

# W3C Workshop Rule Interoperability

## Use Case

# Interoperating between ontology and rules for identifying brain anatomical structures

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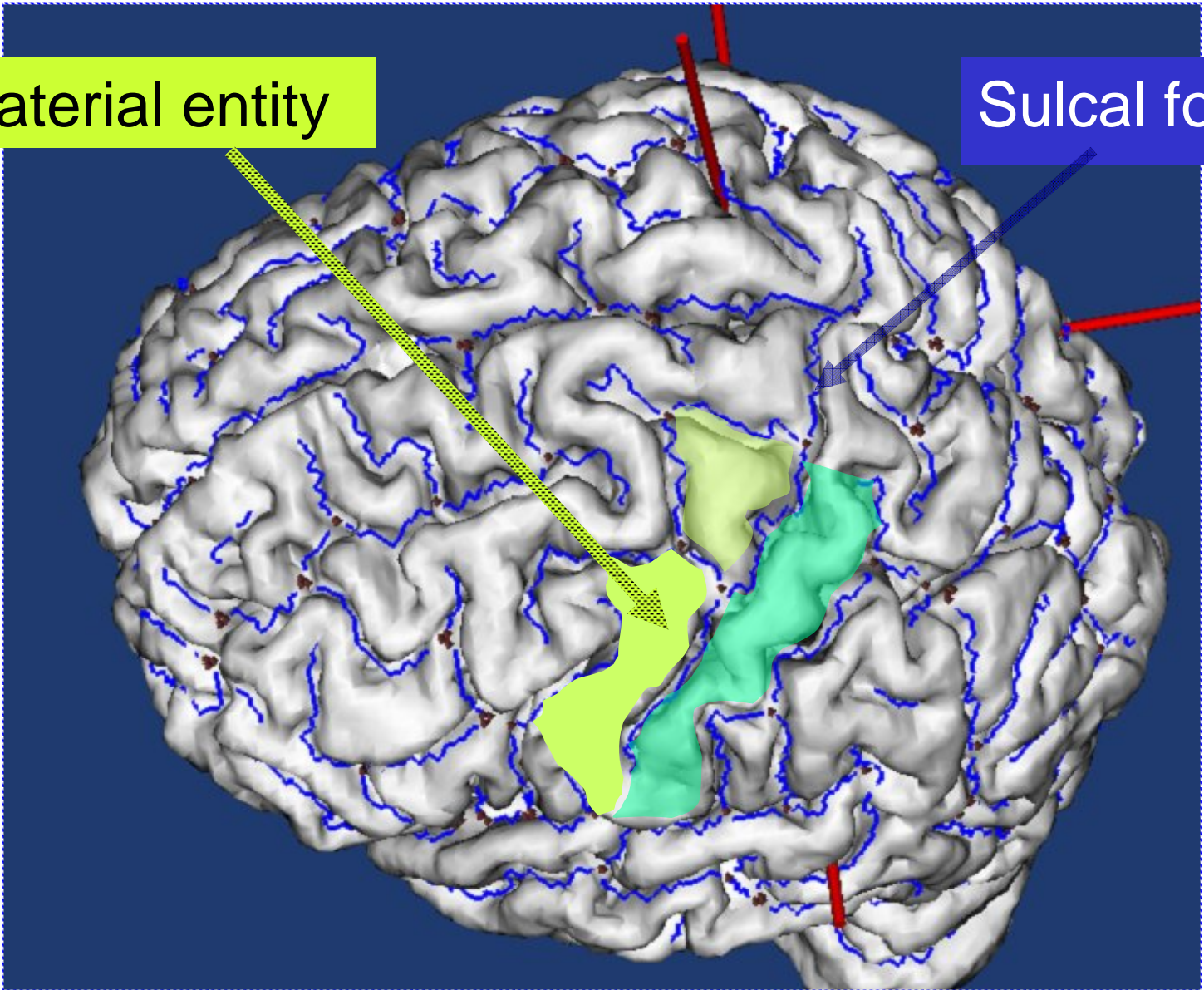
# Sharing and reuse

- Sharing anatomical knowledge
  - Anatomy plays a central role in medicine
    - applications
      - Computer assisted interpretation of 3D MRI images
      - Decision support in (neuro)surgery
      - Intelligent data retrieval in the Semantic Web
- etc.

