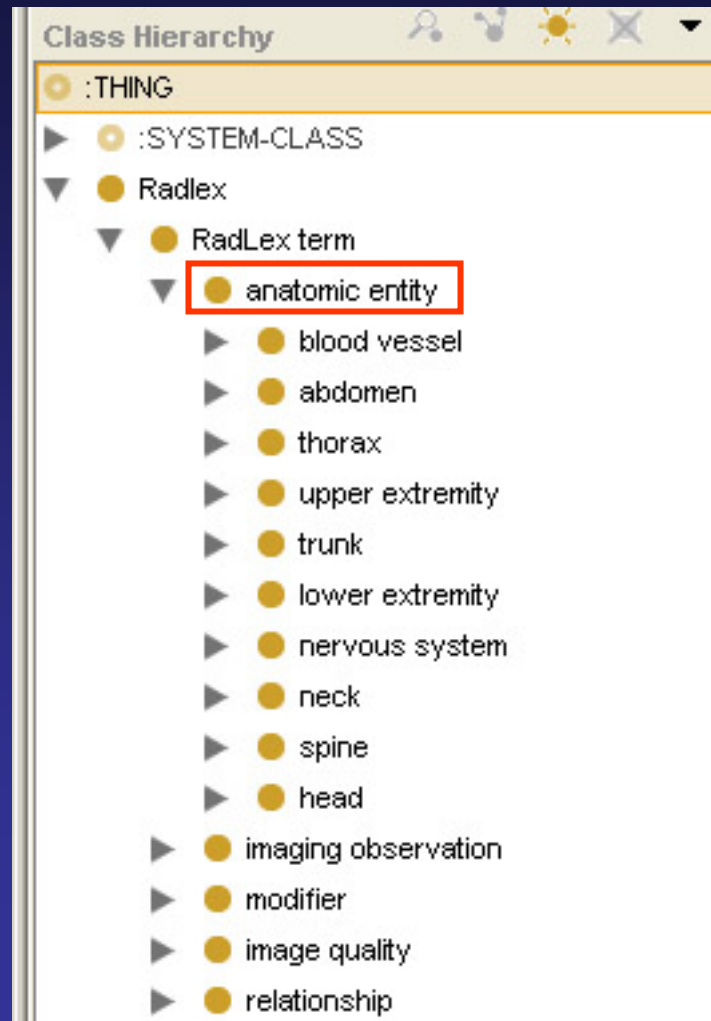
Browse by: Preferred



Tree Browser

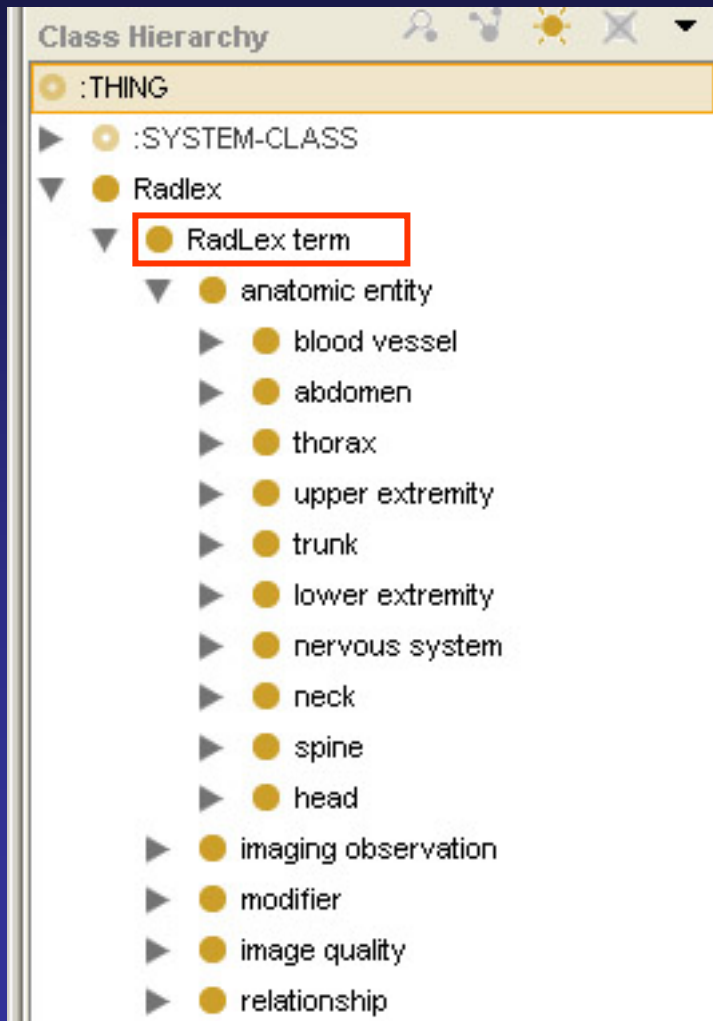
- ⊖ RadLex term
 - + treatment
 - + imaging procedure attribute
 - + substance
 - + procedure step
 - + imaging observation characteristic
 - + modifier
 - + foreign body
 - + imaging observation
 - + anatomic entity
 - + teaching attribute
 - + relationship
 - imaging service request
 - + image quality

RadLex Anatomy Terminology



Problem

RadLex



Clinical data

SNOMED-RT

NCIT

Galen

Other anatomy ontologies

Solution

Terminologies

Ontologies

Solution

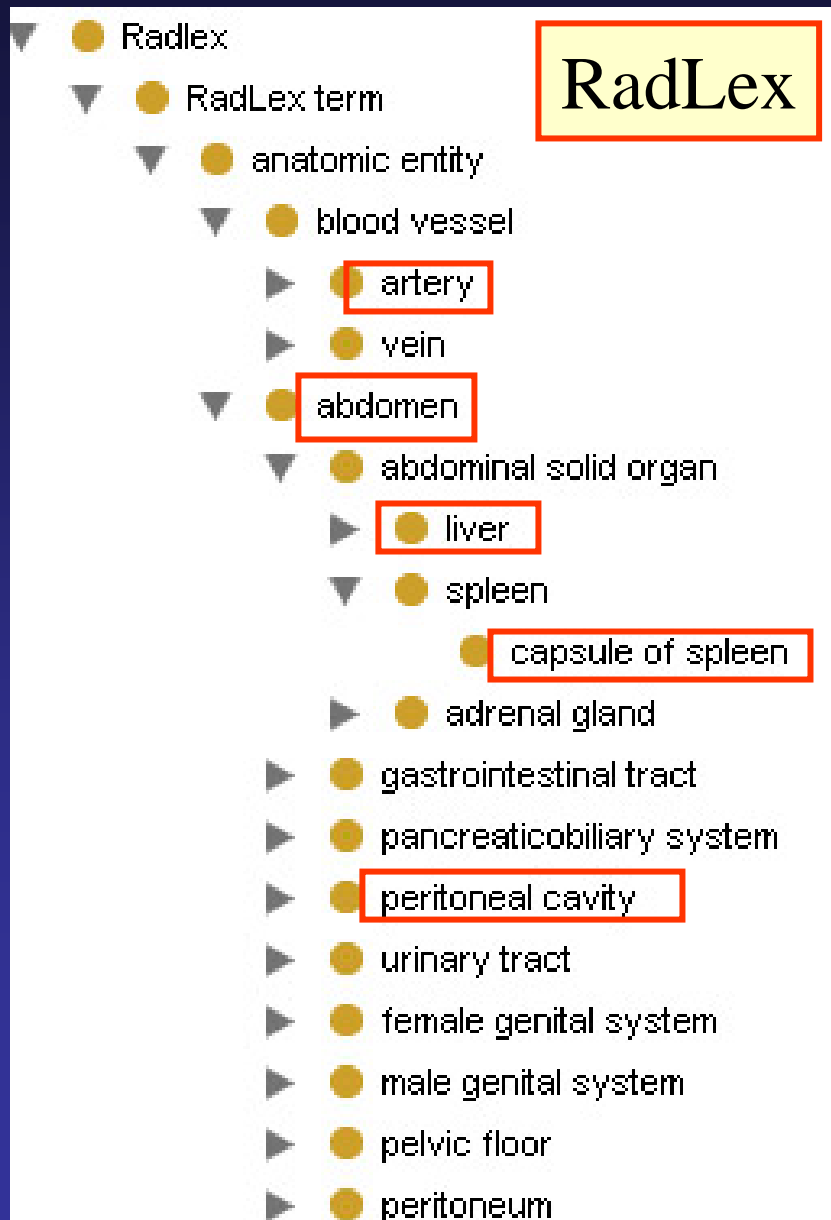
Terminologies

deal with terms and their meaning (semantics)

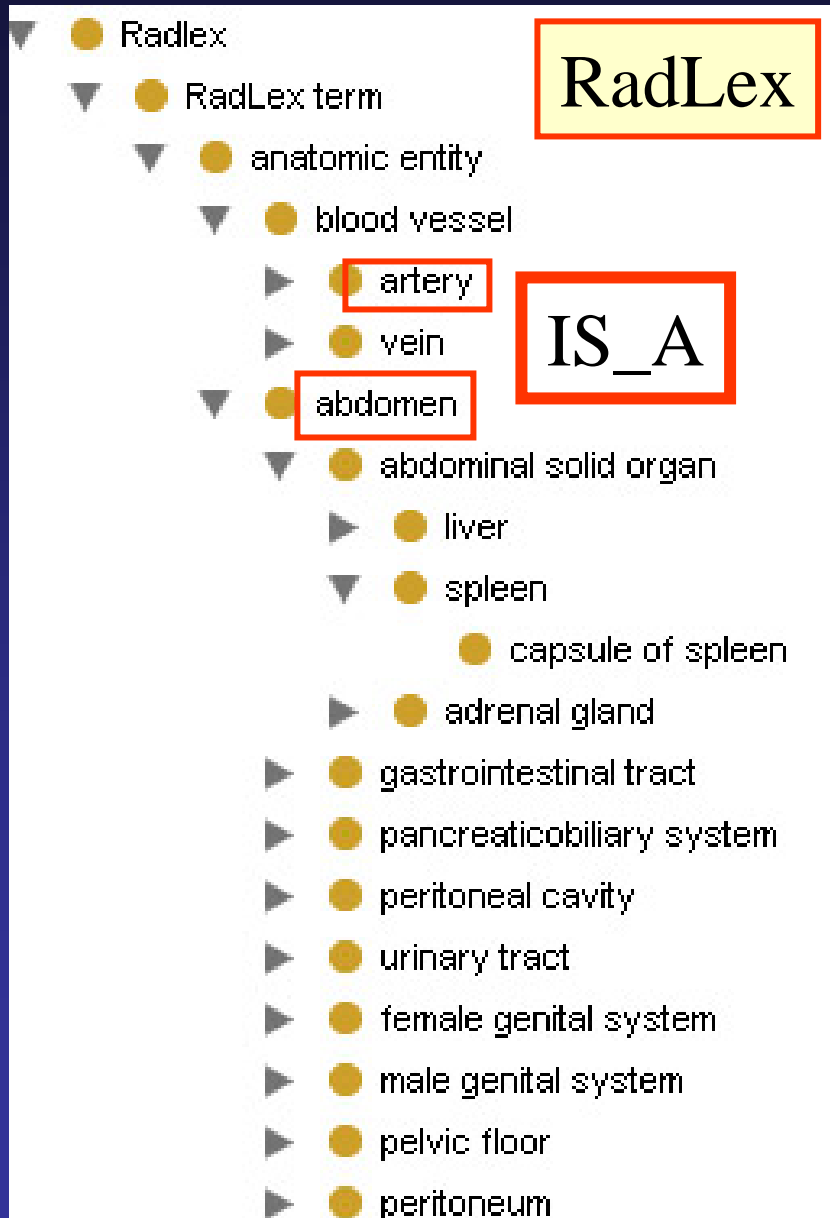
Ontologies

deal with entities and their identity

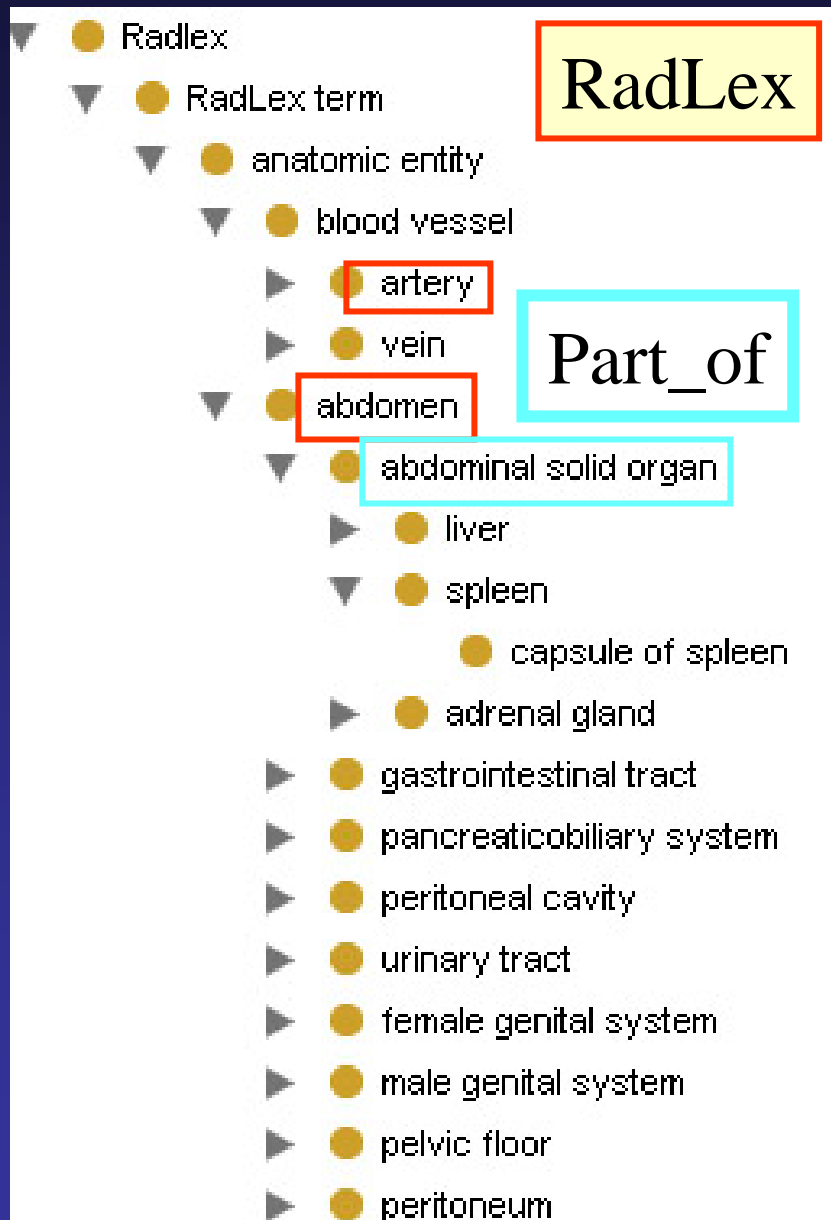
Terminologies vs Ontologies



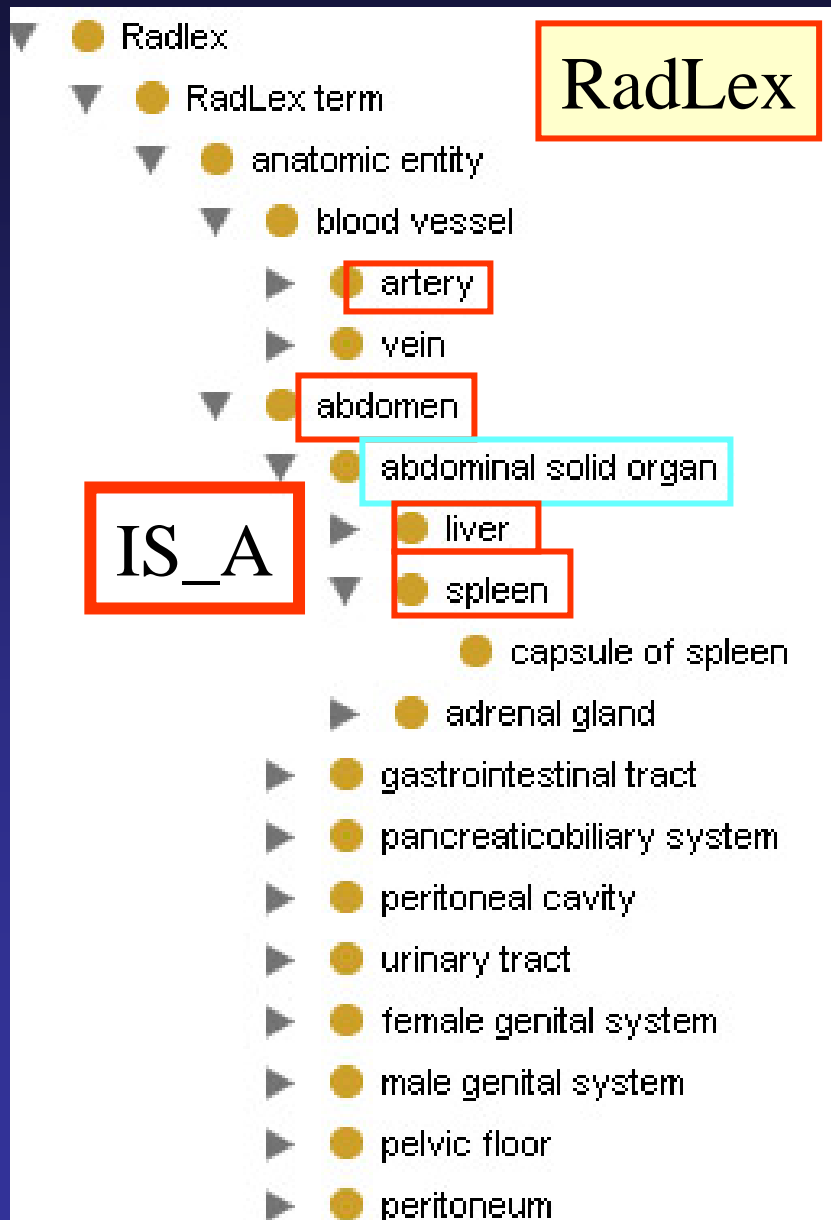
Terminologies vs Ontologies



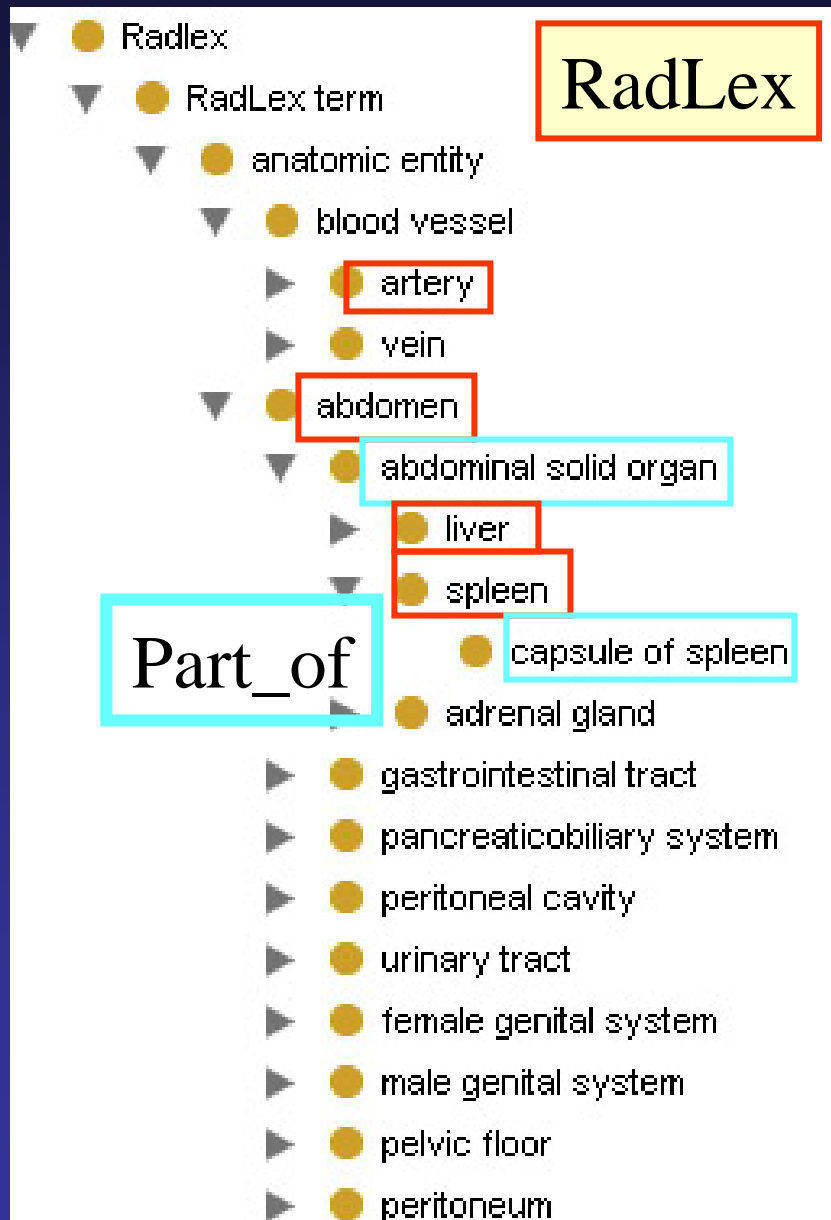
Terminologies vs Ontologies



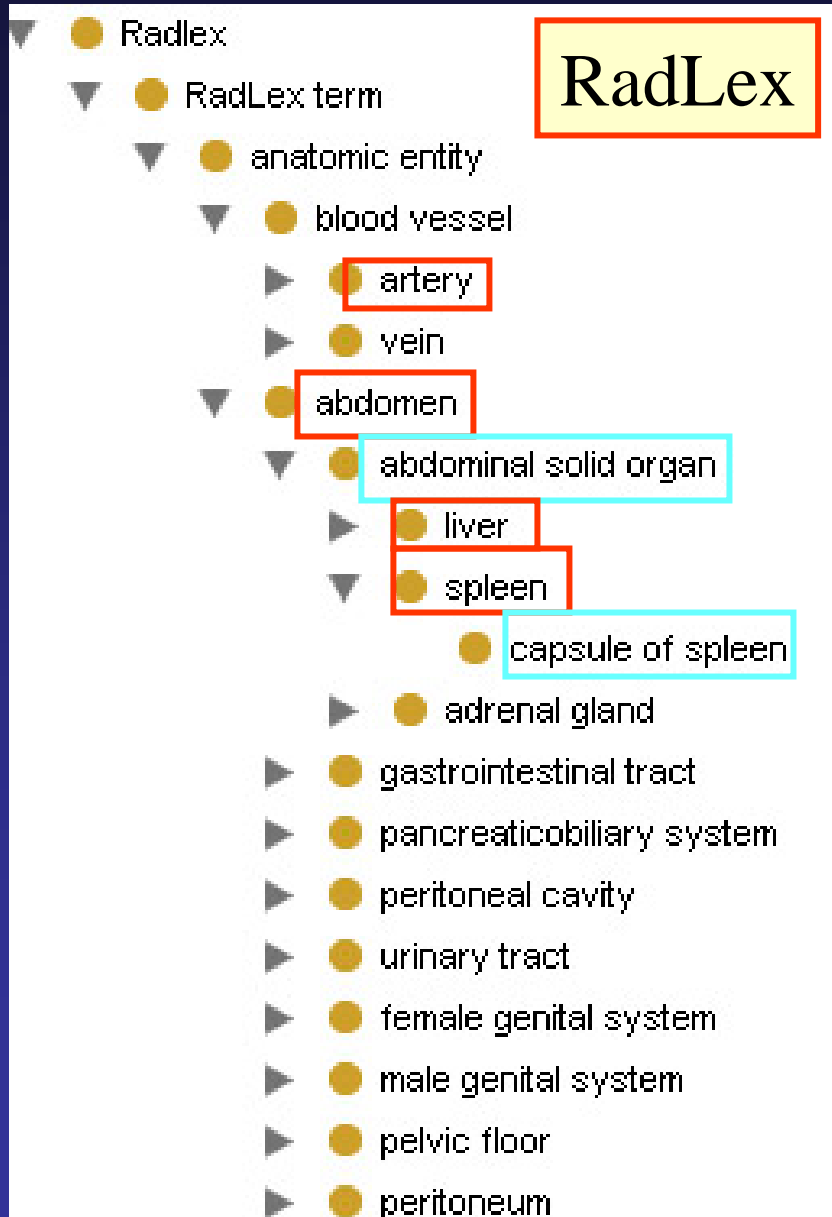
Terminologies vs Ontologies



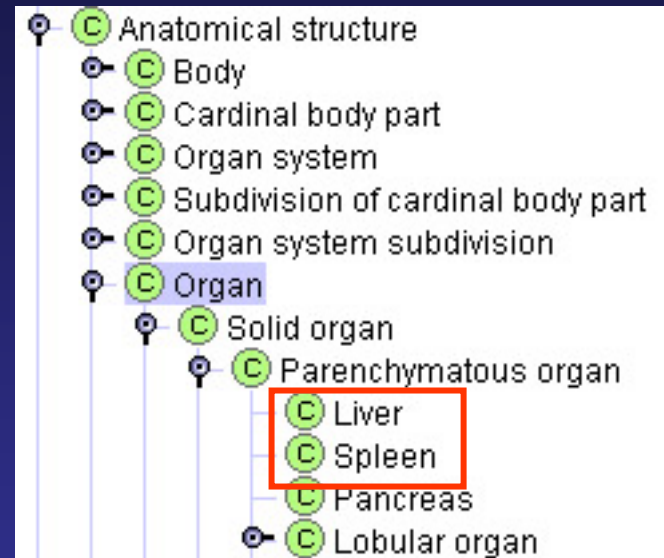
What kind of structure?



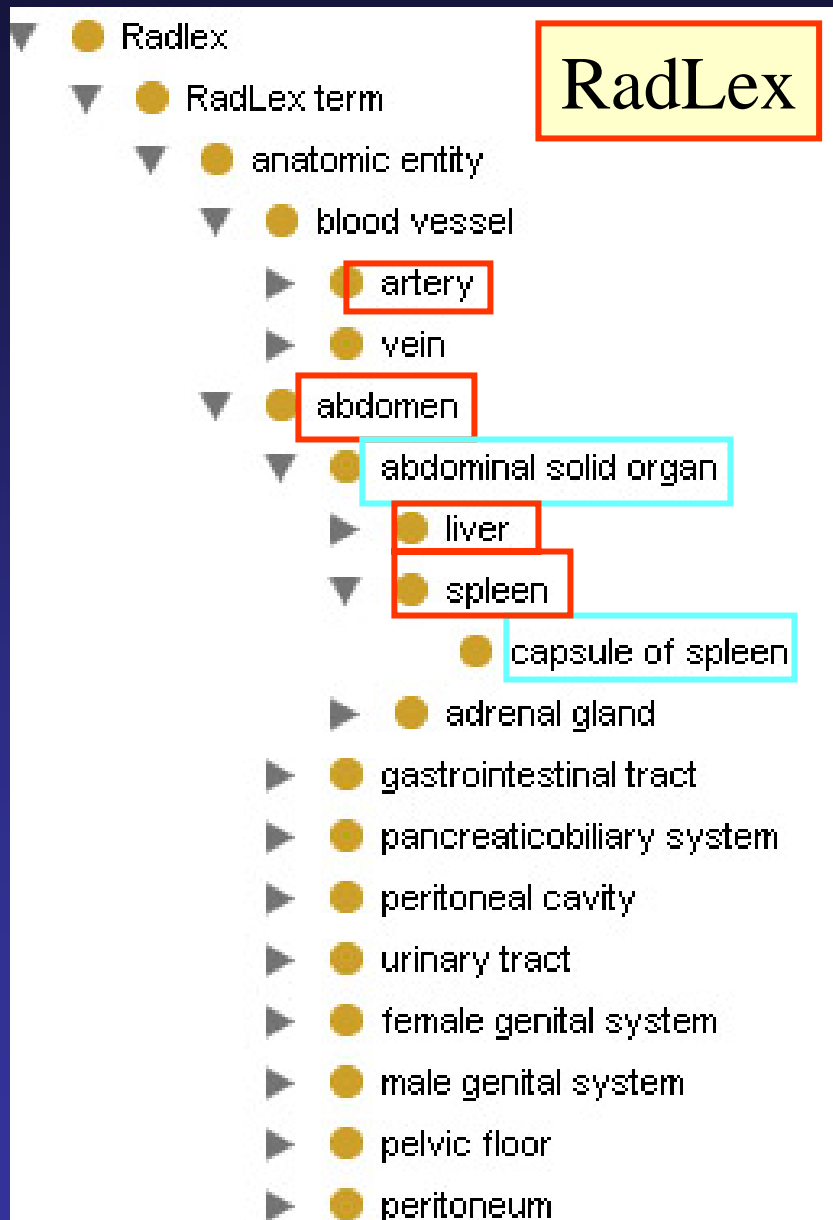
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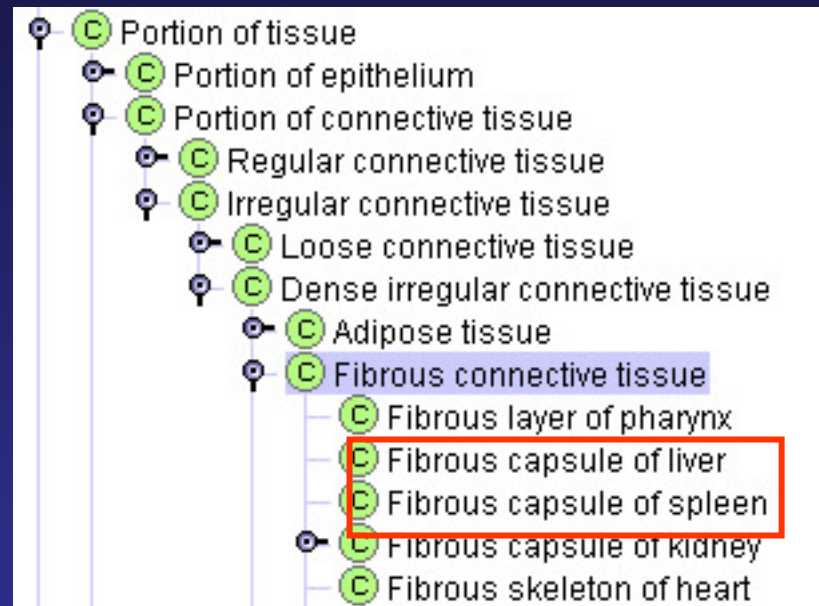
FMA ontology



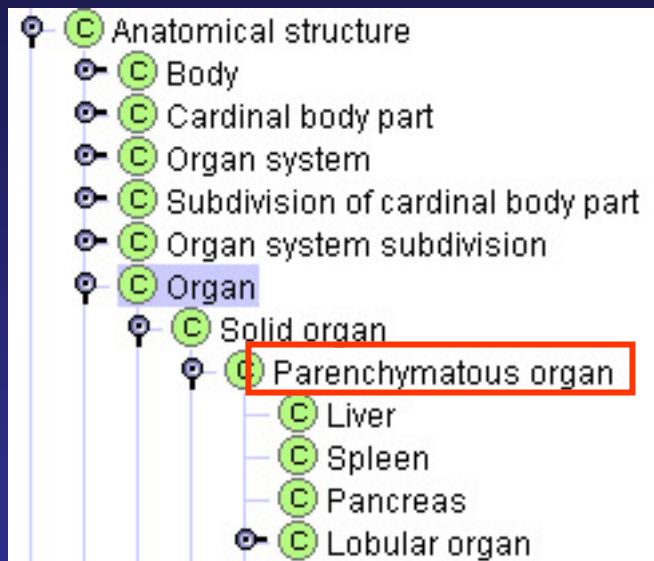
What kind of structure?



FMA ontology

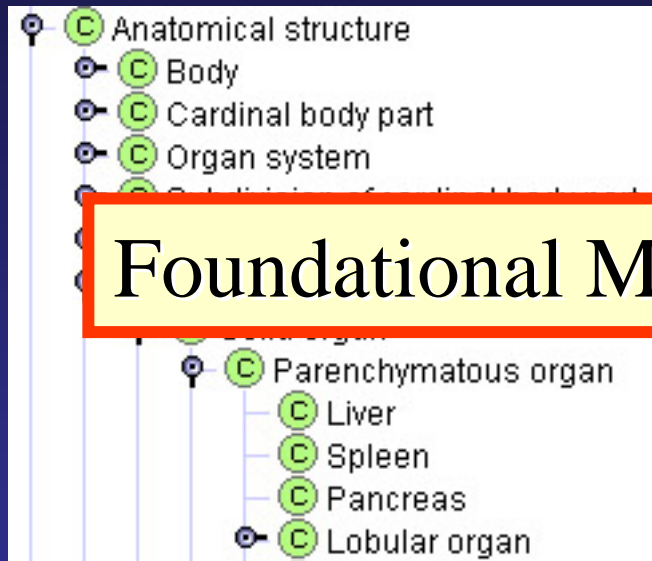


Reference Ontology



Template Slots	
Name	
S	contained in I
S	member of I
S	innervation
S	surrounded by O I
S	systemic part of I
S	primary site of I
S	lymphatic drainage I
S	segmental supply I
S	inherent 3-D shape
S	attributed part O
S	location O
S	orientation
S	has inherent 3-D shape O
S	regional part I
S	regional part of I
S	constitutional part I
S	arterial supply I
S	venous drainage I
S	nerve supply O I

Reference Ontology



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S	venous drainage I
S	nerve supply O I

Foundational Model of Anatomy (FMA)

Approach

De novo view generation

- prune down a reference ontology to specific needs
- extract only elements needed to create new view
(materialized or non-materialized view)

Import framework

- incorporate into an existing project the ontological structure from a reference ontology

Approach

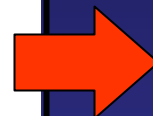
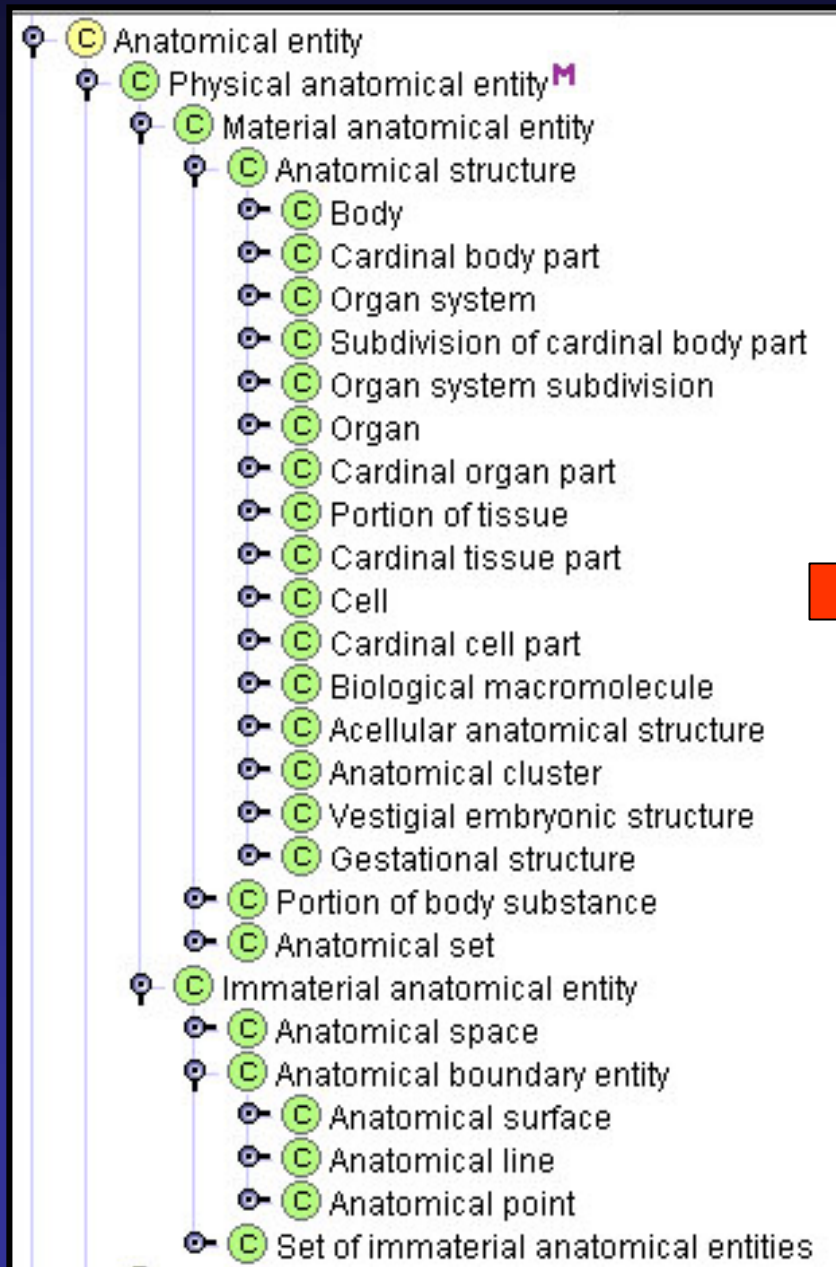
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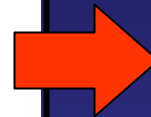
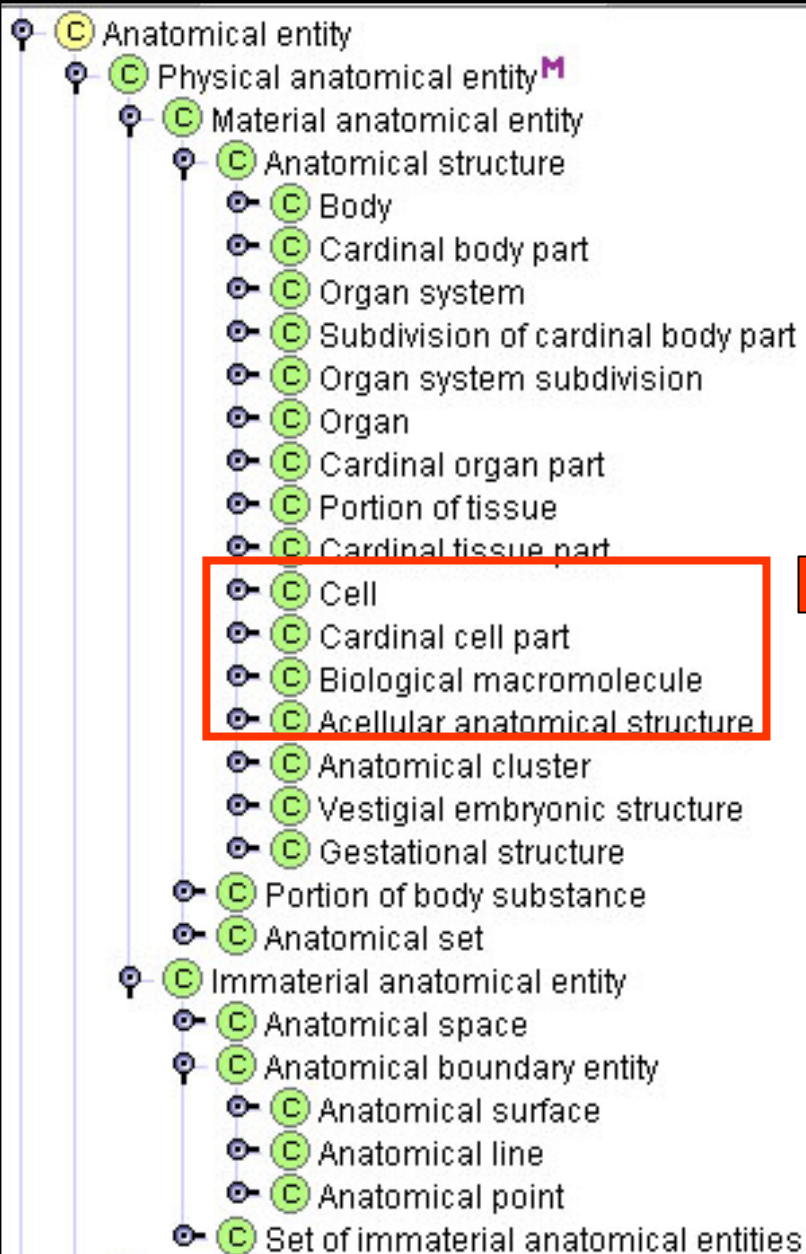
- incorporate into an existing project ontological structure from a reference ontology