# Brain

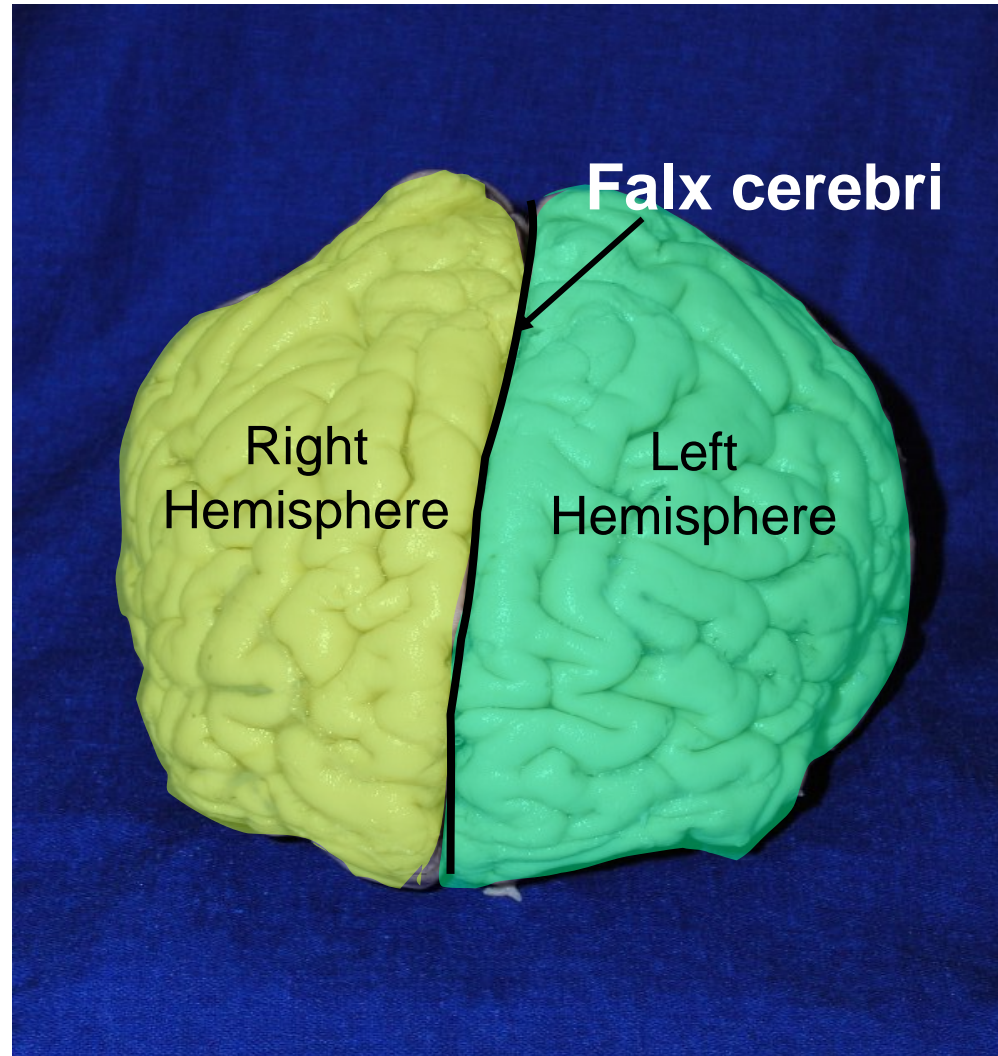
Material entity

Sulcal fold



# Hemispheres

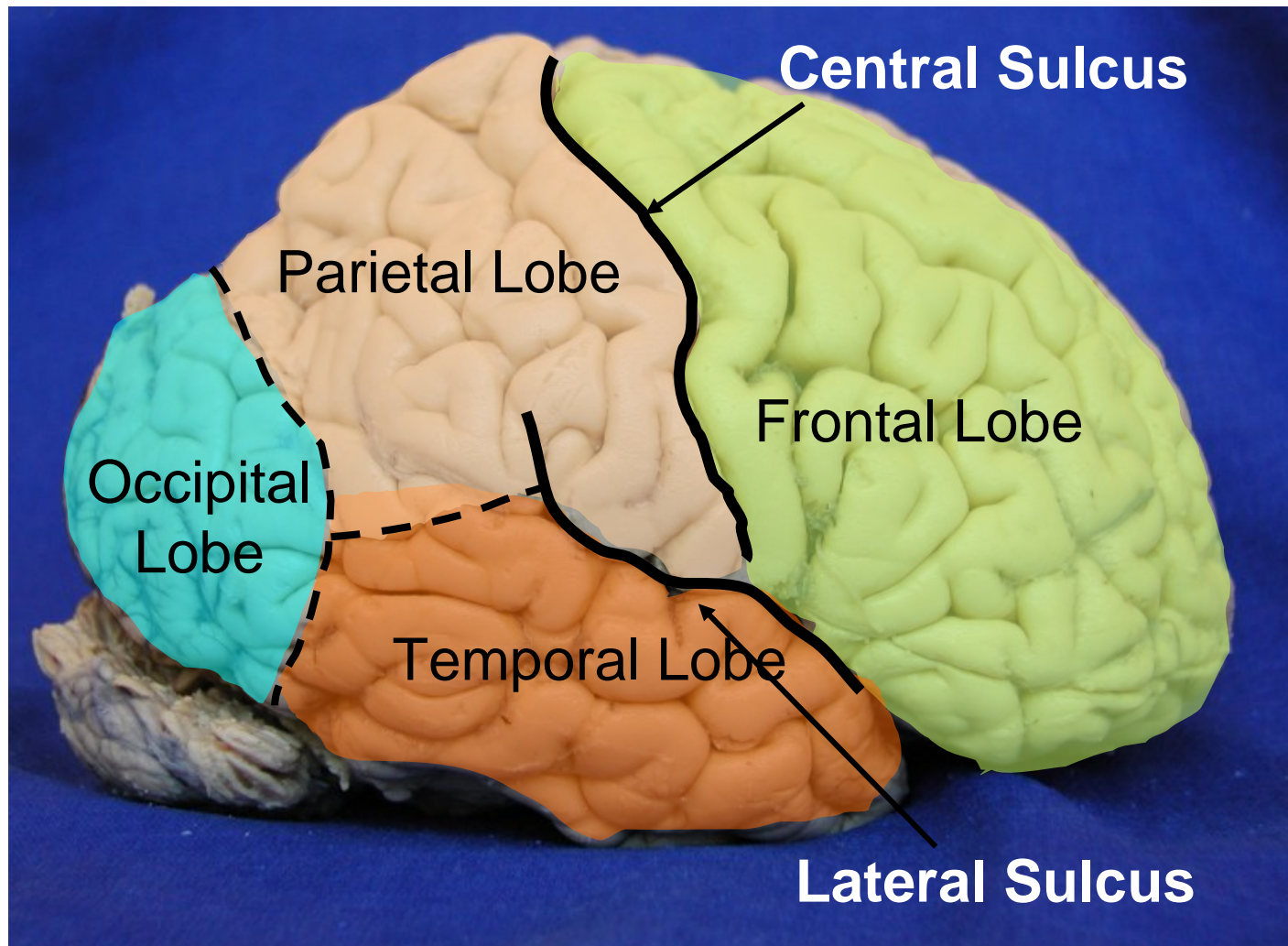
- bounded by "Falx Cerebri"





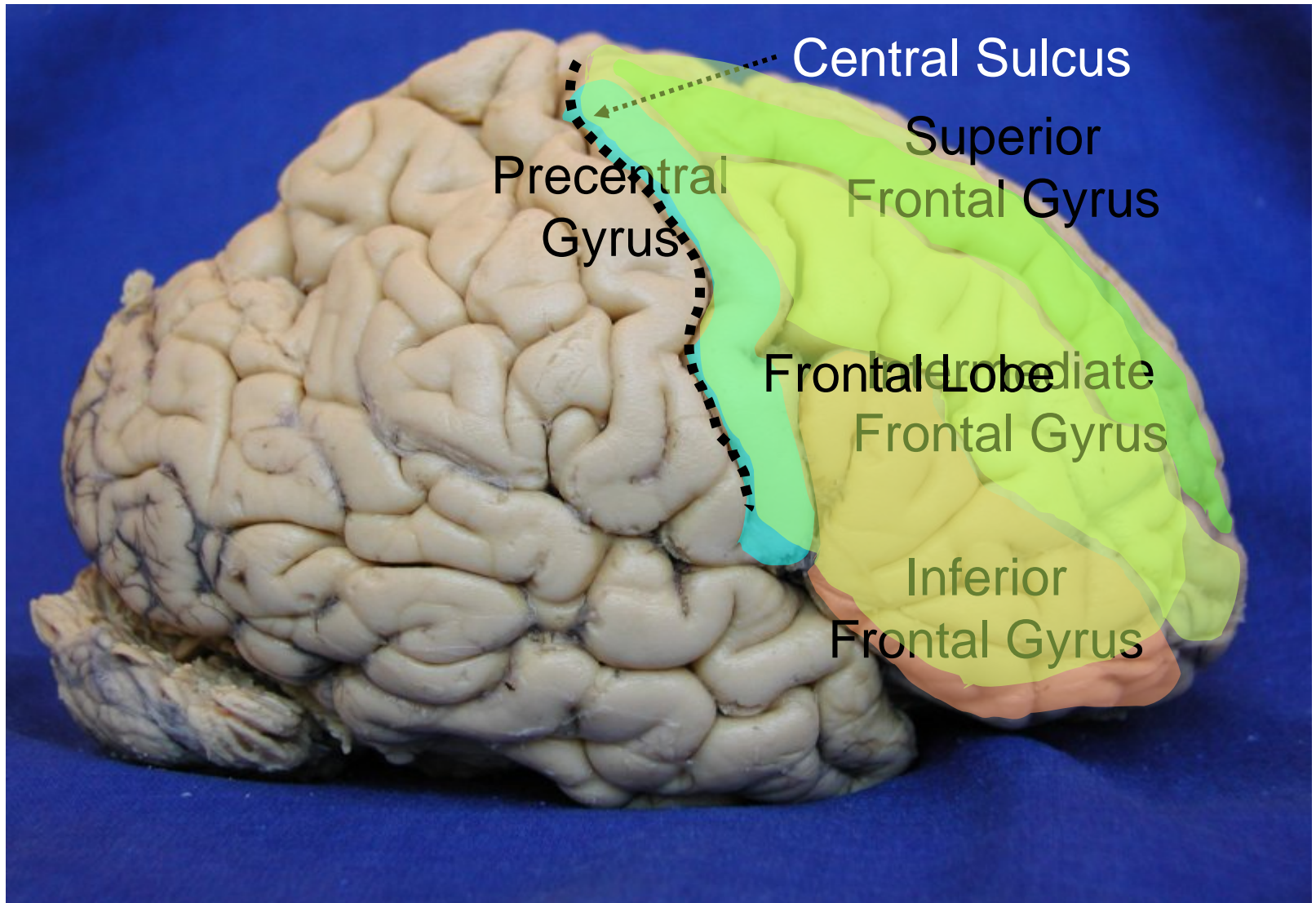
# Lobes

- bounded by **sulci** or **lines**



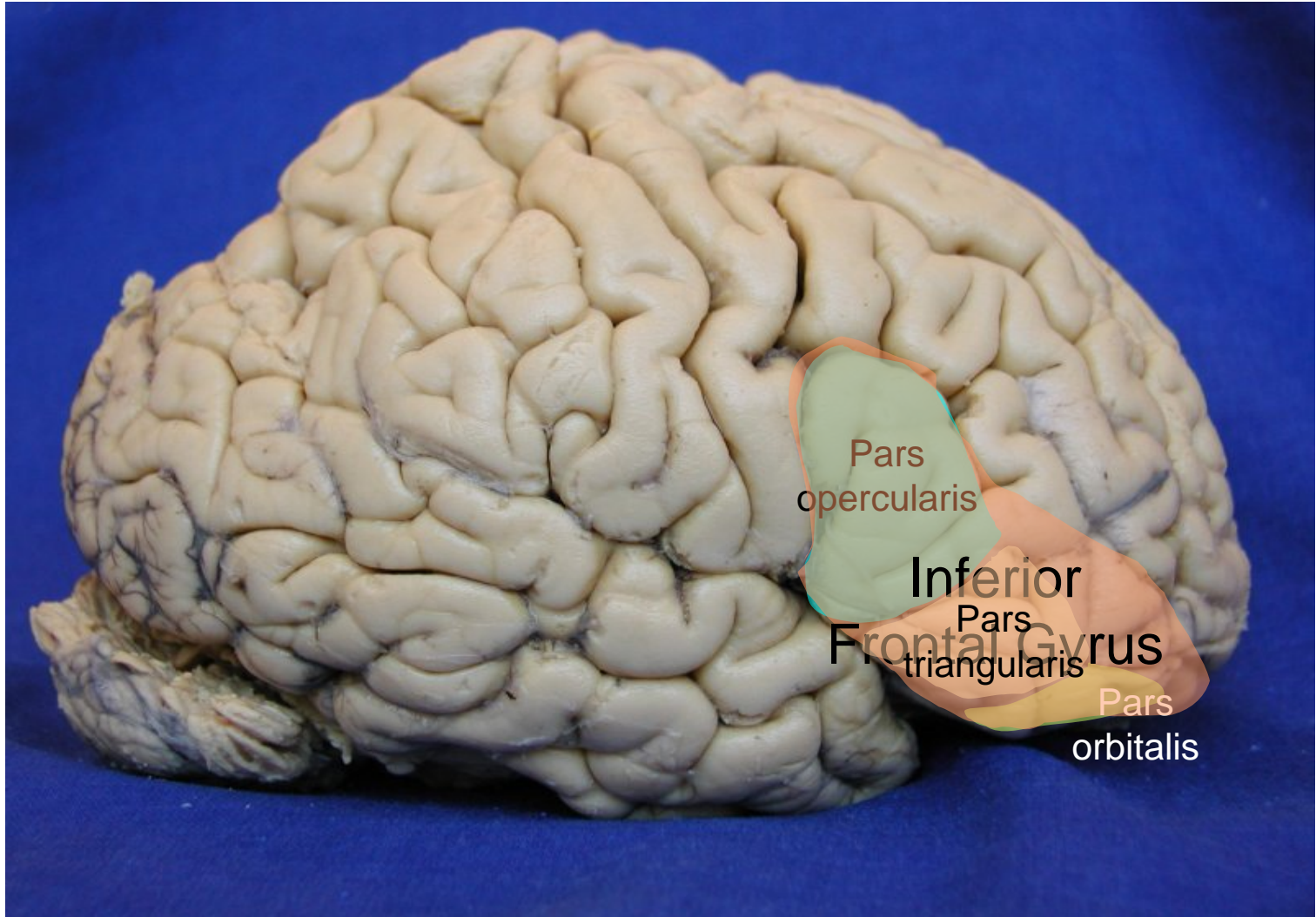
# Gyri

- bounded by **sulci**



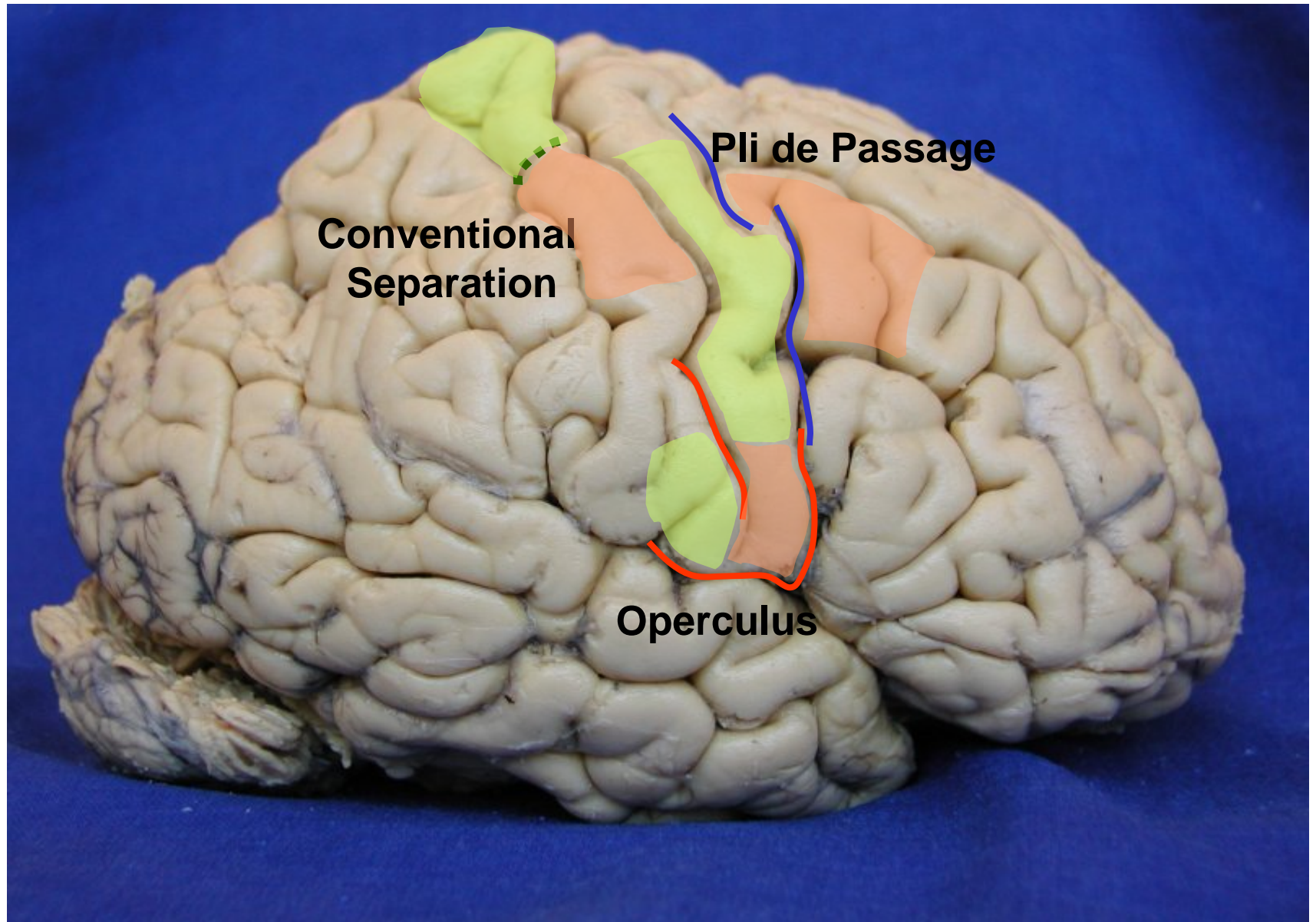
# Pars

- bounded by sulcus segments





# Connections





# Brain Anatomy Ontology

- <http://idm.univ-rennes1.fr/~odameron/anatomy/abstractModel/index.html>

The screenshot shows a web browser window titled 'Laboratoire IDM : Cortex Knowledge Base - Wanadoo'. The address bar contains the URL <http://idm.univ-rennes1.fr/~odameron/anatomy/abstractModel/index.html>. The page content is divided into two main columns.

**Concepts list**

- Hemisphere
  - [FRONTAL LOBE](#)
    - [Orbital Gyrus](#)
    - [PreCentral Gyrus](#) (circled in red)
      - [Superior Pars of PreCentral Gyrus](#)
      - [Inferior Pars of PreCentral Gyrus](#)
    - [Superior Frontal Gyrus](#)
      - [Medial Pars of Superior Frontal Gyrus](#)
      - [Superior Pars of Superior Frontal Gyrus](#)
      - [Inferior Pars of Superior Frontal Gyrus](#)
    - [Middle Frontal Gyrus](#)
      - [Superior Pars of Intermediate Frontal Gyrus](#)
      - [Inferior Pars of Intermediate Frontal Gyrus](#)
    - [Inferior Frontal Gyrus](#)
      - [Orbital Pars of Inferior Frontal Gyrus](#)
      - [Triangular Pars of Inferior Frontal Gyrus](#)
      - [Opercular Pars of Inferior Frontal Gyrus](#)
    - [Gyrus Rectus](#)
    - [Medial Orbital Gyrus](#)