Reference ontology: FMA Ontology



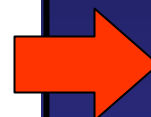
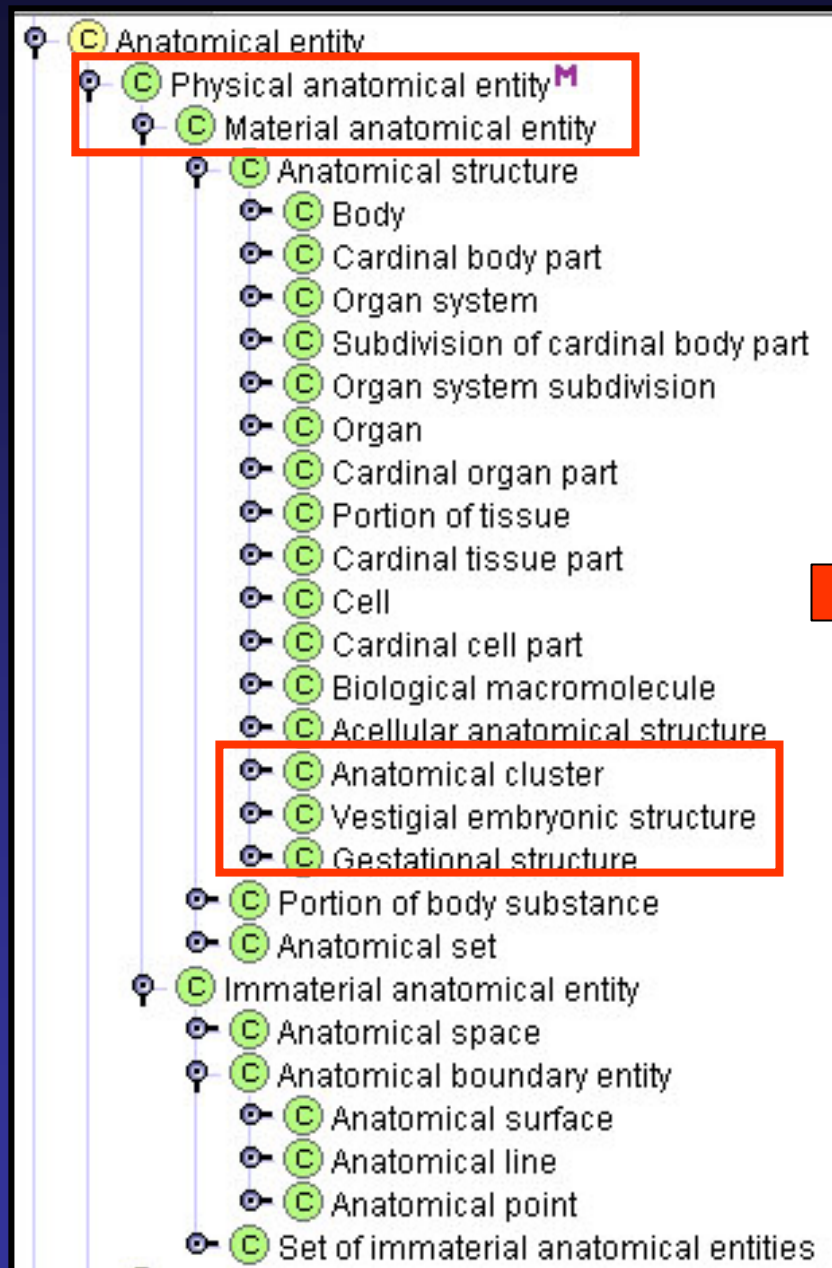
Gross anatomy application
Ontology

Reference ontology: FMA Ontology



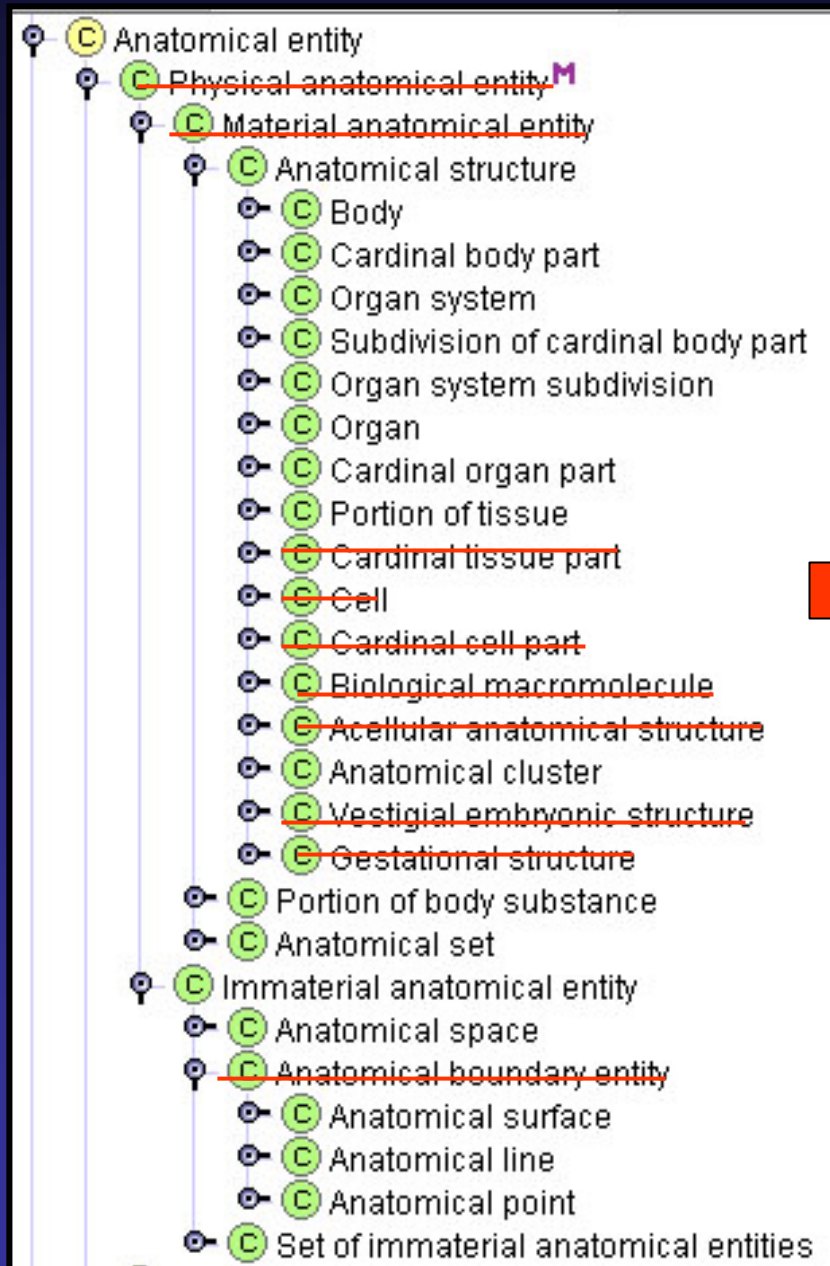
Gross anatomy application
Ontology

Reference ontology: FMA Ontology

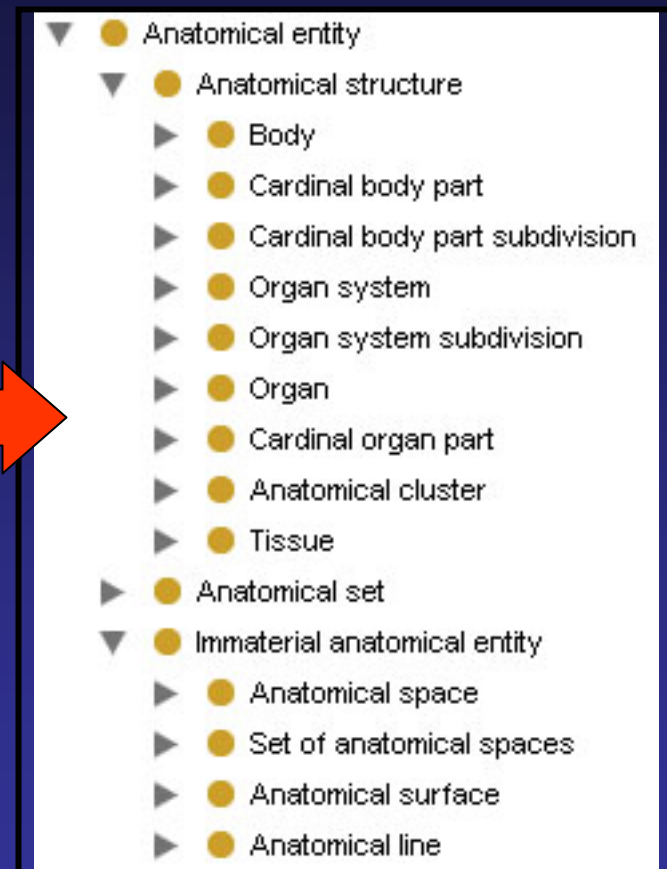


Gross anatomy application
Ontology

Reference ontology: FMA Ontology



Gross anatomy application Ontology



Approach

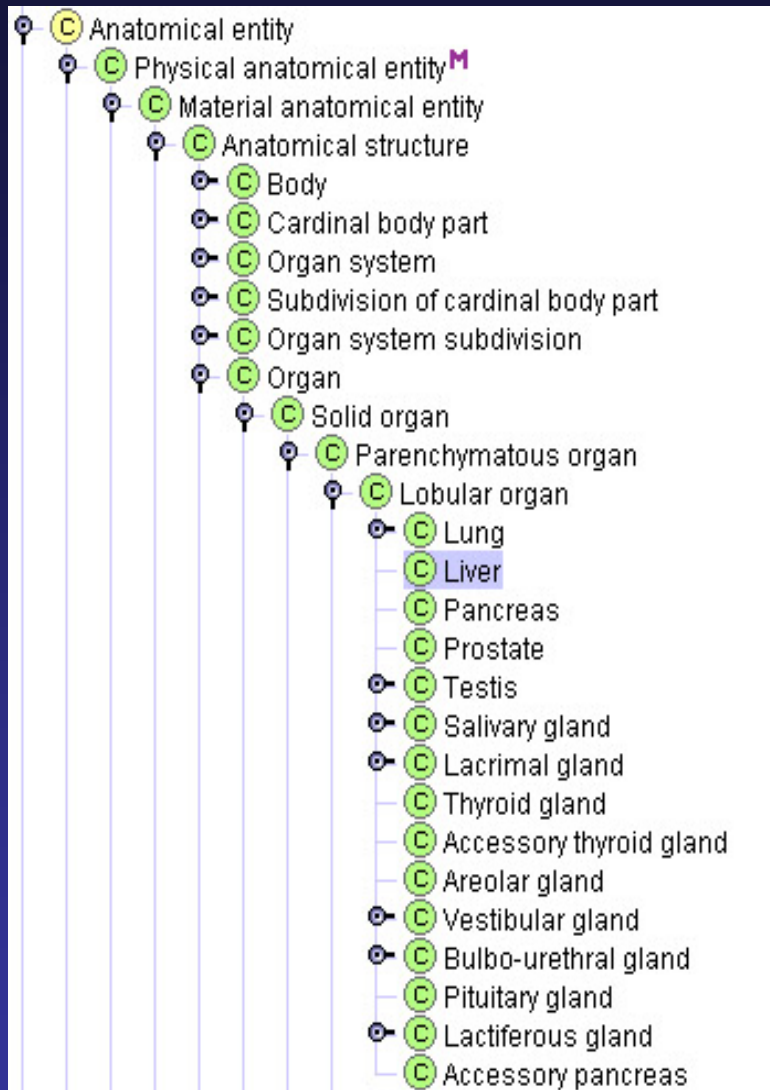
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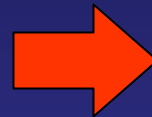
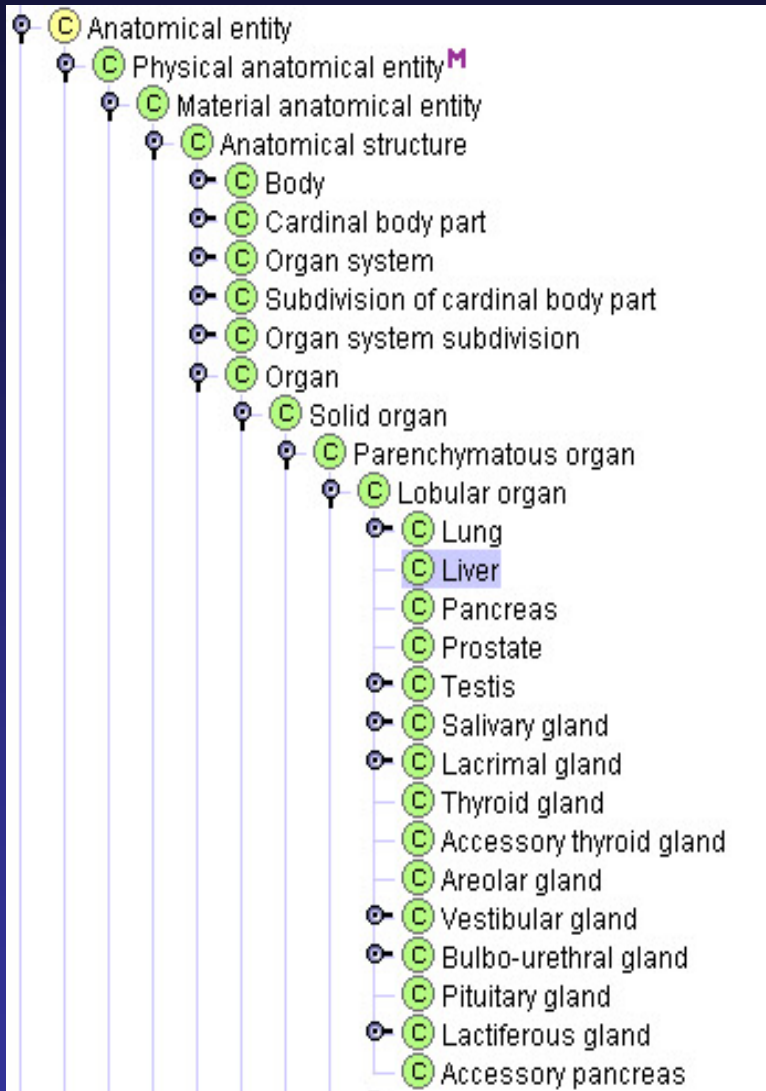
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Reference ontology: FMA Ontology

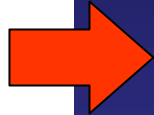
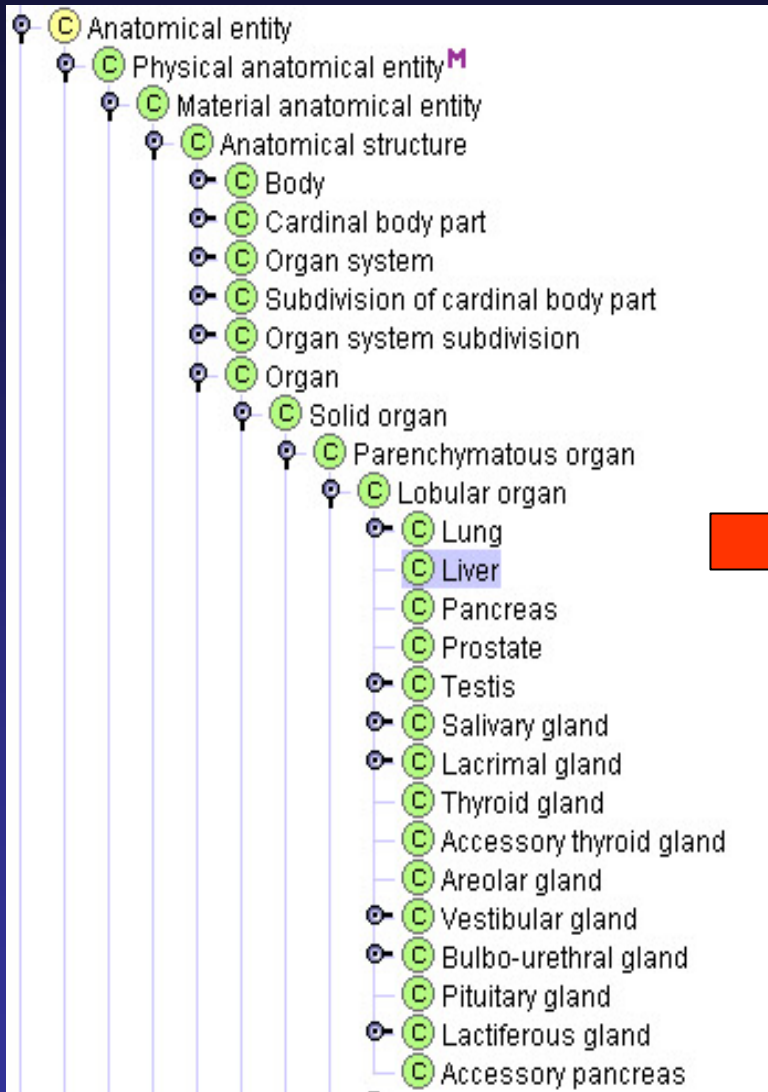