    - [Lateral Orbital Gyrus](#)
    - [Anterior Orbital Gyrus](#)
    - [Posterior Orbital Gyrus](#)
    - [Subcentral Gyrus](#)
    - [ParaCentral Lobule](#)
    - [Transverse Frontopolar Gyrus](#)
      - [Superior Pars of FrontoPolar Gyrus](#)

## Anatomical Composition

### Direct anatomical parts

- [Superior Pars of PreCentral Gyrus](#)
- [Inferior Pars of PreCentral Gyrus](#)

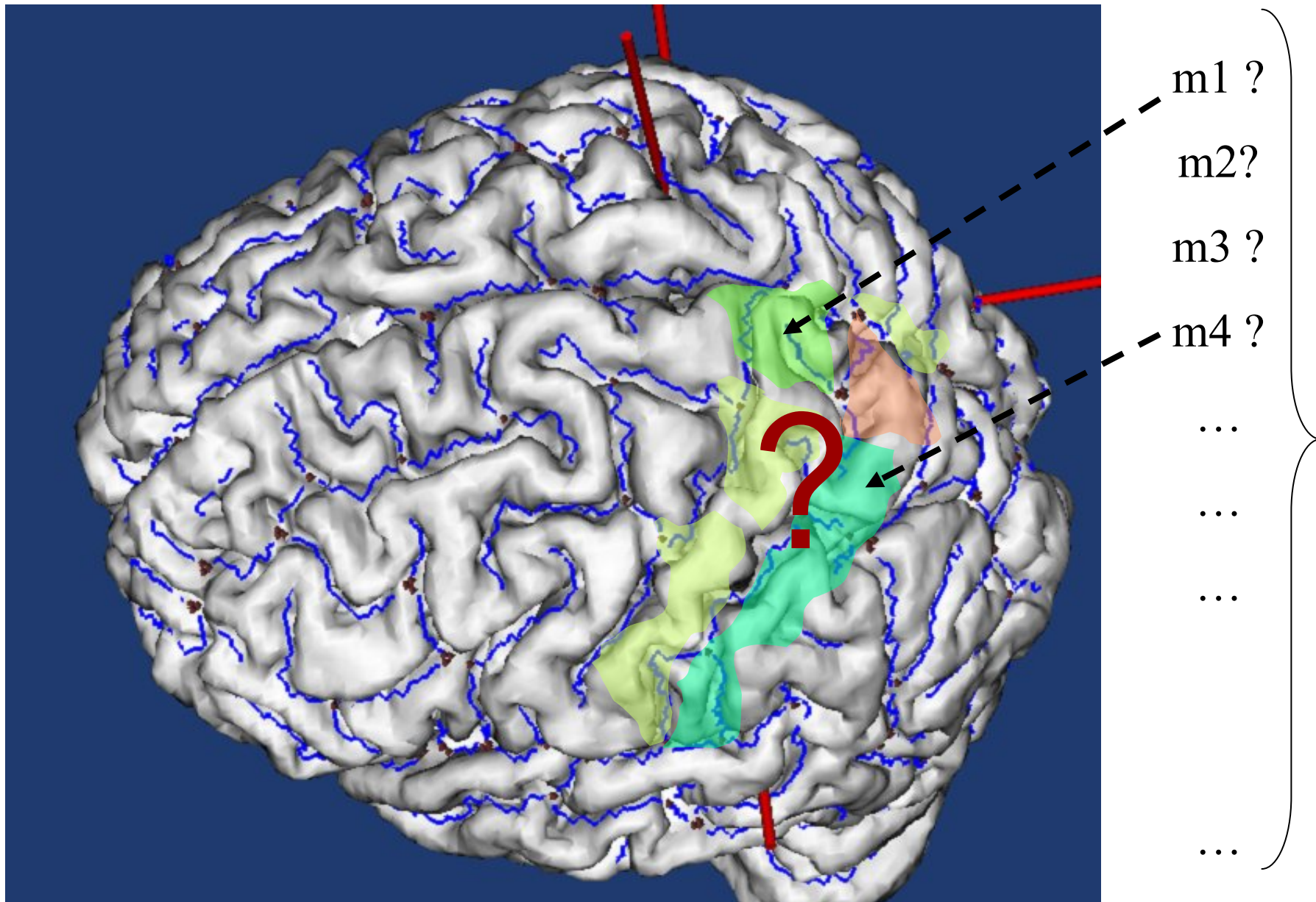
## Anatomical continuity

- [Subcentral Gyrus](#)
- [ParaCentral Lobule](#)
- [Inferior Frontal Gyrus](#)
- [Superior Frontal Gyrus](#)
- [Opercular Pars of Inferior Frontal Gyrus](#)
- [Medial Pars of Superior Frontal Gyrus](#)

## Contiguous sulci

- [Central Sulcus](#)
- [PreCentral Sulcus](#)
- [Lateral Sulcus](#)
- [Anterior subcentral Sulcus](#)
- [Inferior precentral Sulcus](#)
- [Superior precentral Sulcus](#)

# Labeling the gyri and sulci in MRI images



# INTEROPERATING BETWEEN ONTOLOGY and RULES

**Asserted Hierarchy**

CLASS BROWSER

For Project: ● BrainAnatomy

Asserted Hierarchy

- owl:Thing
  - ▶ rdf:List
  - ▼ AnatomicaEntity
    - ▼ MAE
      - Gyrus
      - Hemisphere
      - Lobe
      - Pars
    - ▼ NMAE
      - ▼ GyriConnection
        - ConventionalDeperation
        - Operculus
        - PliDePassage
      - ▼ SulcalFold
        - Sulcus
        - SulcusSegment
      - SulciConnection

BrainAnatomy Protégé 3.1 beta (file:IC:\Program%20Files\Protege\_3.1\_beta\BrainAnatomy.pprj, 0...

File Edit Project OWL Code Window Tools Help

OWLClasses Properties Forms Individuals Metadata → SWRL Rules

SWRL Rules

Name	Expression
Rule-1	$\rightarrow \text{isMAEBoundedBy}(?x, ?y) \wedge \text{isMAEBoundedBy}(?z, ?y) \wedge \text{MAE}(?x) \wedge \text{MAE}(?z) \wedge \text{GyriConnection}(?y) \rightarrow \text{isMAEConnectedTo}(?x, ?z)$
Rule-2	$\rightarrow \text{isMAEBoundedBy}(?x, ?z) \wedge \text{hasSegment}(?y, ?z) \wedge \text{SulcalFold}(?y) \wedge \text{SulcalFold}(?z) \wedge \text{MAE}(?x) \rightarrow \text{isMAEBoundedBy}(?y, ?z)$
Rule-3	$\rightarrow \text{hasAnatomicalPart}(?x, ?y) \wedge \text{hasAnatomicalPart}(?y, ?x) \wedge \text{AnatomicaEntity}(?x) \wedge \text{AnatomicaEntity}(?y) \rightarrow \text{sameAs}(?x, ?y)$
Rule-4	$\rightarrow \text{hasSegment}(?x, ?y) \wedge \text{hasSegment}(?y, ?x) \wedge \text{SulcalFold}(?x) \wedge \text{SulcalFold}(?y) \rightarrow \text{sameAs}(?x, ?y)$



# Rule Base

- **Dependencies** between properties
  - Ontology properties
    - Mereological
    - Spatial
    - Mereological and spatial
  - Ontology and other domain properties
- Queries

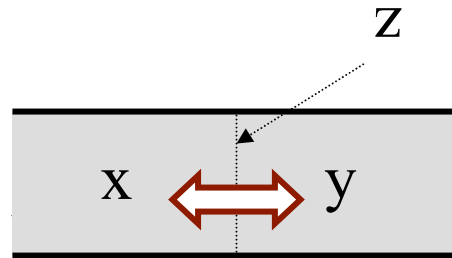
# Topological dependency

- If two entities have a common boundary, they are connected

**isConnectedTo** (?x, ?y) ←

**isBoundedBy** (?x, ?z)

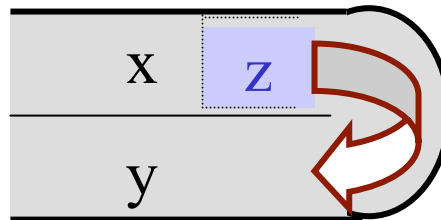
**∧ isBoundedBy** (?y, ?z)



# Propagation of connection along part-of

- If a part of a gyrus is connected to another gyrus, the two gyri are connected

**isConnectedTo** (?x, ?y) ←  
**hasPart** (?x, ?z)  
 $\wedge$  **isConnectedTo** (?z, ?y)



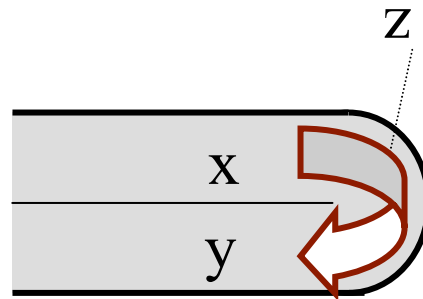


## Other domain properties

- if there is a connection relation between entities, they are connected

**isConnectedTo** (?x, ?y) ←

**connectsMAE** (?z, ?x, ?y)



# Query

- For given items  $m_i$  of a region under study, find all the possible instances of anatomical entities  $?x_i$  they are part of ?

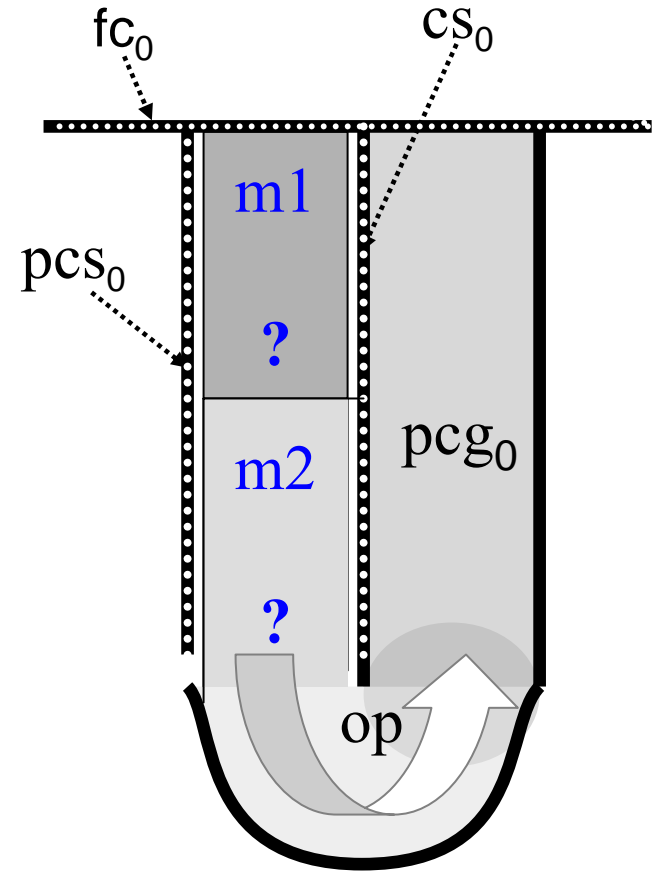
$$Q (?x_1, \dots, ?x_n) :- \bigwedge_{i=1,n} AE(?x_i) \wedge \text{hasPart}(?x_i, m_i)$$

- **Answering queries with ontology and rules**

# Very simple example

- Current facts

- `boundedBy (m1 , fc0)`
- `boundedBy (m1 , cs0)`
- `boundedBy (m1 , pcs0)`
- `connects (op , m2 , pcg0)`
- `falxCerebri (fc0)`
- `centralSulcus (cs0)`
- `preCentralSulcus (pcs0)`
- `AE (op)`



- Query

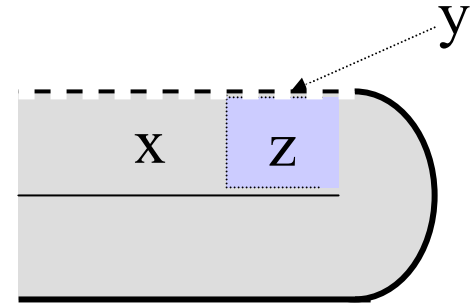
$Q(?x_1) :- AE (?x_1) \wedge \text{hasPart} (?x_1, m_1) \wedge \text{hasPart} (?x_1, m_2)$

all the possible instances of AE which  $m_1$  and  $m_2$  can be part of ?