Reference ontology: FMA Ontology



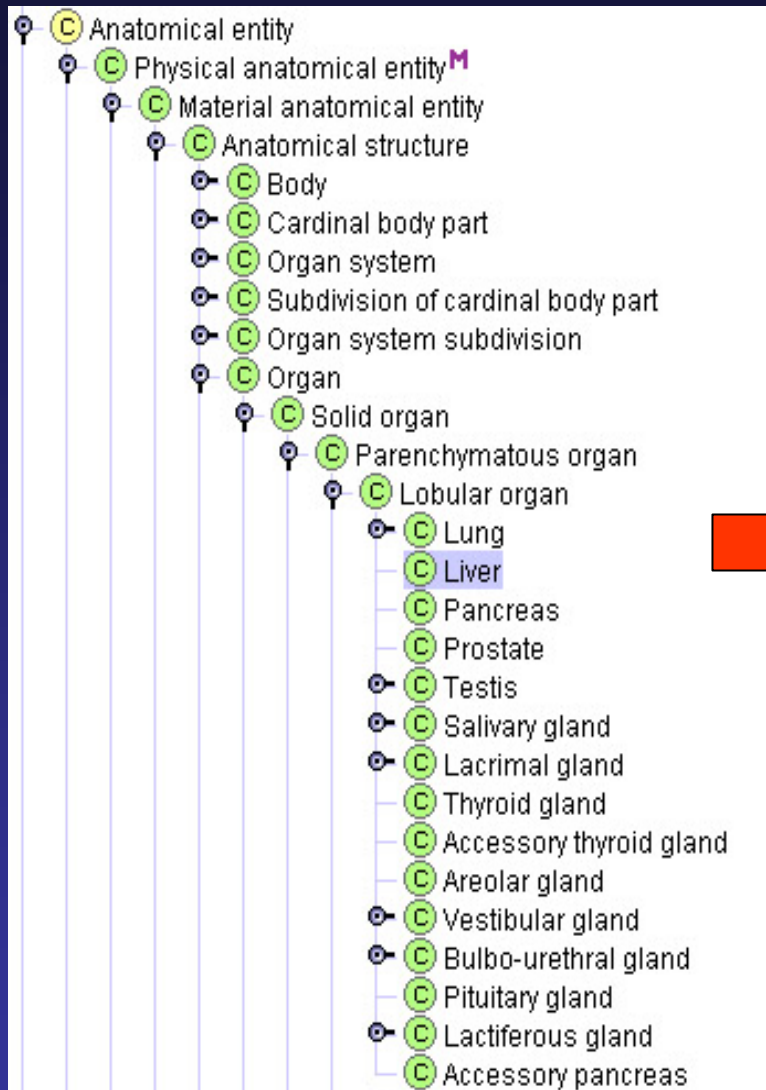
Liver
Ontology

Reference ontology: FMA Ontology

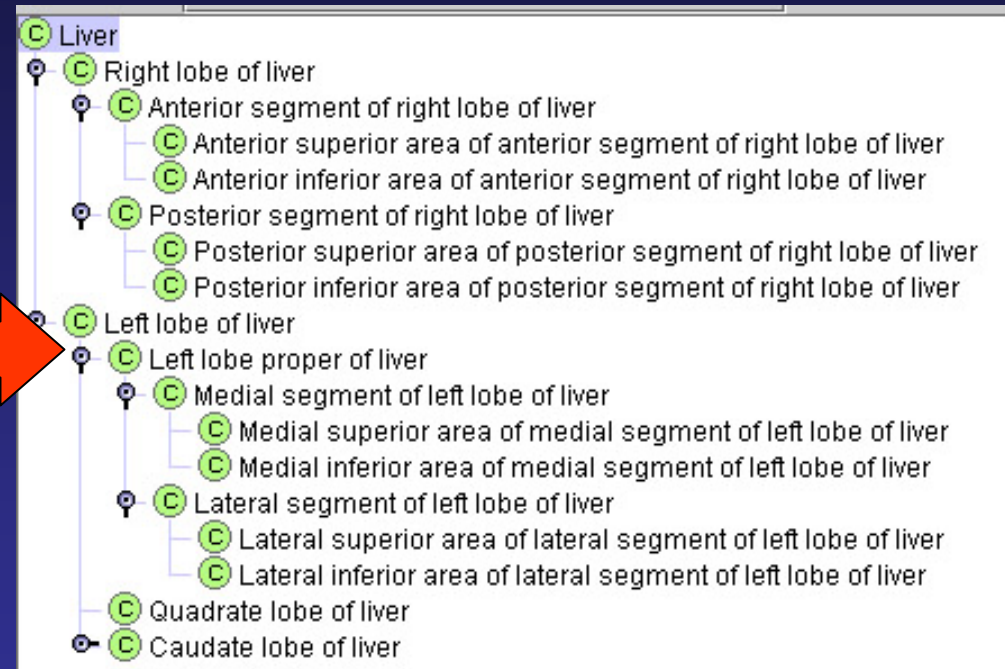


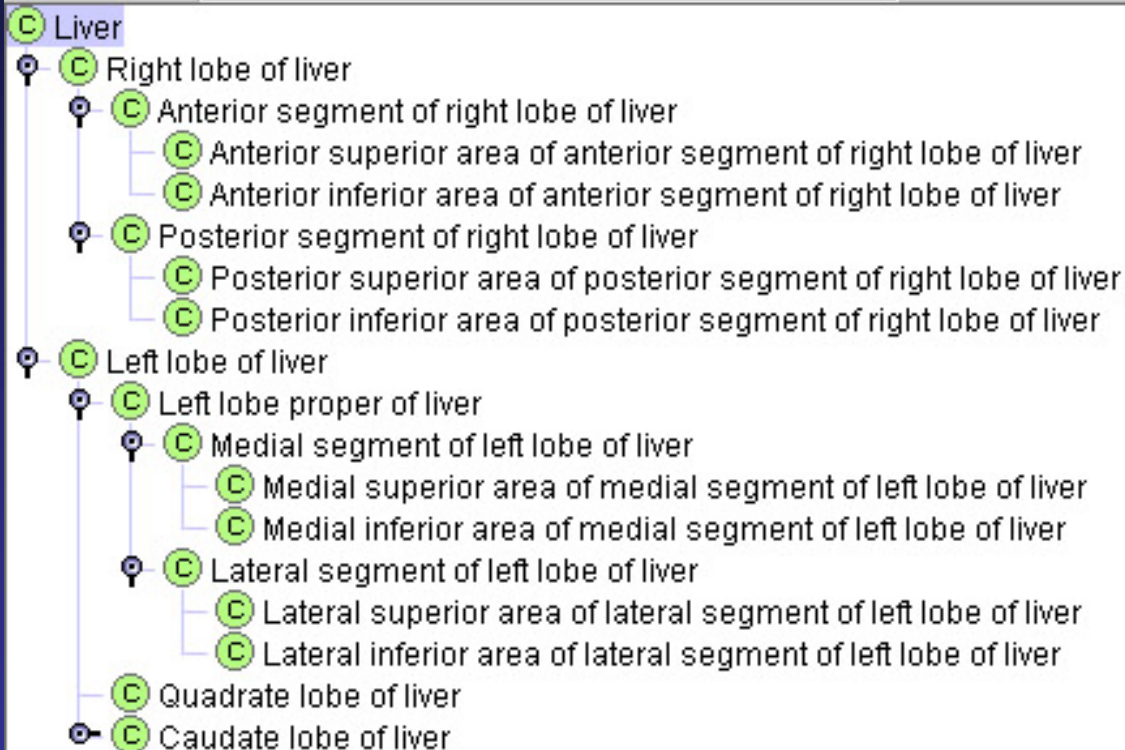
Part_of relation

Reference ontology: FMA Ontology

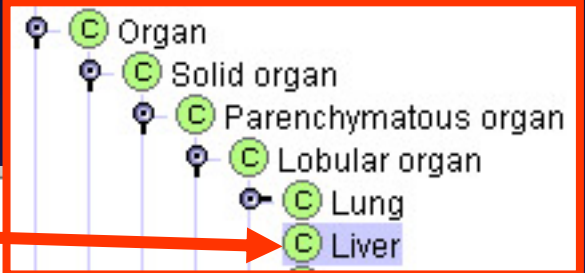
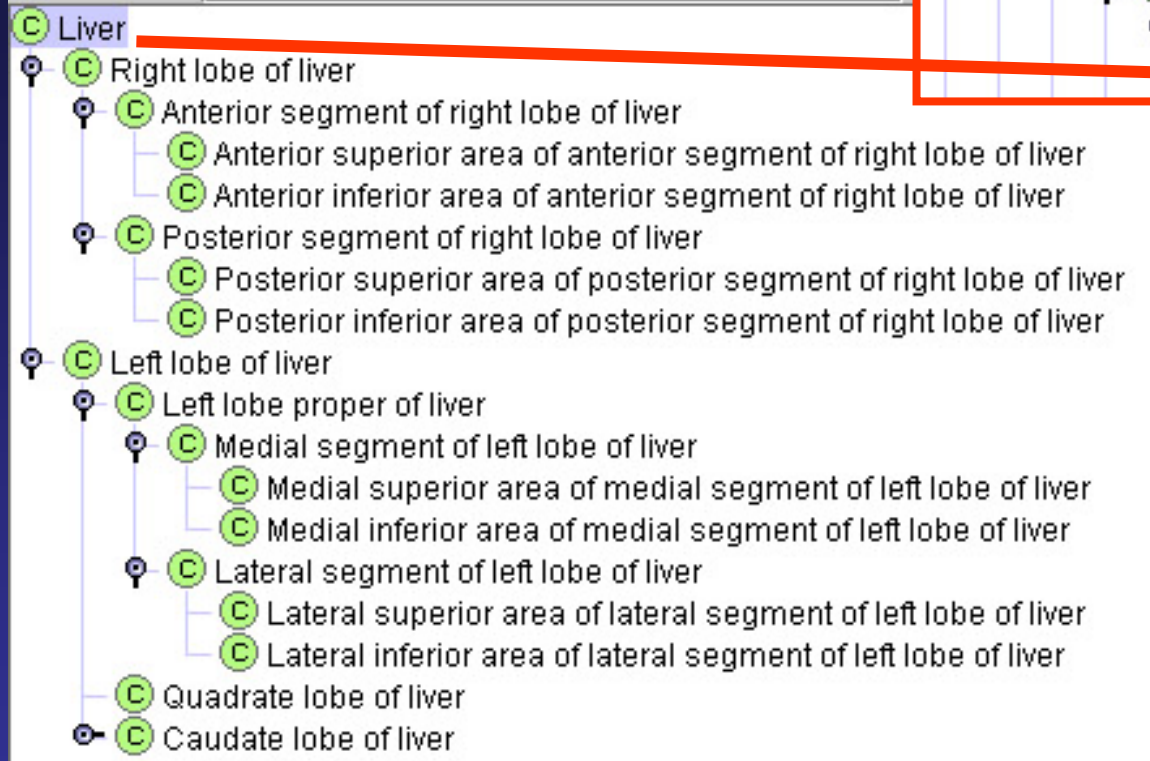


Part_of relation

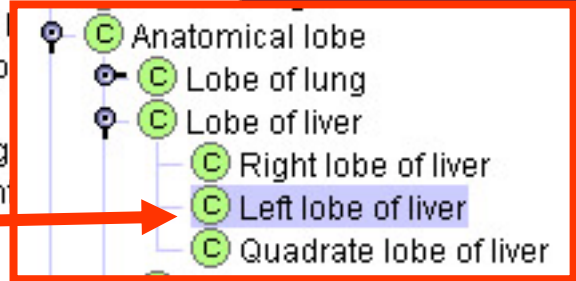
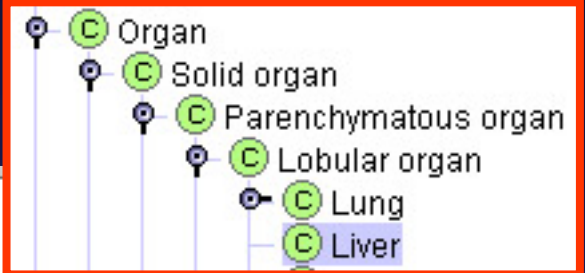
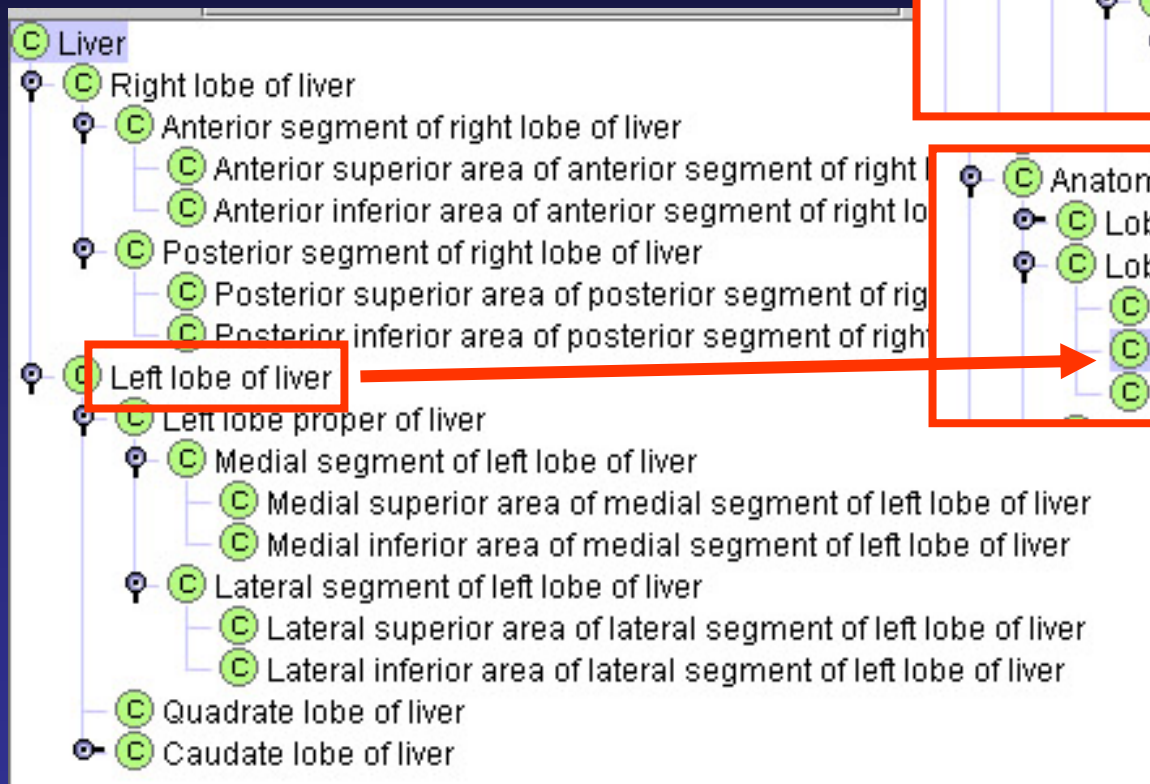




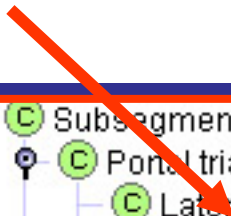
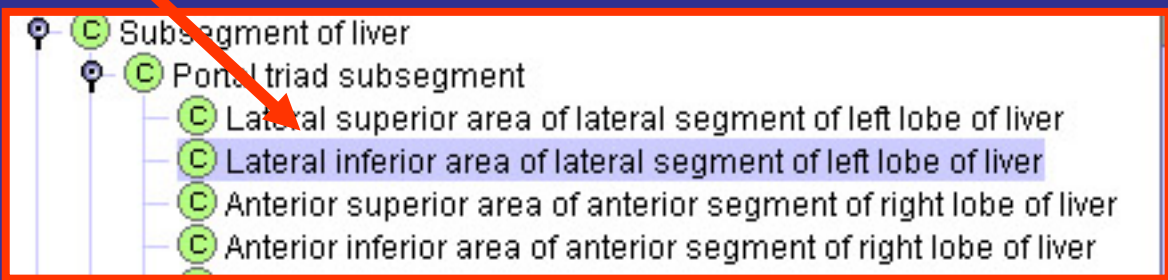
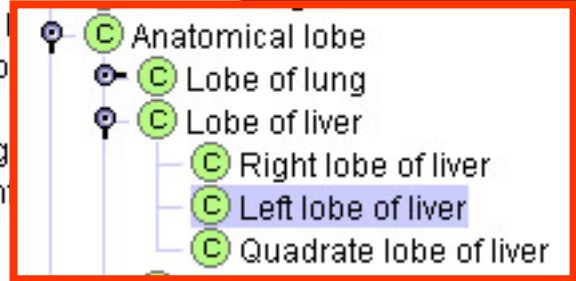
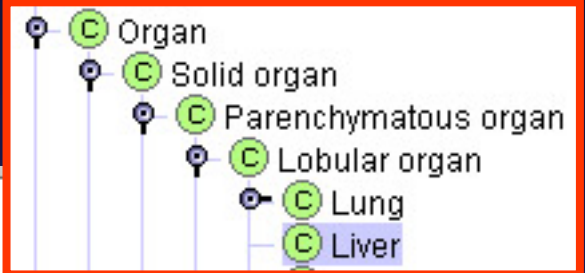
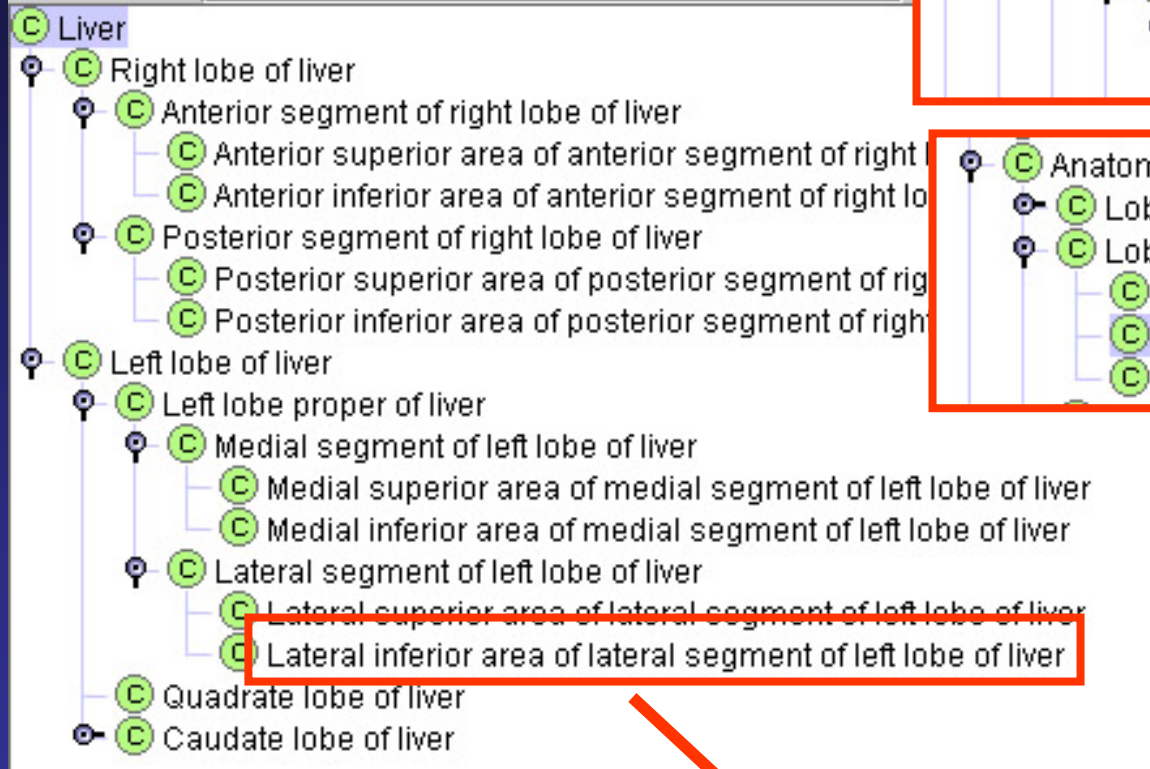
Is_a relation



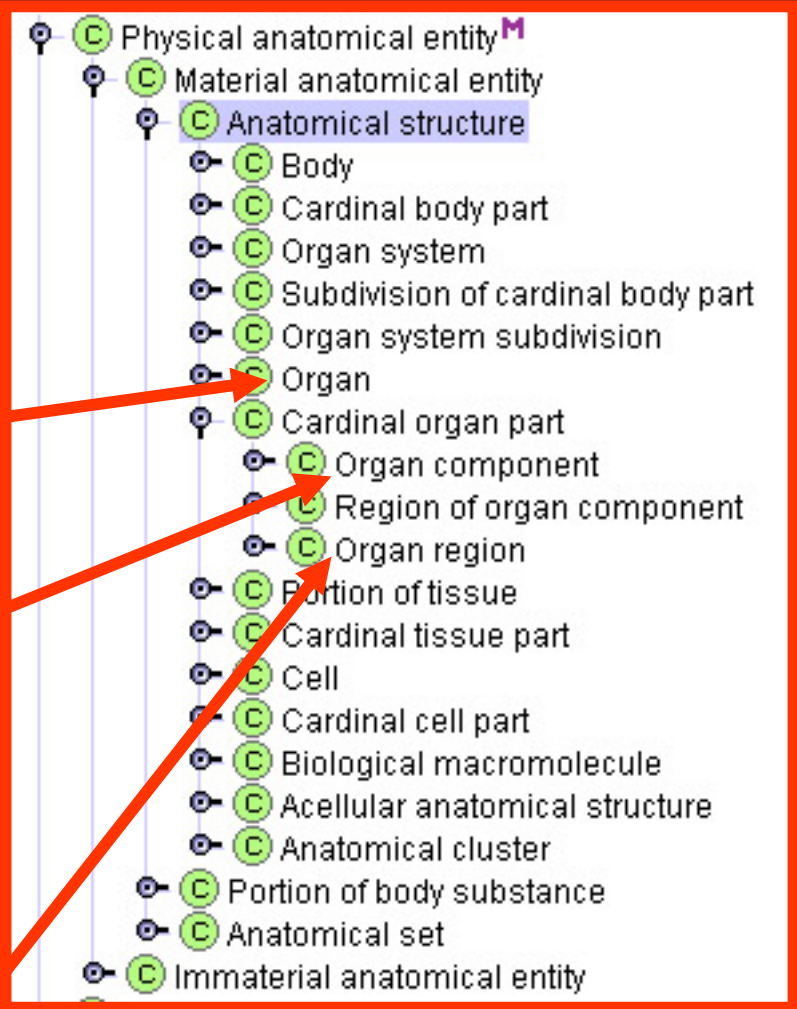
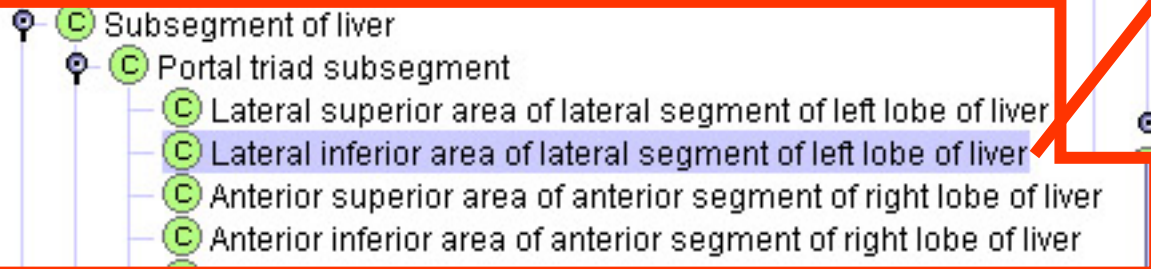
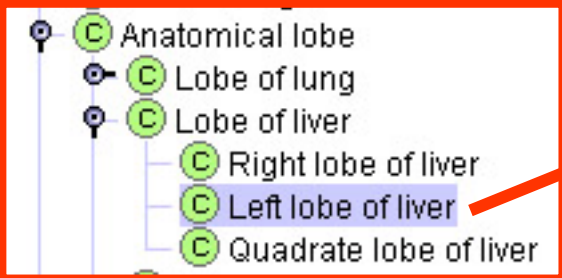
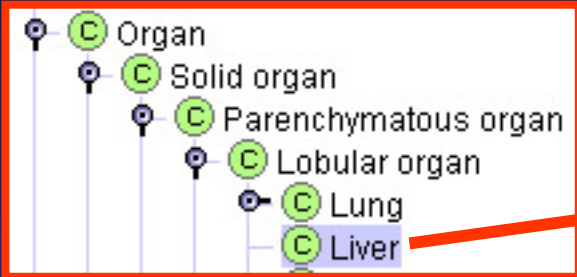
Is_a relation