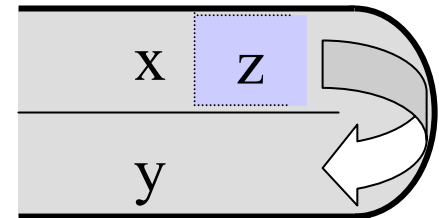


# (1) Rules

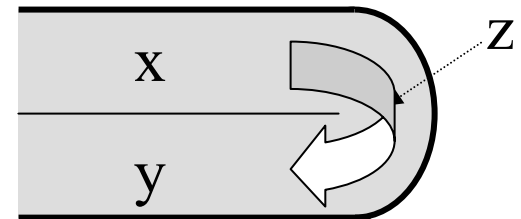
$\text{isBoundedBy} (?x, ?y)$   $\xleftarrow{R1}$   
 $\text{hasPart} (?x, ?z)$   
 $\wedge \text{isBoundedBy} (?z, ?y)$



$\text{isConnectedTo} (?x, ?y)$   $\xleftarrow{R2}$   
 $\text{hasPart} (?x, ?z)$   
 $\wedge \text{isConnectedTo} (?z, ?y)$



$\text{isConnectedTo} (?x, ?y)$   $\xleftarrow{R3}$   
 $\text{connects} (?z, ?x, ?y)$



# Rules reasoning

(1)

$\text{isBoundedBy}(g_0, cs_0)$  ← R1

$\text{hasPart}(g_0, m1)$

$\wedge \text{isBoundedBy}(m1, cs_0)$  ← facts

... ..

$\text{isConnectedTo}(m2, pcg_0)$  ← R2

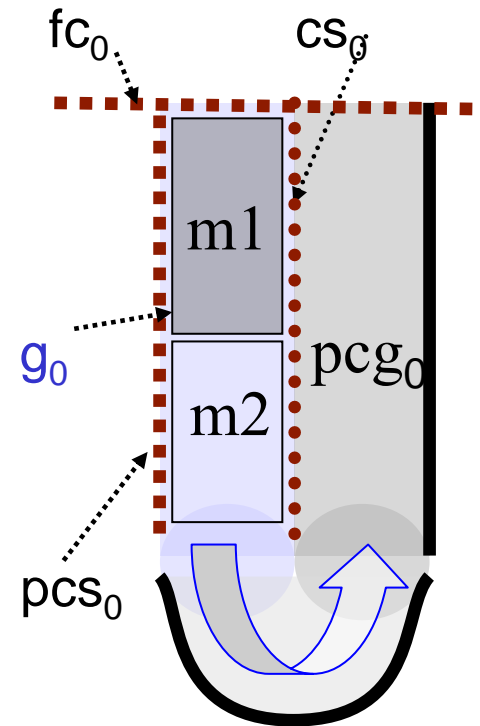
$\text{connects}(op, m2, pcg_0)$  ← facts

(4)

$\text{isConnectedTo}(g_0, pcg_0)$  ← R3

$\text{hasPart}(g_0, m2)$

$\wedge \text{isConnectedTo}(m2, pcg_0)$

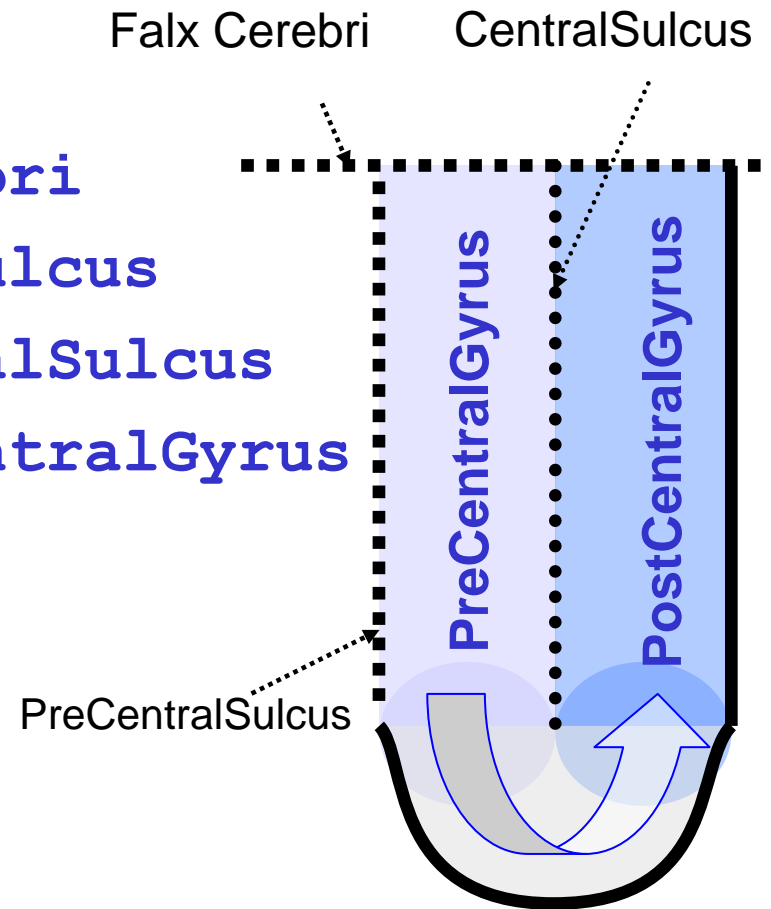


## (2) Ontology

### PreCentralGyrus ≡

- Gyrus
- =1 isBoundedBy FalxCerebri
- =1 isBoundedBy CentralSulcus
- =1 isBoundedBy PreCentralSulcus
- =1 isConnectedTo PostCentralGyrus

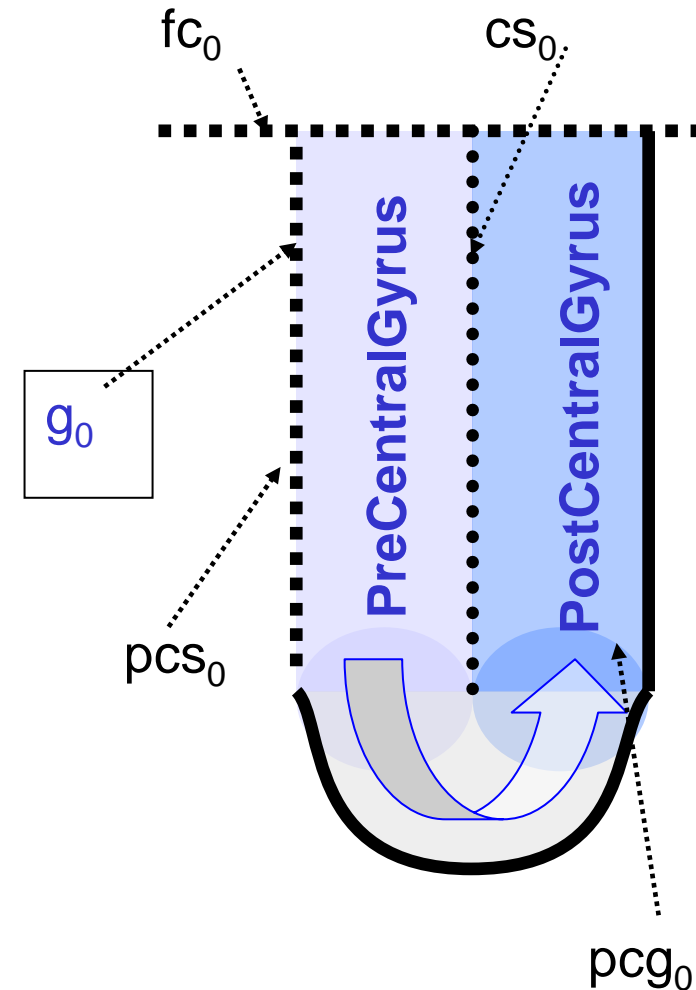
etc.