Is_a relation



Is_a relation



Approach

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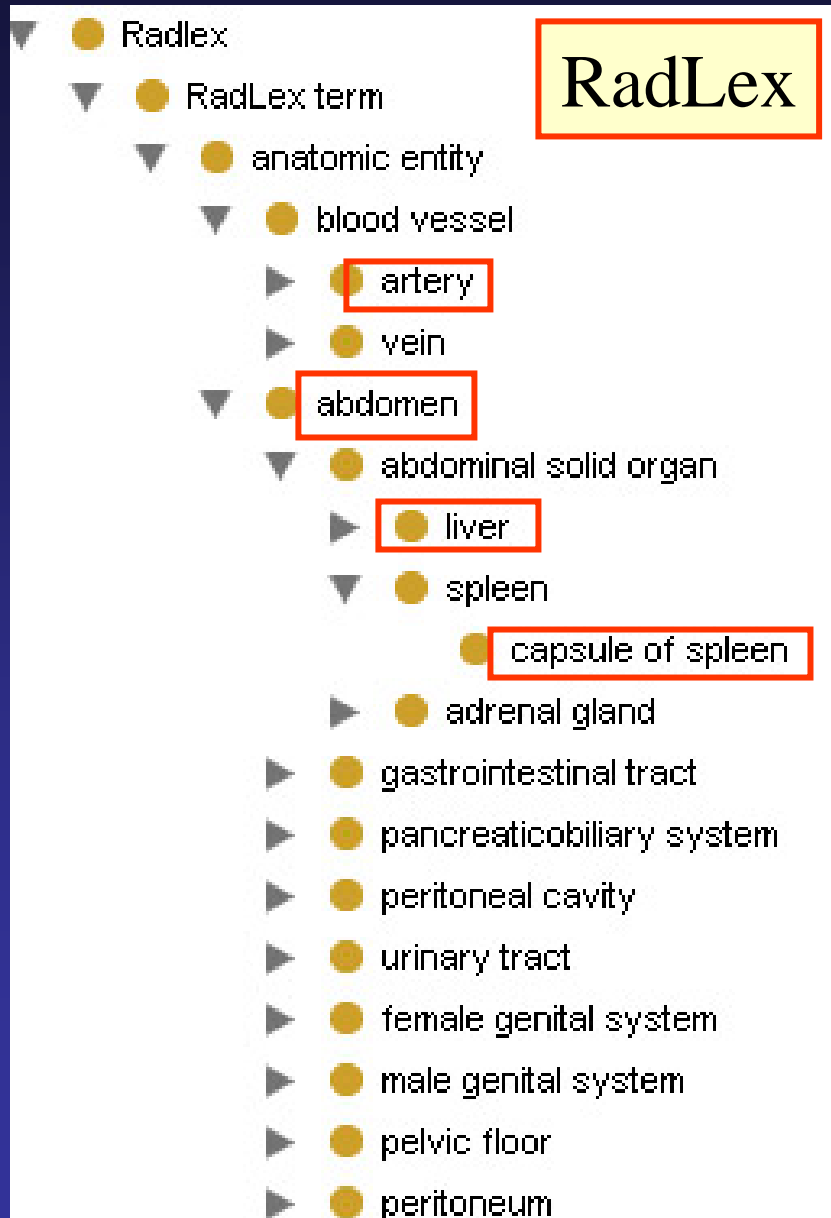
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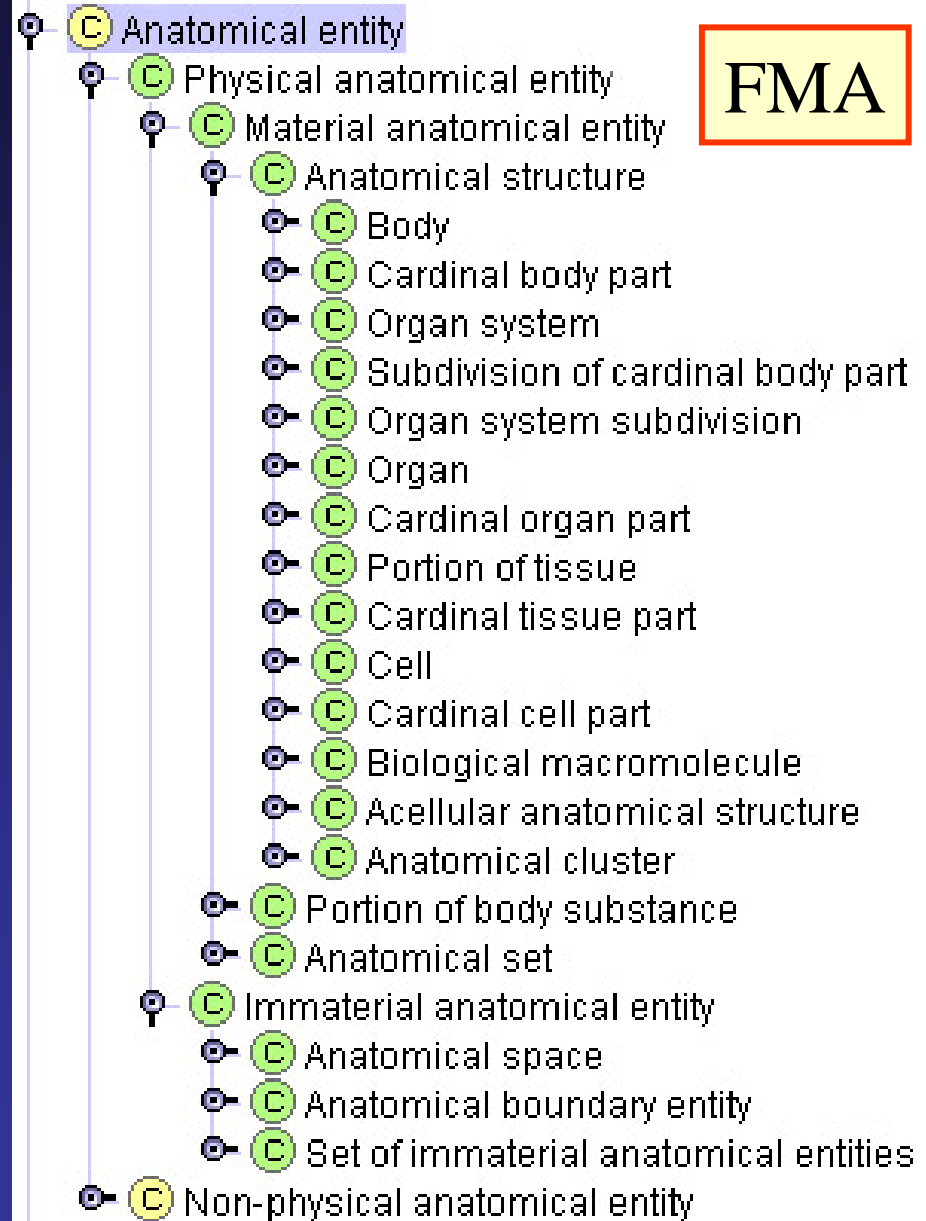
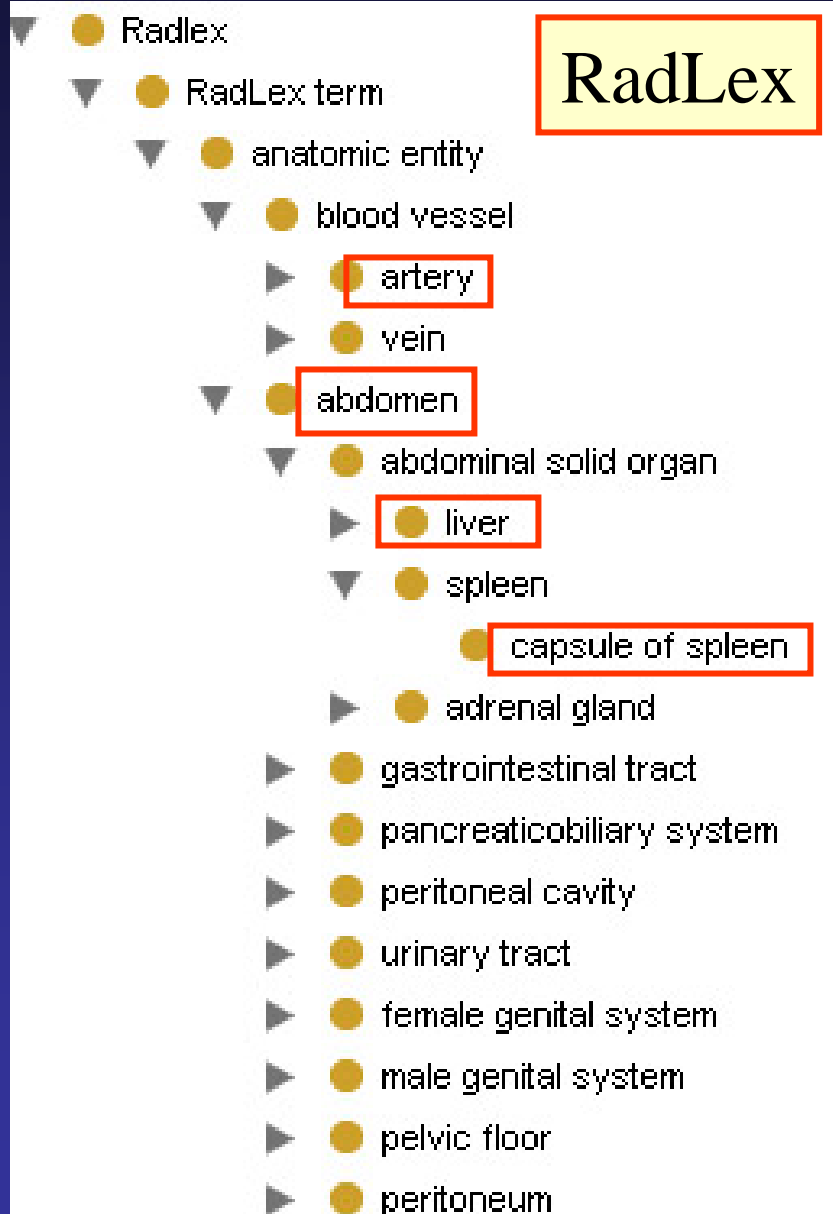
- incorporate into an existing project ontological structure from a reference ontology

RadLex

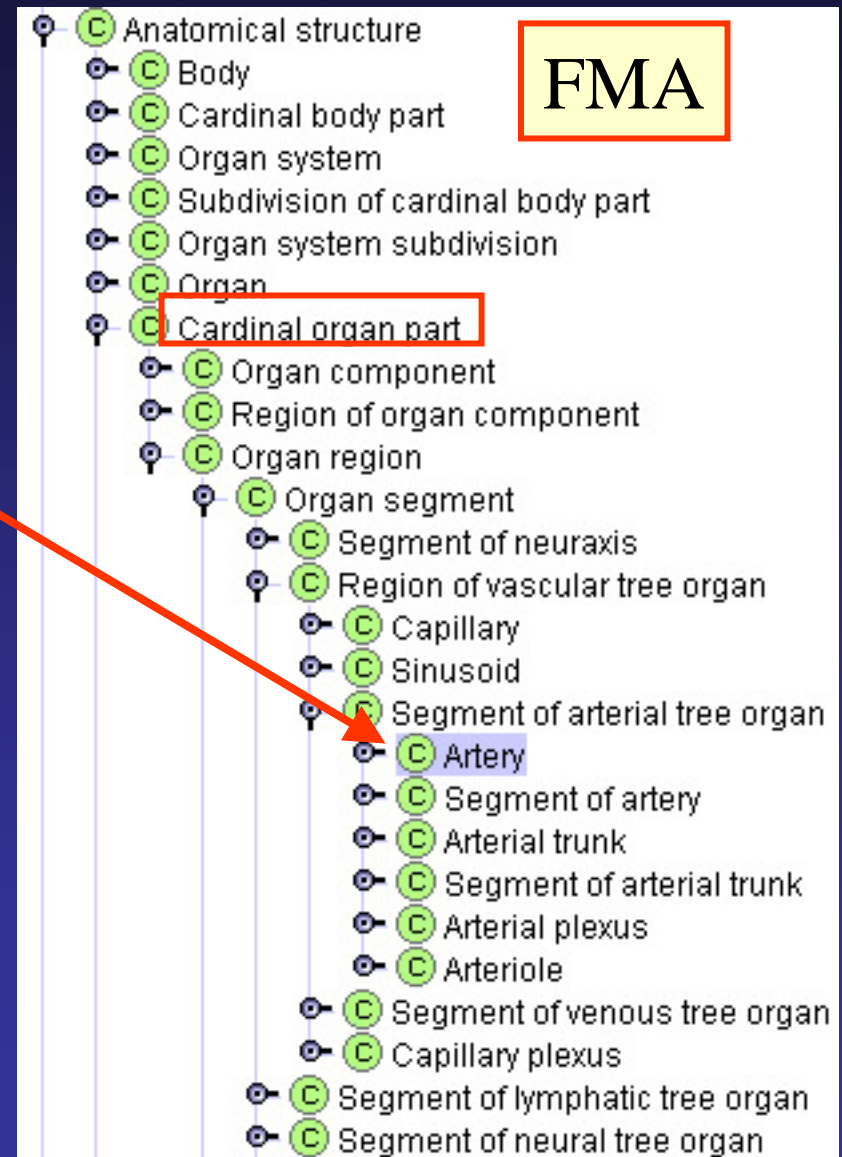
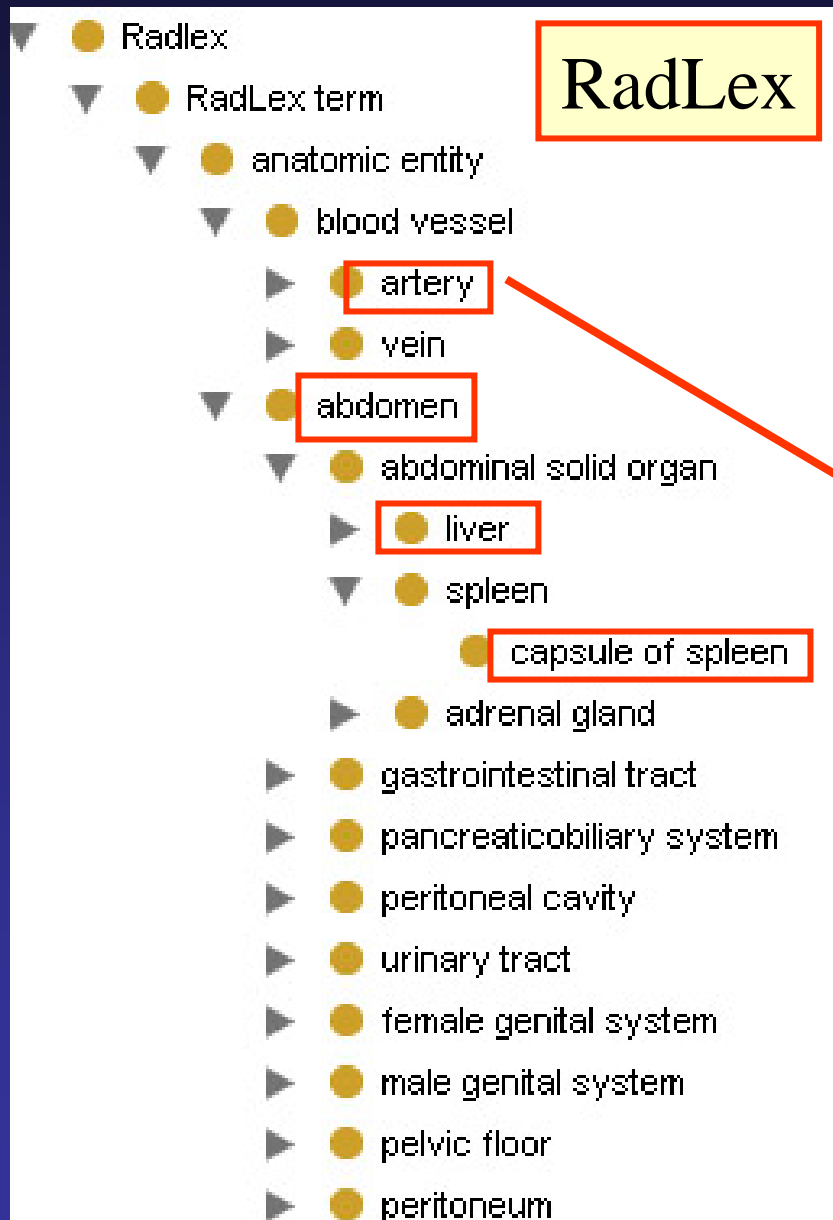
Transform terminology into an ontology



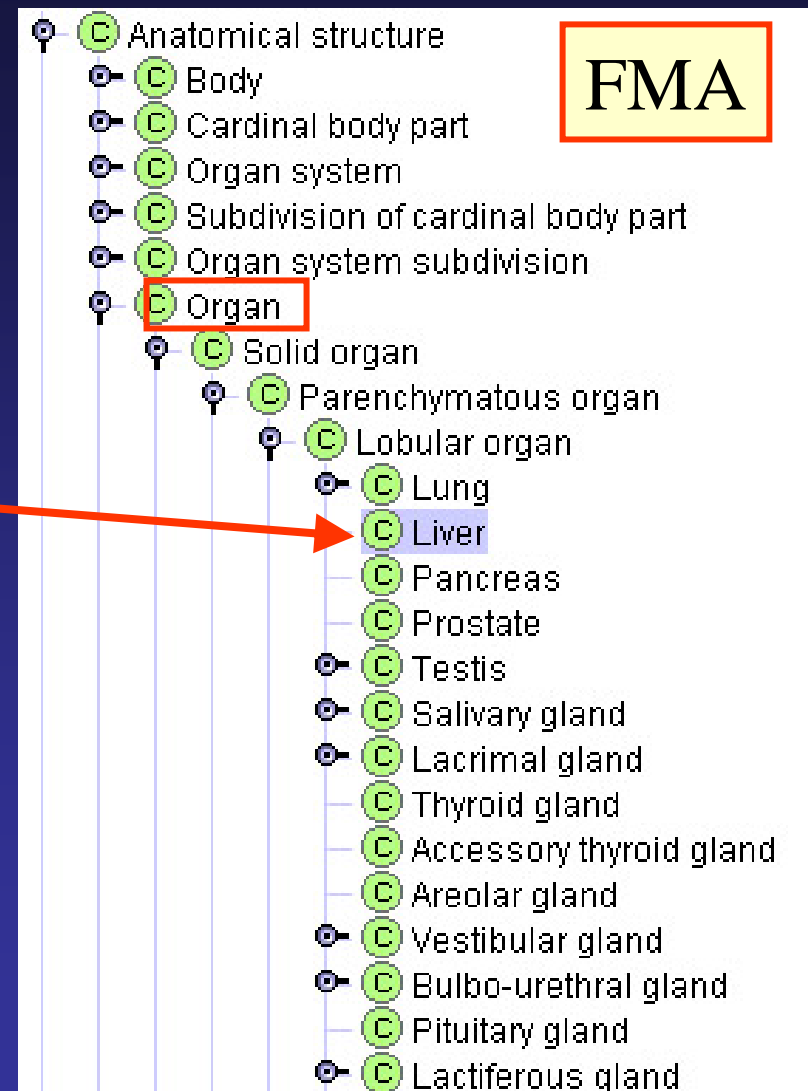
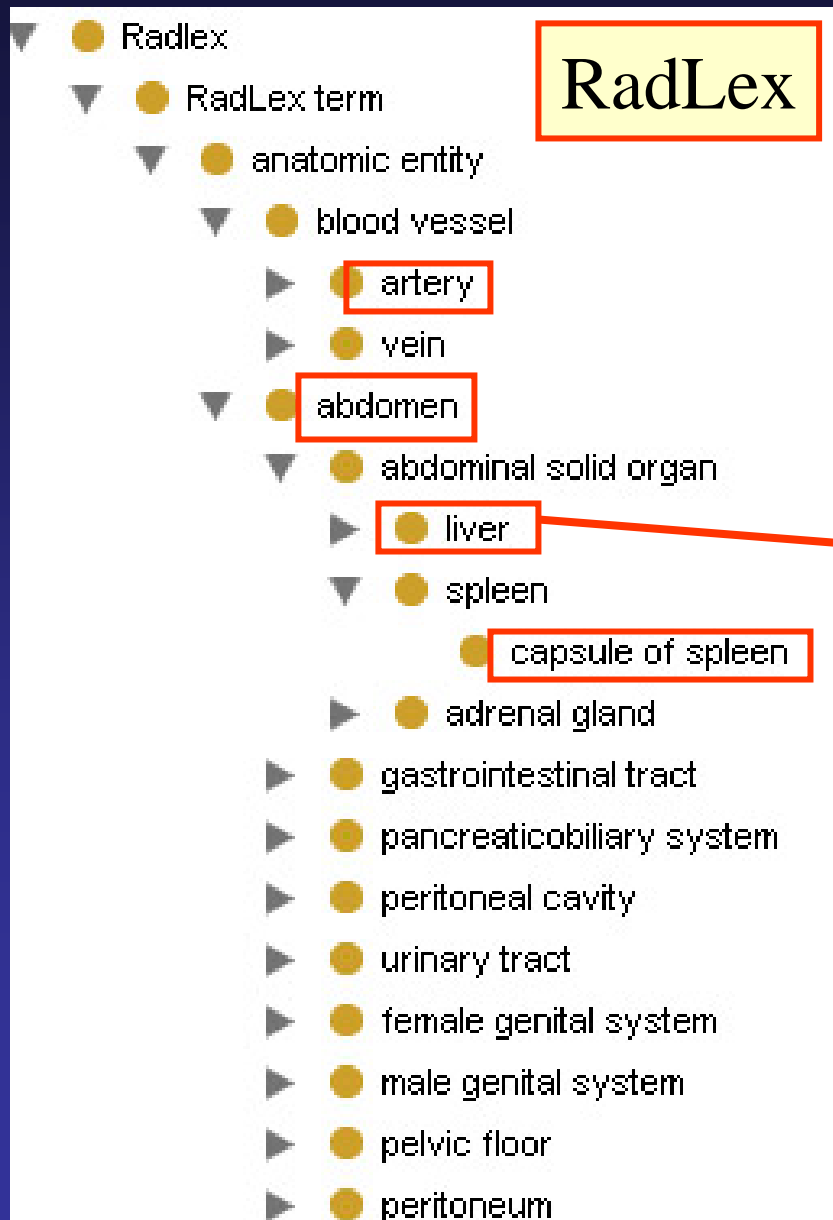
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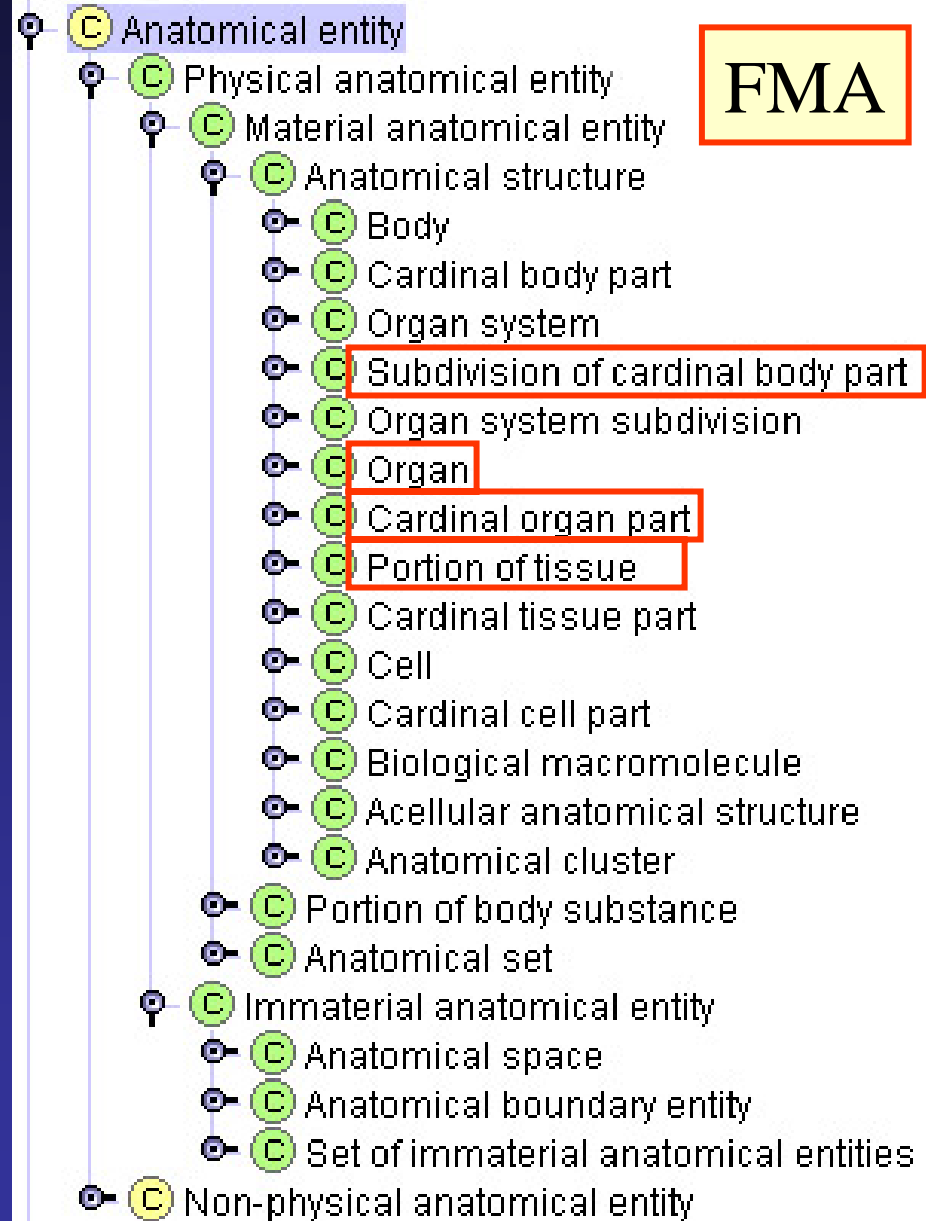
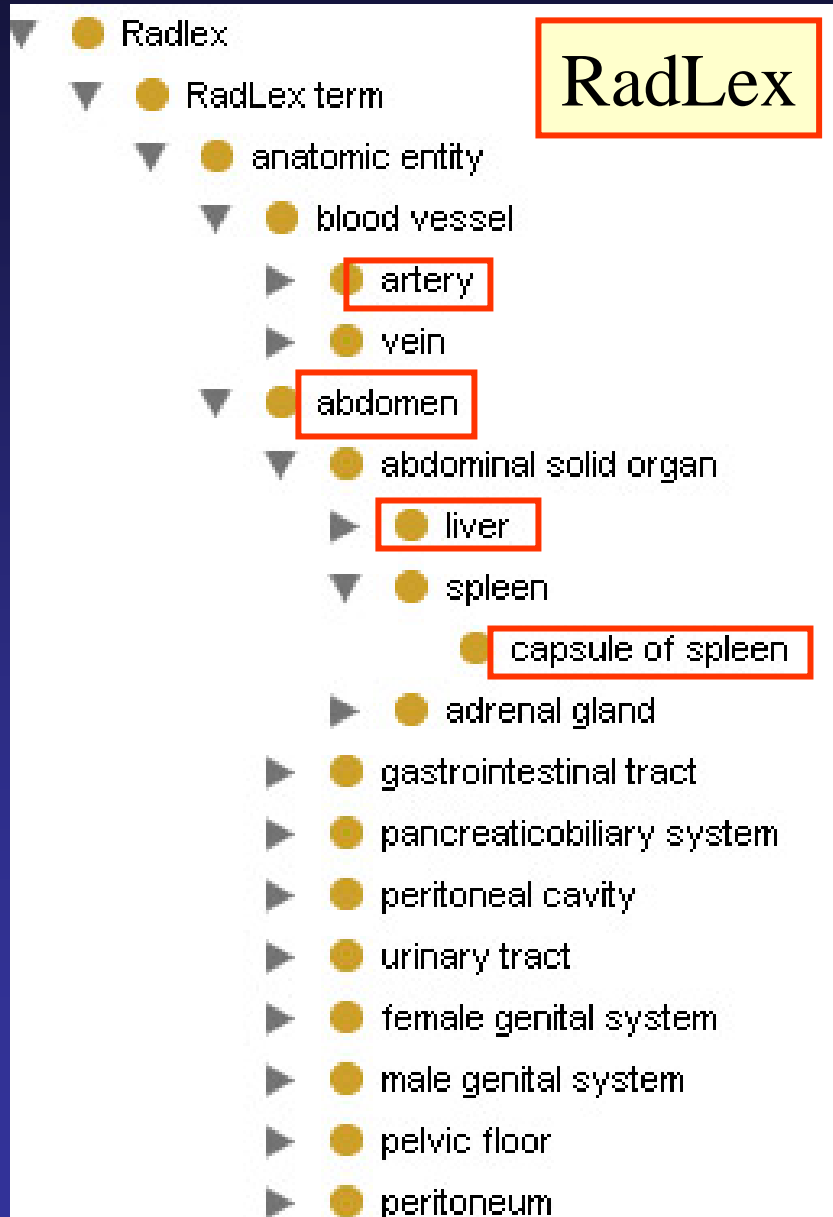
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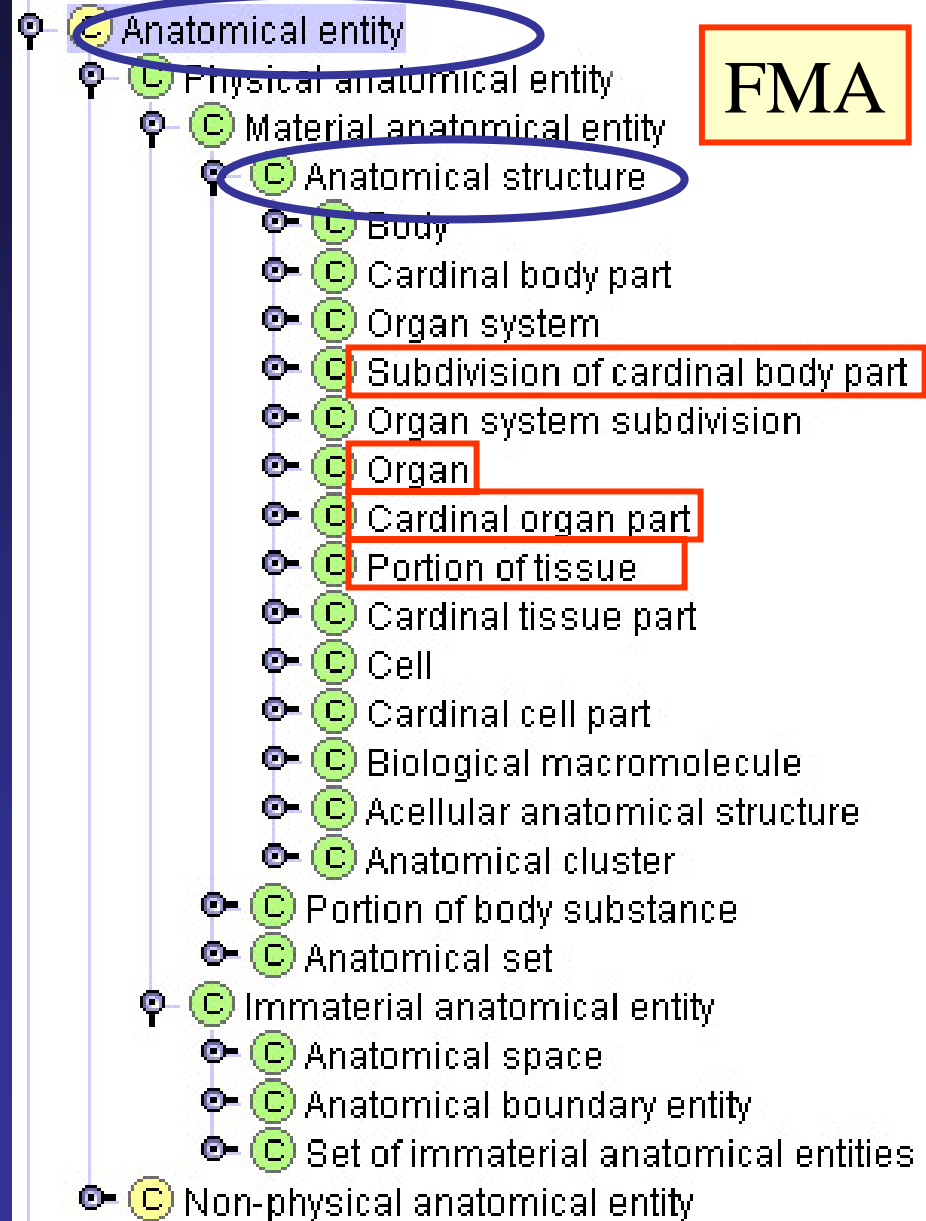
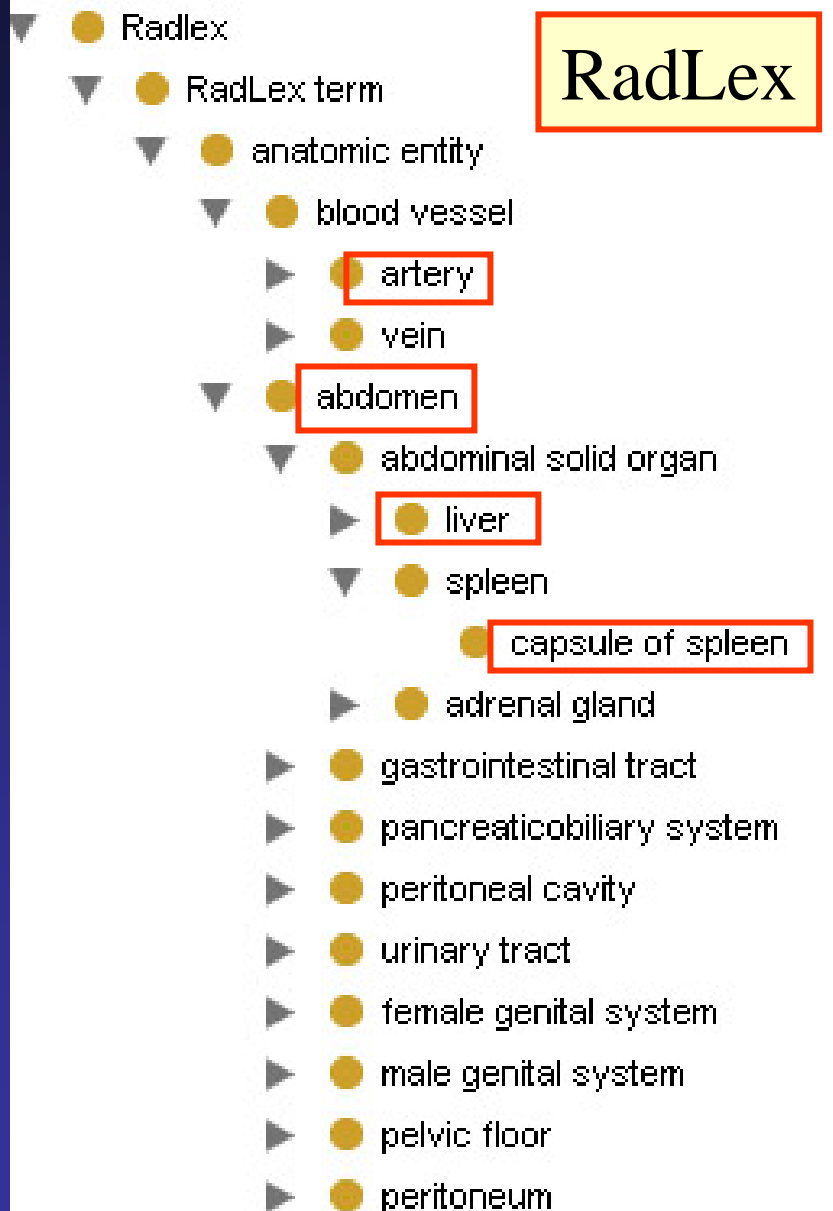
Transform terminology into an ontology



Transform terminology into an ontology



Transform terminology into an ontology

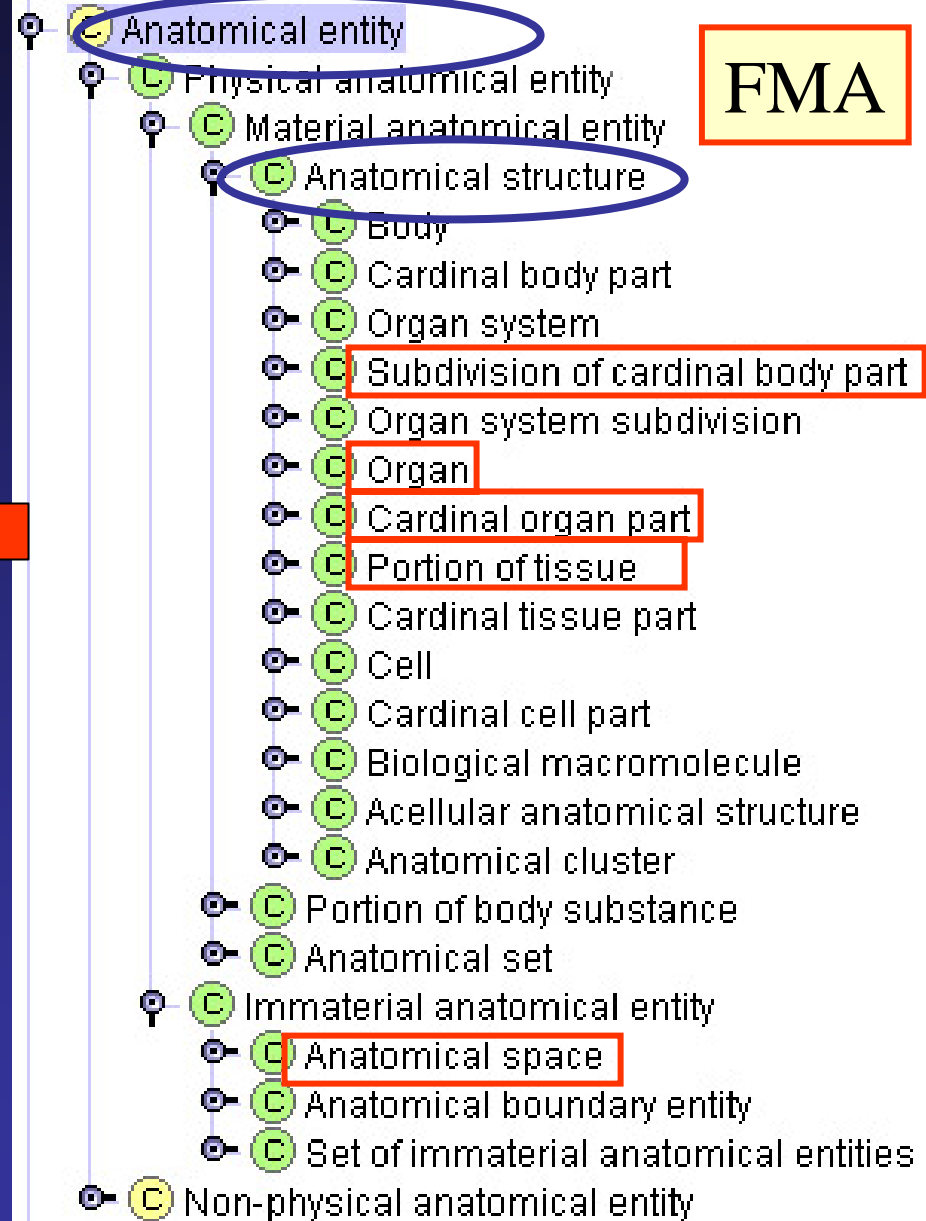


Class taxonomy of FMA-RadLex

- ▼ ● Radlex entity
 - ▼ ● Anatomical entity
 - ▼ ● Anatomical structure
 - ▶ ● Body
 - ▶ ● Cardinal body part
 - ▶ ● Cardinal body part subdivision
 - ▶ ● Organ system
 - ▶ ● Organ system subdivision
 - ▶ ● Organ
 - ▶ ● Cardinal organ part
 - ▶ ● Anatomical cluster
 - ▶ ● Portion of tissue