# Ontology reasoning

- (1)  $\text{isBoundedBy}(g_0, cs_0)$
- (2)  $\text{isBoundedBy}(g_0, fc_0)$
- (3)  $\text{isBoundedBy}(g_0, pcs_0)$
- (4)  $\text{isConnectedTo}(g_0, pcg_0)$

$\Rightarrow g_0$  instance of PreCentralGyrus



# Test Case

- Annexes

- Ontology
- Other domain relations
- Rules



# "Sharable" rule base

**Rule 9:**  $\text{isMAEContiguousTo}(m1,m2) \leftarrow \text{separatesMAE}(s,m1,m2) \wedge \text{MAE}(m1) \wedge \text{MAE}(m2) \wedge \text{SF}(s)$

*/Propagation of MAE boundary (i.e. a first sulcal fold) to a second sulcal fold containing the first/*

**Rule 10:**  $\text{isMAEBoundedBy}(m,s) \leftarrow \text{isMAEBoundedBy}(m,ss) \wedge \text{hasSegment}(s,ss) \wedge \text{SF}(s) \wedge \text{SF}(ss) \wedge \text{MAE}(m)$

*/Propagation of MAE boundary (with a first material entity) to a second material entity containing the first, only if the boundary is not contained in the second material entity/*

**Rule 11:**  $\text{isMAEBoundedBy}(m,s) \leftarrow \text{isMAEBoundedBy}(sm,s) \wedge \text{hasAnatomicalPart}(m,sm)$

$\wedge \text{isNotContainedIn}(s,m)$

$\wedge (\text{SF}(s) \vee \text{gyriConnection}(s)) \wedge \text{MAE}(sm) \wedge \text{MAE}(m)$

*/Propagation of contiguity to parts/*

**Rule 12:**  $\text{isMAEContiguousTo}(m1,sm2) \leftarrow \text{isMAEContiguousTo}(m1,m2) \wedge \text{hasAnatomicalPart}(m2,sm2)$

$\wedge \text{isMAEBoundedBy}(m1,s) \wedge \text{isMAEBoundedBy}(m2,s) \wedge \text{isMAEBoundedBy}(sm2,s)$

$\wedge \text{MAE}(m1) \wedge \text{MAE}(m2) \wedge \text{MAE}(sm2) \wedge \text{SF}(s)$

*/Propagation of contiguity (to a first material entity) to a second material entity containing the first/*

**Rule 13:**  $\text{isMAEContiguousTo}(m1,m2) \leftarrow \text{isMAEContiguousTo}(m1,sm2) \wedge \text{hasAnatomicalPart}(m2,sm2)$

$\wedge \text{hasNoCommonParts}(m1,m2)$

$\wedge \text{MAE}(m1) \wedge \text{MAE}(m2) \wedge \text{MAE}(sm2)$

*/Propagation of MAE separation to parts/*

**Rule 14:**  $\text{separatesMAE}(s,m1,sm2) \leftarrow \text{separatesMAE}(s,m1,m2) \wedge \text{hasAnatomicalPart}(m2,sm2) \wedge \text{isMAEBoundedBy}(sm2,s)$

$\wedge \text{SF}(s) \wedge \text{MAE}(m1) \wedge \text{MAE}(m2) \wedge \text{MAE}(sm2)$

*/Propagation of MAE separation (of a first material entity) to a second material entity containing the first/*

**Rule 15:**  $\text{separatesMAE}(s,m1,m2) \leftarrow \text{separatesMAE}(s,m1,sm2) \wedge \text{hasAnatomicalPart}(m2,sm2)$

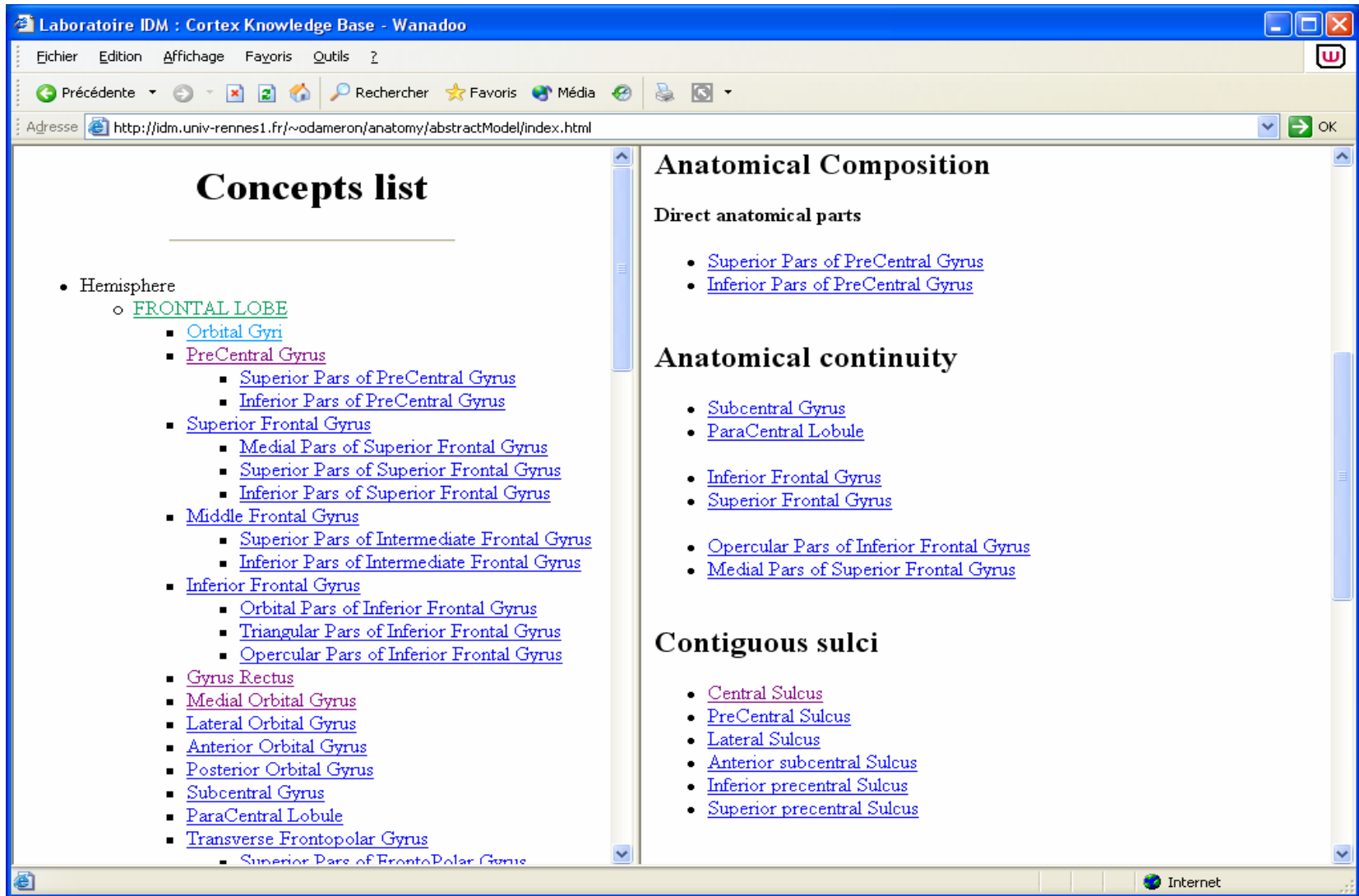
$\wedge \text{hasNoCommonParts}(m1,m2)$

$\wedge \text{SF}(s) \wedge \text{MAE}(m1) \wedge \text{MAE}(m2) \wedge \text{MAE}(sm2)$

*/Propagation of MAE separation (i.e. a first sulcal fold) to a second sulcal fold containing the first/*

# Full Brain cortex anatomy ontology

<http://idm.univ-rennes1.fr/~odameron/anatomy/abstractModel/index.html>



**Laboratoire IDM : Cortex Knowledge Base - Wanadoo**

Fichier Edition Affichage Favoris Outils ?