FMA-RadLex

- ▶ ● Immaterial anatomical entity
 - ▶ ● Anatomical space
 - ▶ ● Set of anatomical spaces
 - ▶ ● Anatomical surface
 - ▶ ● Anatomical line
- ▶ ● body substance



Methodology

Operations

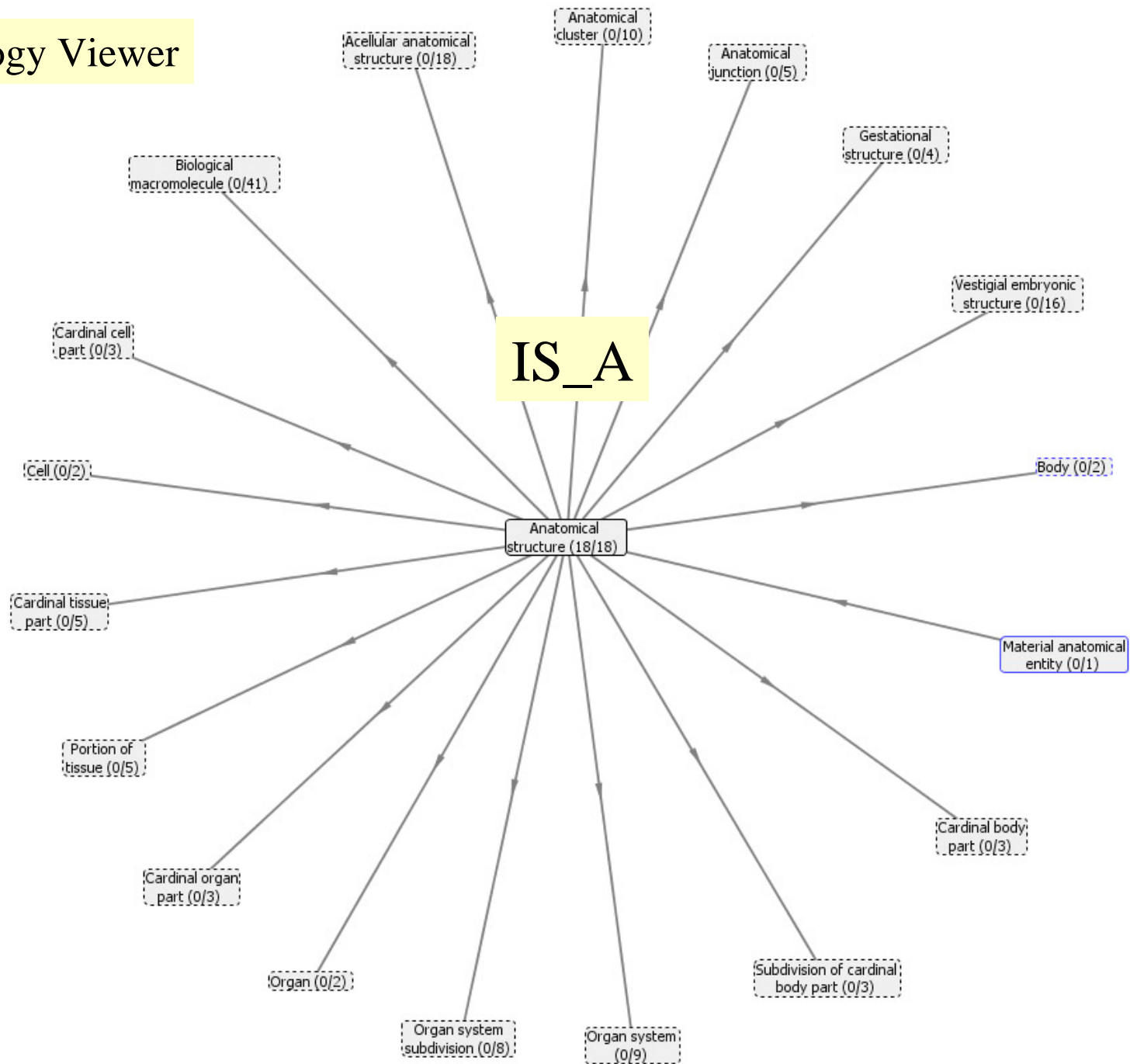
Deletion of links

Addition of links

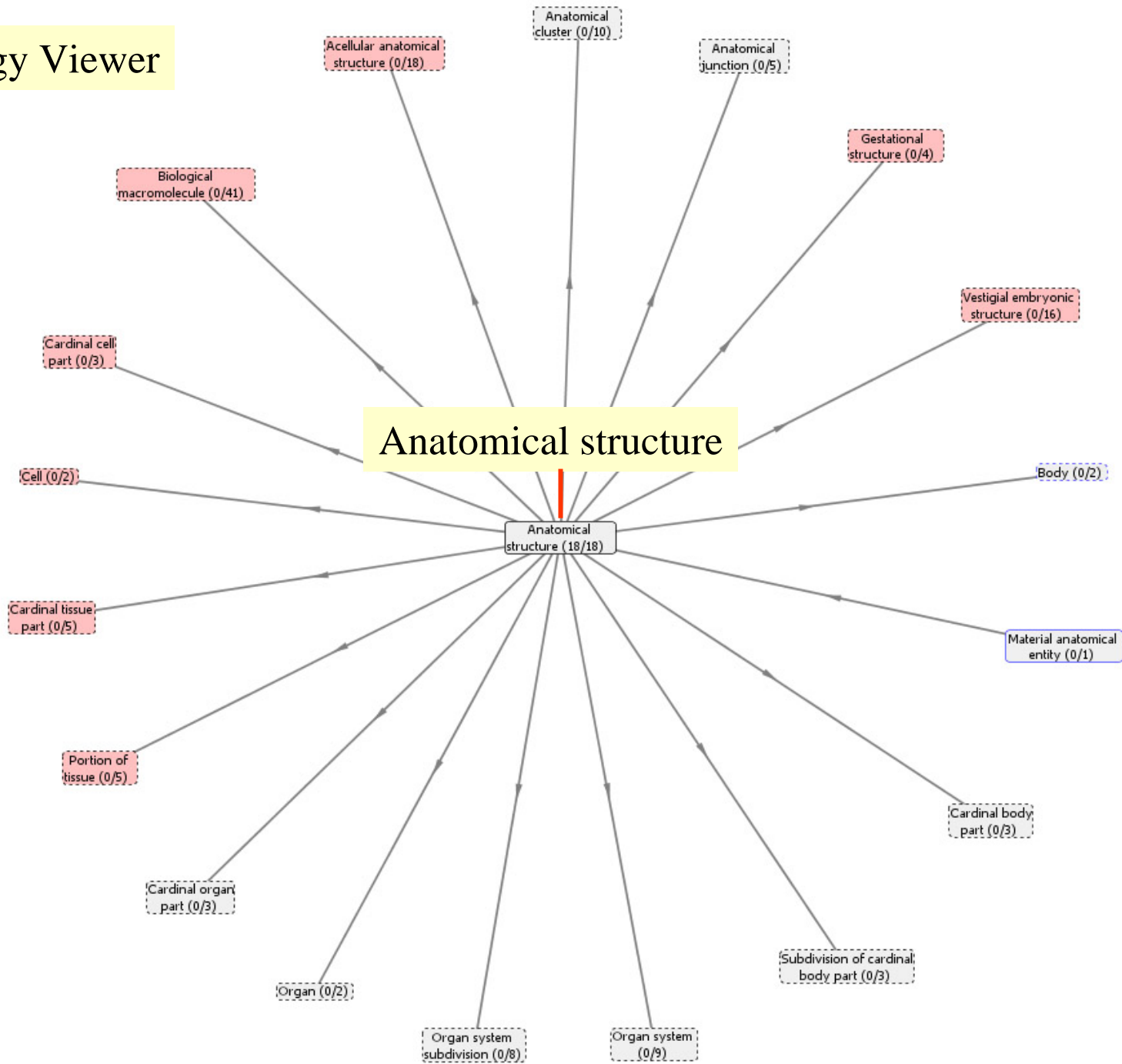
existing classes

new classes

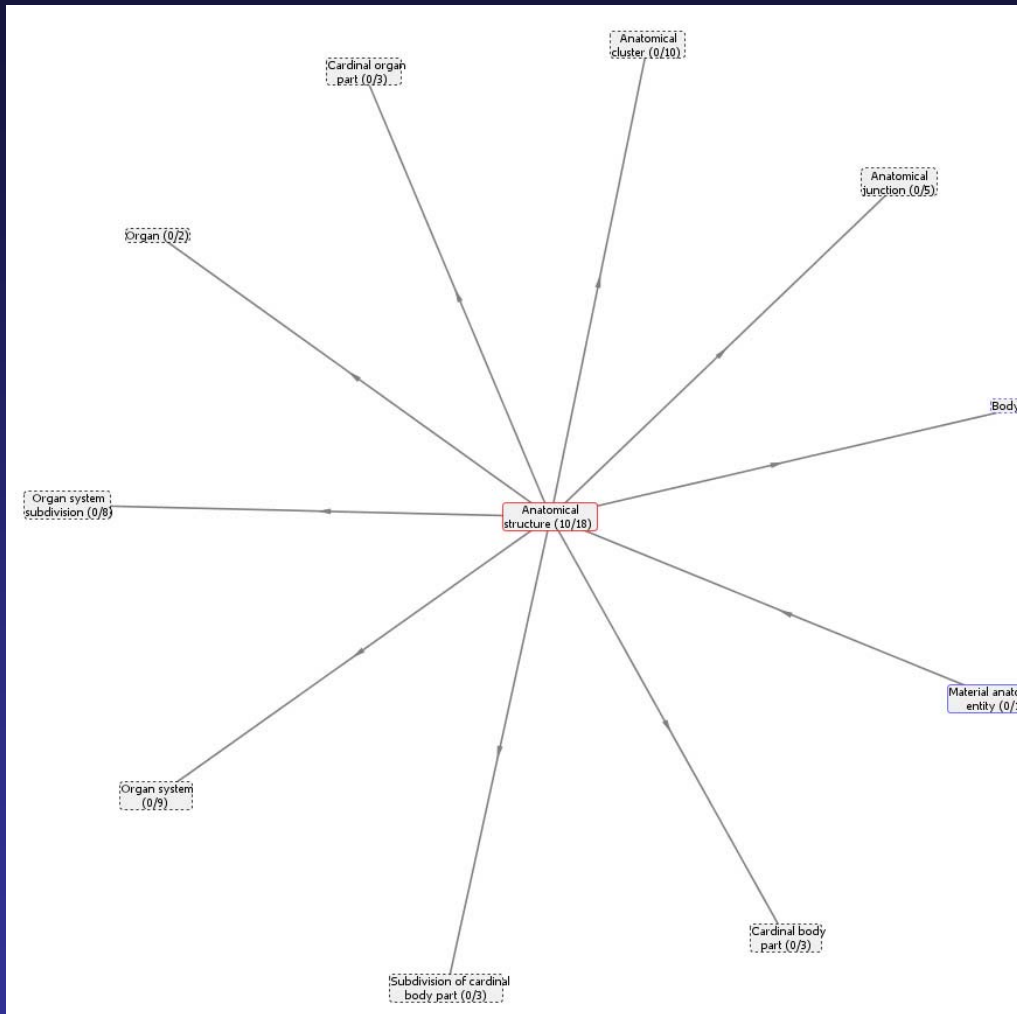
Ontology Viewer



Ontology Viewer

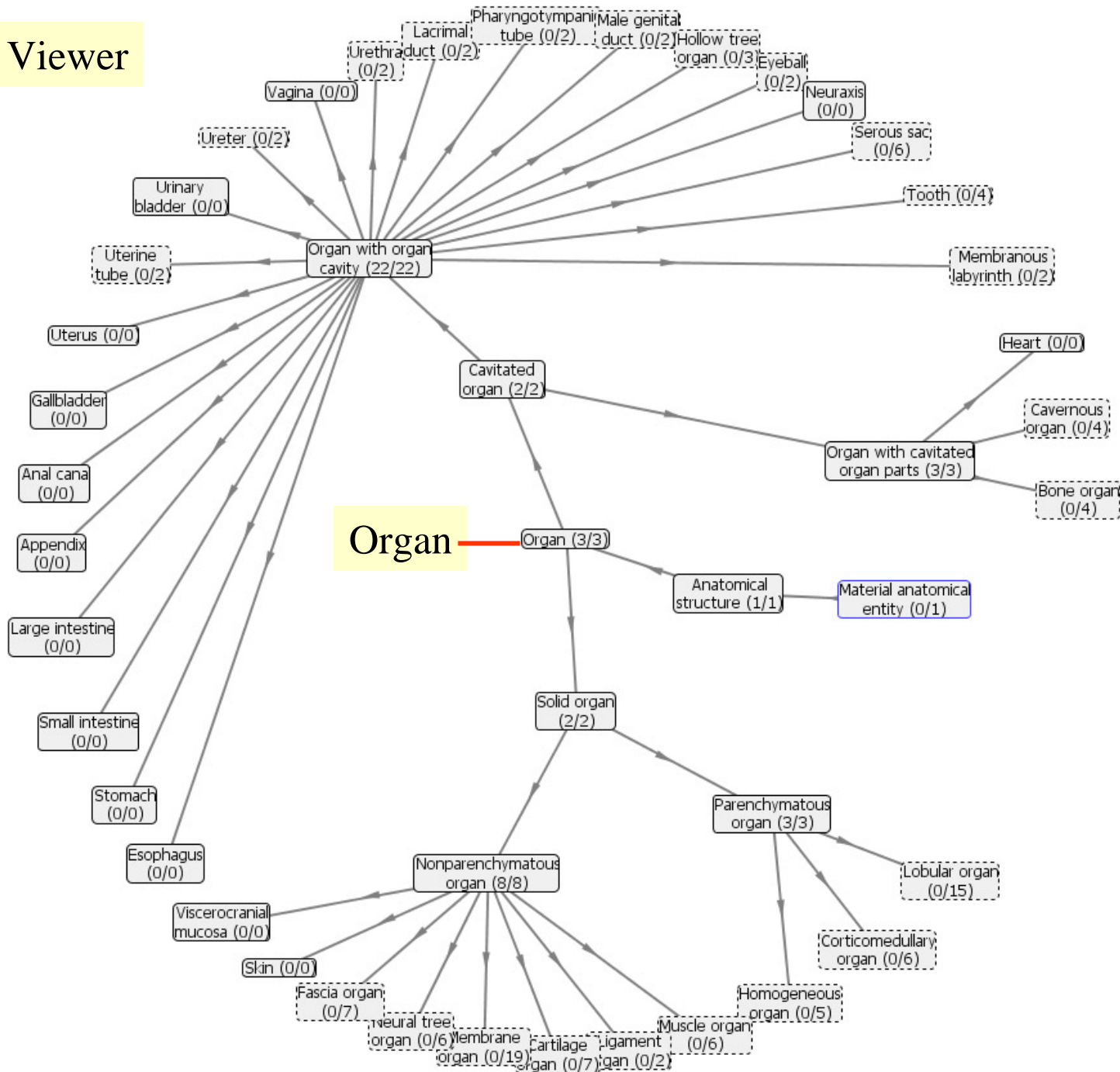


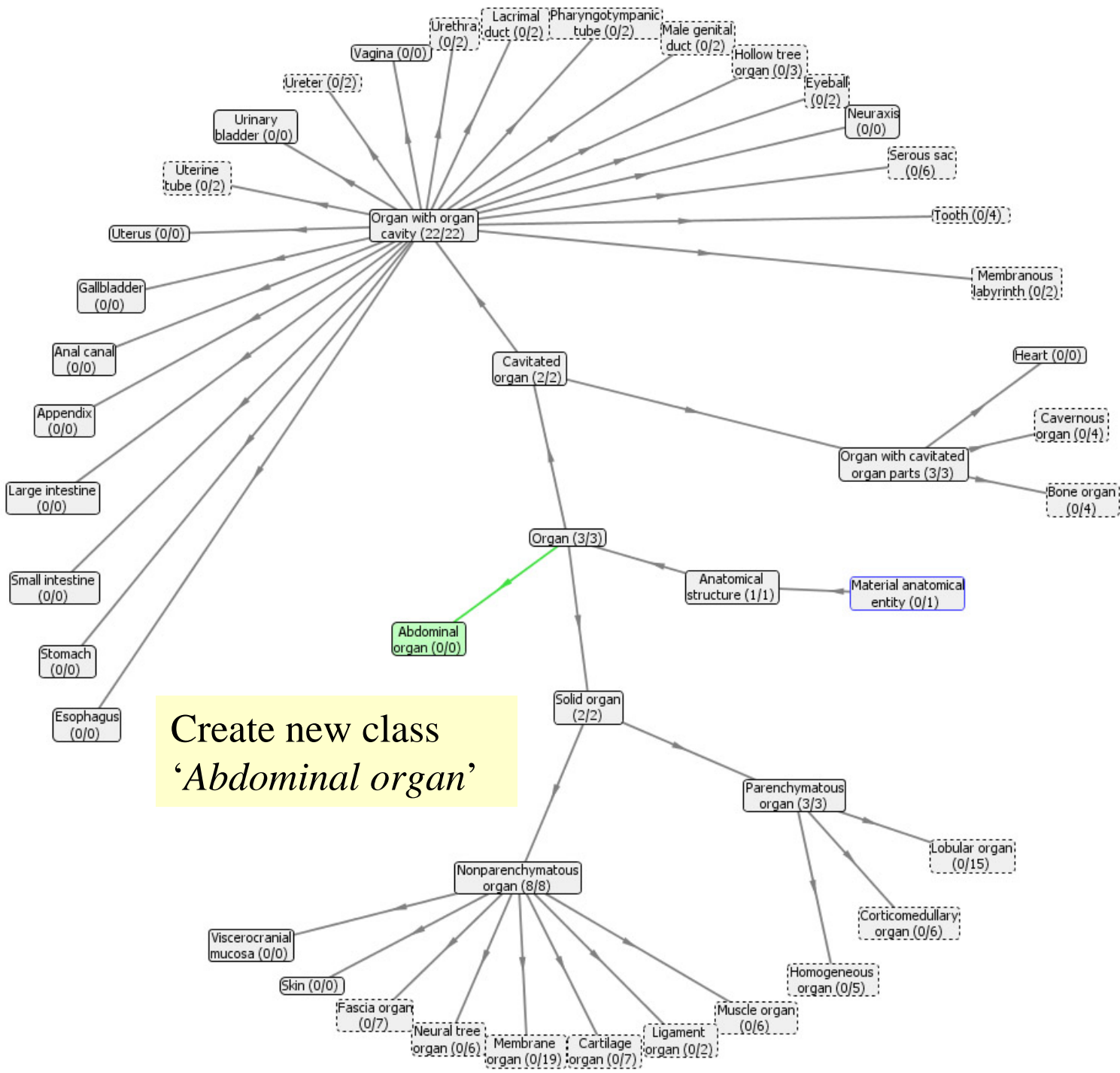
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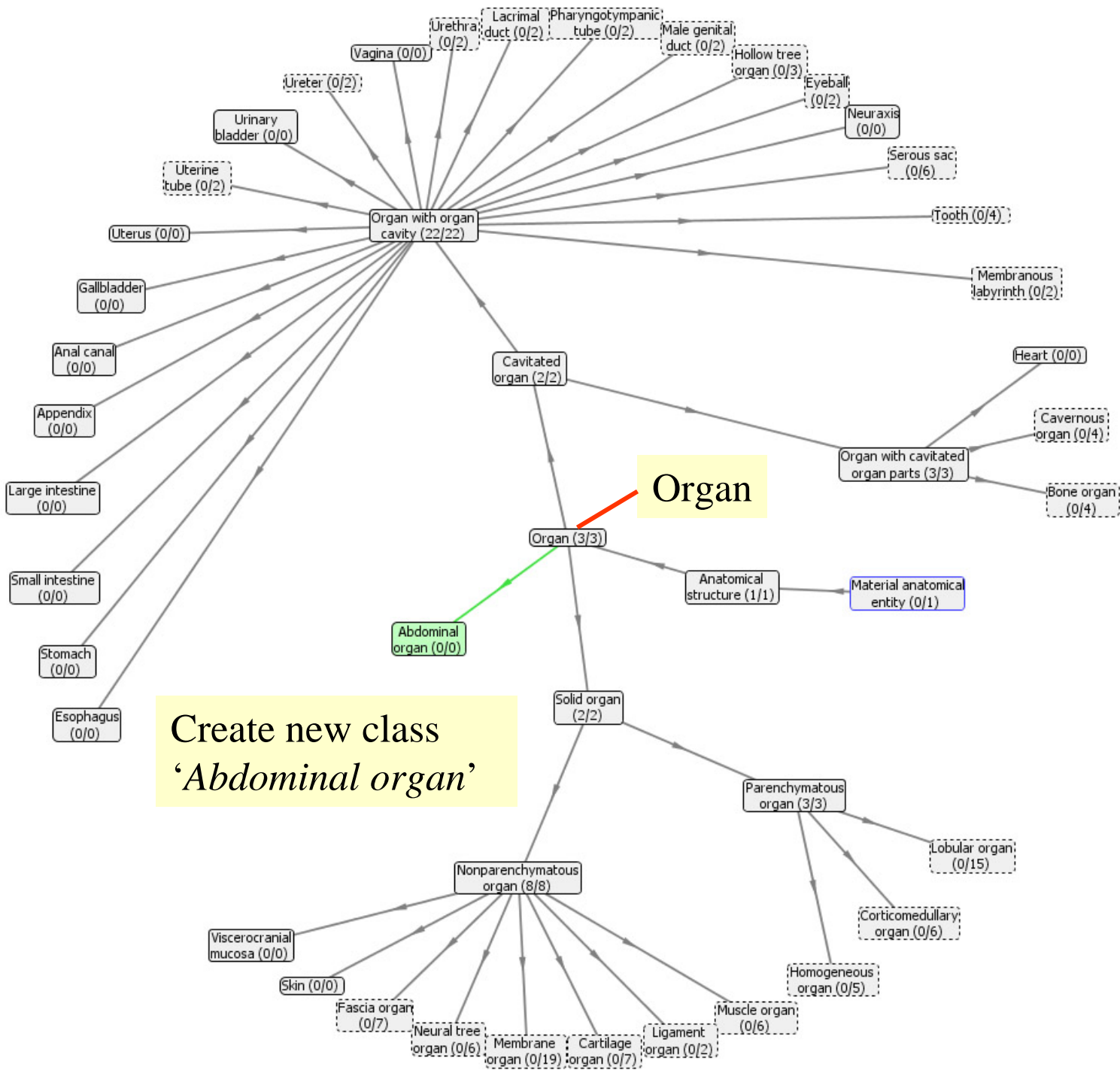
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 - ▶ ● Body
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 - ▶ ● Organ system subdivision
 - ▶ ● Organ
 - ▶ ● Cardinal organ part
 - ▶ ● Anatomical cluster
 - ▶ ● Portion of tissue
 - ▶ ● Anatomical junction
 - ▶ ● Anatomical set
 - ▶ ● Immaterial anatomical entity
 - ▶ ● finding
 - ▶ ● modifier
 - ▶ ● treatment
 - ▶ ● relationship
 - ▶ ● teaching attribute
 - ▶ ● image quality
 - ▶ ● image acquisition, processing, and display
 - ▶ ● uncertainty

Ontology Viewer

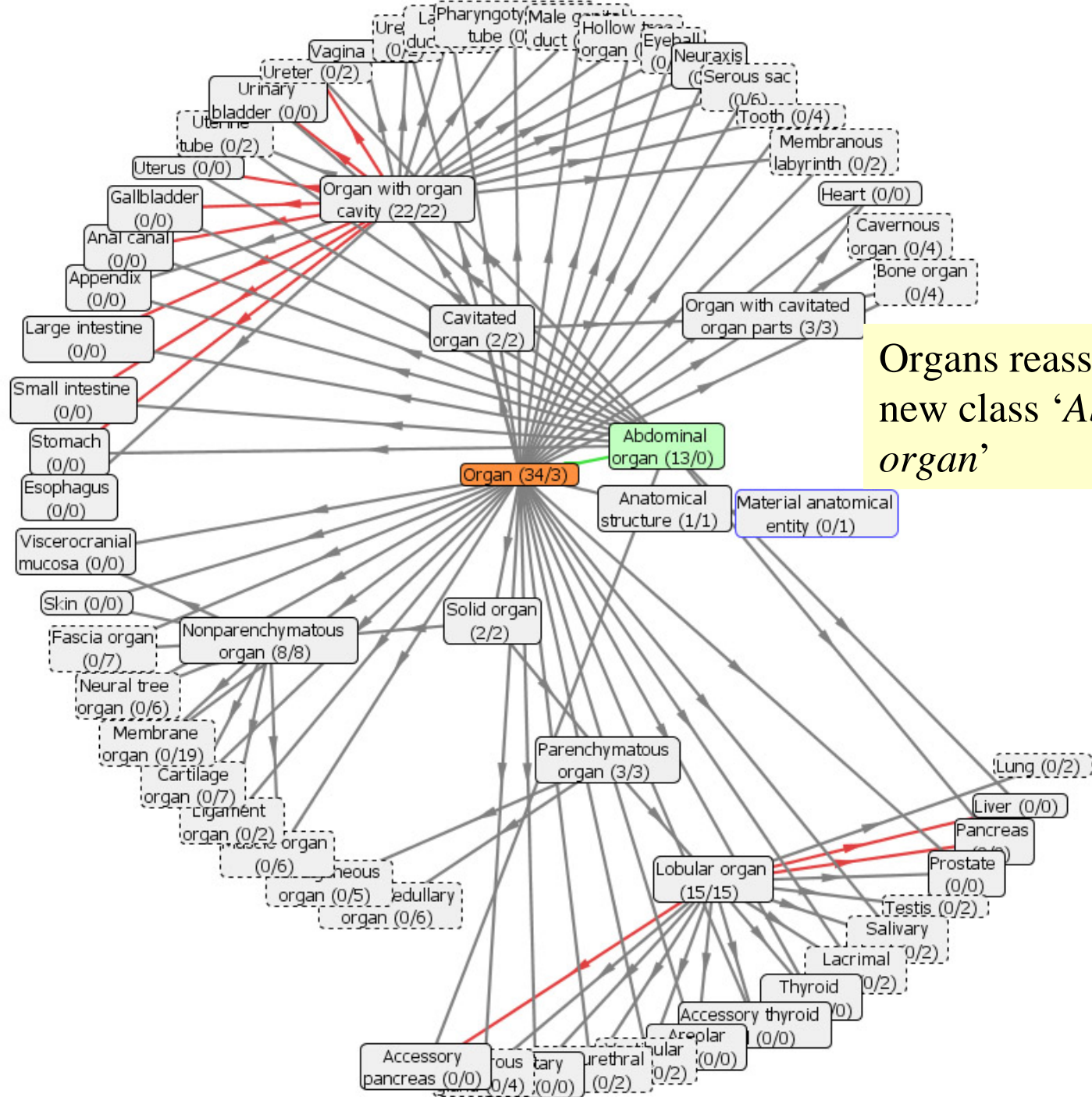




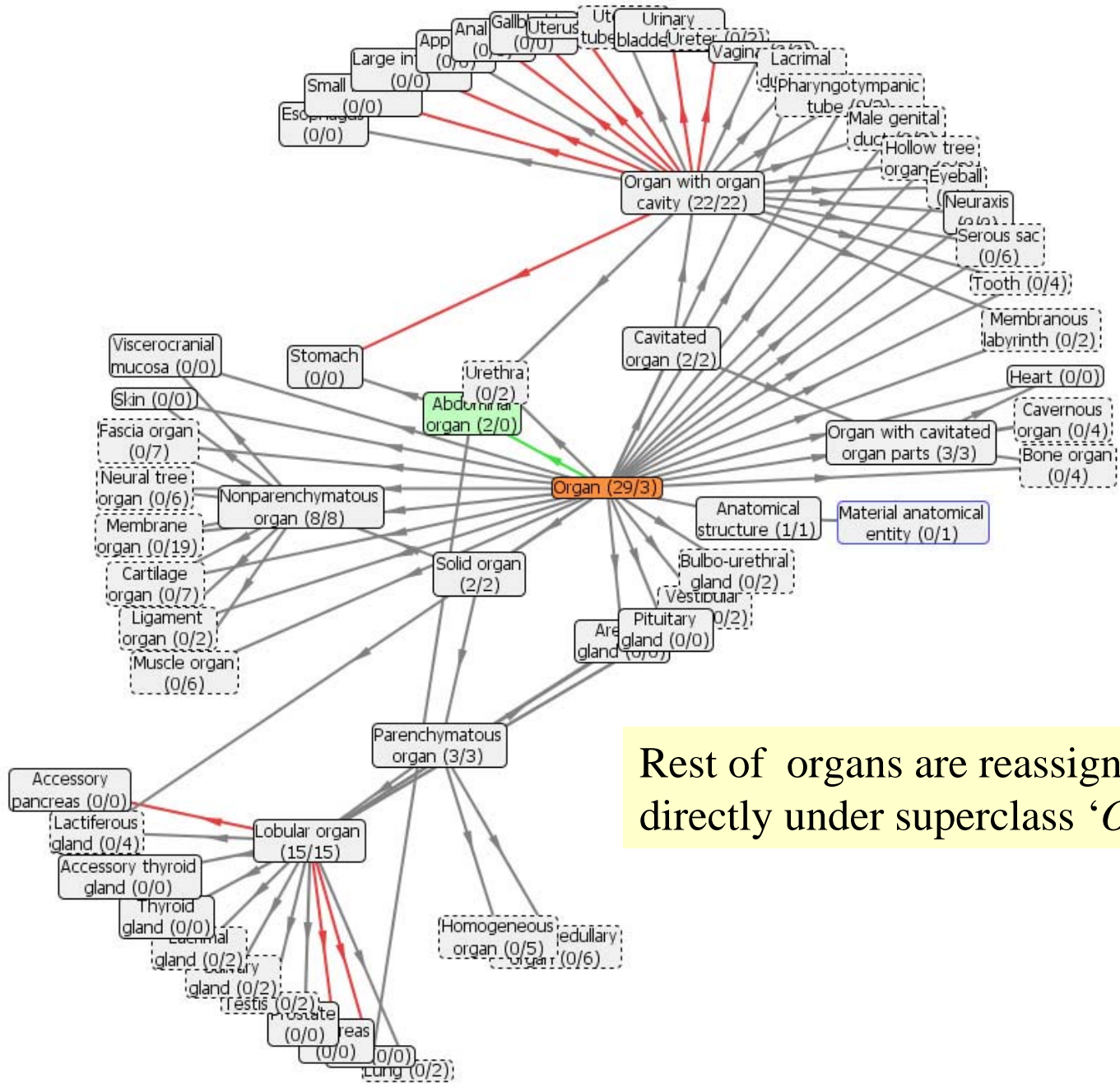
Create new class
'Abdominal organ'



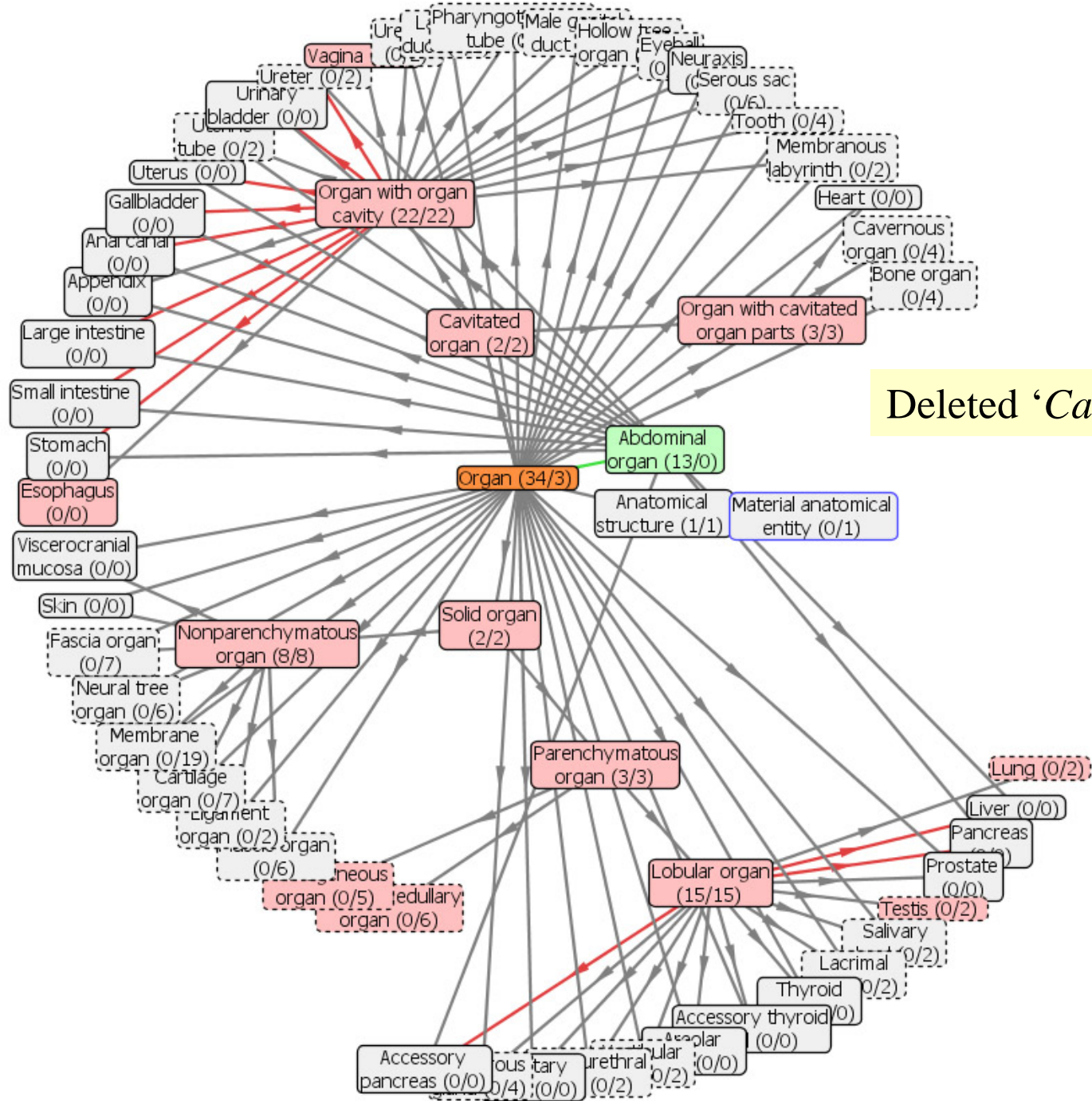
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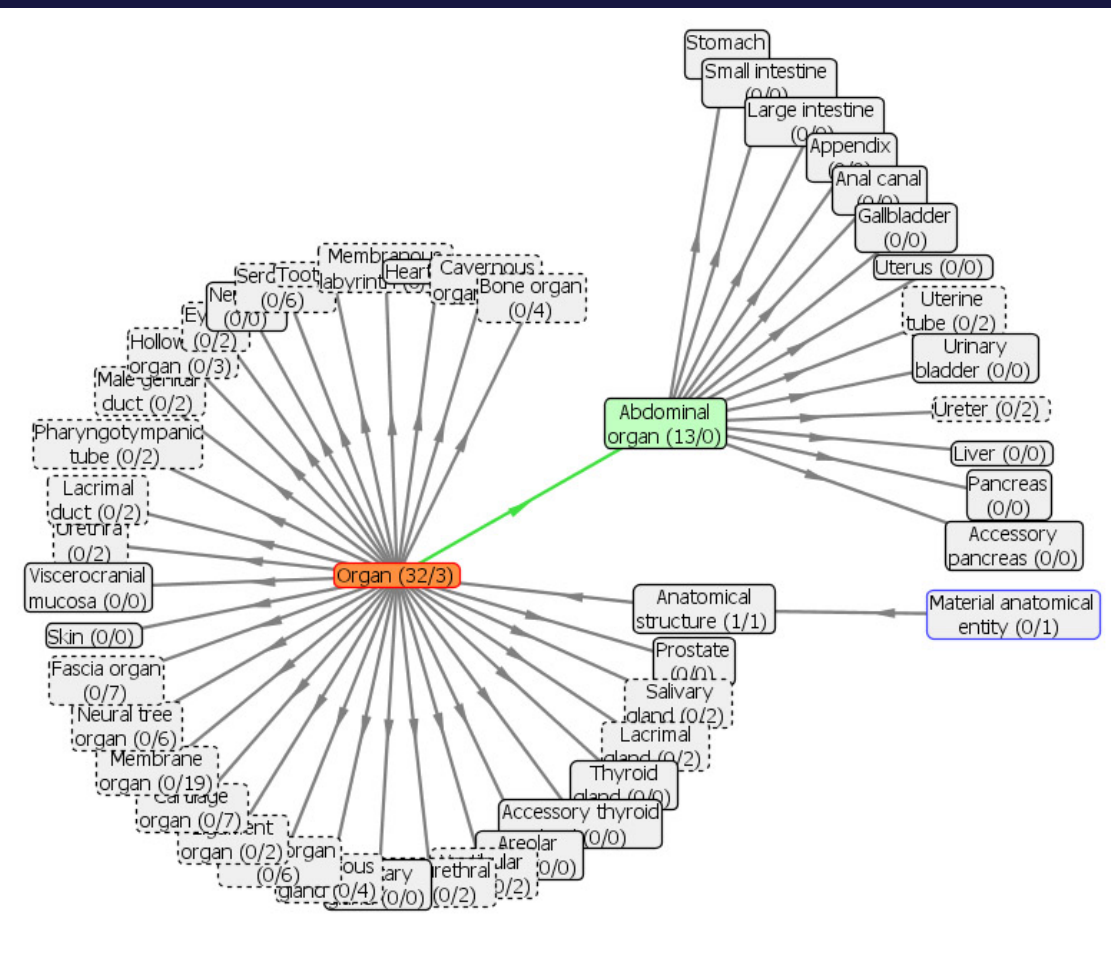
Organs reassigned to new class 'Abdominal organ'



Rest of organs are reassigned directly under superclass 'Organ'



Deleted 'Cavitated Organ'



- ▼ ● Organ
- ▶ ● heart
- ▶ ● lung
- ▼ ● abdominal solid organ
- liver
- spleen
- adrenal gland
- pancreas
- ▶ ● ovary
- ▶ ● prostate
- ▶ ● kidney
- ▶ ● Bone organ
- ▶ ● Muscle organ
- ▶ ● Ligament organ
- ▶ ● Neural tree organ

Methodology

Automated/semi-automated query methods

Marianne Shaw:

“Generating application ontologies from reference ontologies”

Paper session S10

Todd Detwiler:

“Regular paths in SparQL: querying the NCI thesaurus”

Paper session S81

Conclusion

New application ontologies can be derived from established and principled ontologies.

Reference ontologies can enhance and augment existing application ontologies or terminologies.

Principles used are extensible and generalizable to other domains.

Reuse and harmonization of ontologies.