Précédente Recherche Favoris Média

Adresse <http://idm.univ-rennes1.fr/~odameron/anatomy/abstractModel/index.html> OK

## Concepts list

- Hemisphere
  - [FRONTAL LOBE](#)
    - [Orbital Gyrus](#)
    - [PreCentral Gyrus](#)
      - [Superior Pars of PreCentral Gyrus](#)
      - [Inferior Pars of PreCentral Gyrus](#)
    - [Superior Frontal Gyrus](#)
      - [Medial Pars of Superior Frontal Gyrus](#)
      - [Superior Pars of Superior Frontal Gyrus](#)
      - [Inferior Pars of Superior Frontal Gyrus](#)
    - [Middle Frontal Gyrus](#)
      - [Superior Pars of Intermediate Frontal Gyrus](#)
      - [Inferior Pars of Intermediate Frontal Gyrus](#)
    - [Inferior Frontal Gyrus](#)
      - [Orbital Pars of Inferior Frontal Gyrus](#)
      - [Triangular Pars of Inferior Frontal Gyrus](#)
      - [Opercular Pars of Inferior Frontal Gyrus](#)
    - [Gyrus Rectus](#)
    - [Medial Orbital Gyrus](#)
    - [Lateral Orbital Gyrus](#)
    - [Anterior Orbital Gyrus](#)
    - [Posterior Orbital Gyrus](#)
    - [Subcentral Gyrus](#)
    - [ParaCentral Lobule](#)
    - [Transverse Frontopolar Gyrus](#)
      - [Superior Pars of Frontopolar Gyrus](#)

## Anatomical Composition

### Direct anatomical parts

- [Superior Pars of PreCentral Gyrus](#)
- [Inferior Pars of PreCentral Gyrus](#)

### Anatomical continuity

- [Subcentral Gyrus](#)
- [ParaCentral Lobule](#)
- [Inferior Frontal Gyrus](#)
- [Superior Frontal Gyrus](#)
- [Opercular Pars of Inferior Frontal Gyrus](#)
- [Medial Pars of Superior Frontal Gyrus](#)

## Contiguous sulci

- [Central Sulcus](#)
- [PreCentral Sulcus](#)
- [Lateral Sulcus](#)
- [Anterior subcentral Sulcus](#)
- [Inferior precentral Sulcus](#)
- [Superior precentral Sulcus](#)

Internet

# Potential requirements

- **Ontology Web language**

1. OWL DL expressiveness (or sublanguage)
2. Extended by qualified cardinality constraints

- **Rule Web language**

3. ontology concepts and roles in rule body and head as unary or binary predicates in atoms.
4. “ordinary” domain relations, not ontology concept nor role, in body and head atoms.
5. n-ary predicates in body and head atoms
6. queries expressed by n-ary predicates
7. “safe” rules, i.e. a variable that occurs in the head also occurs in the body

# Candidate technologies

Any language extending OWL DL with rules

1. To represent all the knowledge described in the ontology and rule annexes, as naturally as possible
2. To **interoperate between rules and ontology** for reasoning
3. To indicate properties (decidability, completeness, correctness) that are guaranteed

# Workshop Protégé With Rules, July 18<sup>th</sup>, Madrid

- *In conjunction with the 8th International Protégé Conference*
- *Supported by the RuleML Initiative*

[www.med.univ-rennes1.fr/~cgolb/Protege2005/ProtegeWithRulesCFP.htm](http://www.med.univ-rennes1.fr/~cgolb/Protege2005/ProtegeWithRulesCFP.htm)

The screenshot displays the Protégé 3.1 beta interface for a project named "BrainAnatomy". The main window is titled "BrainAnatomy Protégé 3.1 beta (file:VC:\Program%20Files\Protege\_3.1\_beta\BrainAnatomy.pprj, OWL File...)". The interface includes a menu bar (File, Edit, Project, OWL, Code, Window, Tools, Help) and a toolbar with various icons. Below the toolbar, there are tabs for "OWLClasses", "Properties", "Forms", "Individuals", "Metadata", and "SWRL Rules".

The "CLASS BROWSER" is active on the left, showing a class hierarchy for "BrainAnatomy". The hierarchy is as follows:

- AnatomicaEntity
  - MAE
    - Gyrus
    - Hemisphere
    - Lobe
    - Pars
  - NMAE
    - GyriConnection
      - ConventionalDeperation
      - Operculus
      - PliDePassage
    - SulcalFold
    - SulciConnection

The "INSTANCE BROWSER" is active on the right, showing the "swrl:Imp" class. It has two tabs: "Asserted" and "Inferred". The "Inferred" tab is selected, displaying a list of SWRL rules under the heading ":NAME". The rules are:

- $\rightarrow \text{hasAnatomicalPart}(?x, ?y) \wedge \text{hasAnatomicalPart}(?y, ?x) \wedge \text{AnatomicaEntity}(?x) \wedge \text{AnatomicaEntity}(?y)$
- $\rightarrow \text{hasSegment}(?x, ?y) \wedge \text{hasSegment}(?y, ?x) \wedge \text{SulcalFold}(?x) \wedge \text{SulcalFold}(?y) \rightarrow \text{sameAs}(?x, ?y)$
- $\rightarrow \text{isMAEBoundedBy}(?x, ?y) \wedge \text{isMAEBoundedBy}(?z, ?y) \wedge \text{MAE}(?x) \wedge \text{MAE}(?z) \wedge \text{GyriConnection}(?y)$
- $\rightarrow \text{isMAEBoundedBy}(?x, ?z) \wedge \text{hasSegment}(?y, ?z) \wedge \text{SulcalFold}(?y) \wedge \text{SulcalFold}(?z) \wedge \text{MAE}(?x) \rightarrow \text{is}$

At the bottom of the instance browser, there is a "Types" section showing "swrl:Imp".





FMA+ Protégé 2.1.2 (file:C:\Documents%20and%20Settings\Christine\Bureau\FMA+.pprj, OWL Files)

Project Edit Window OWL Wizards Code Help

OWLClasses Properties Forms Individuals Metadata

Subclass Relationship Frontal\_lobe (type=owl:Class)

Asserted Hierarchy

- Muscle\_layer\_of\_male\_urethra
- Muscle\_layer\_of\_pre-prostatic\_urethra
- Muscle\_layer\_of\_spongy\_urethra
- Muscle\_layer\_of\_subdivision\_of\_male\_urethra
- Muscle\_layer\_of\_urethra
- Muscular\_layer\_of\_membranous\_urethra
- Muscular\_layer\_of\_prostatic\_urethra
- Organ\_component\_of\_anal\_canal
- Organ\_component\_of\_cartilage\_organ
- Organ\_component\_of\_cavernous\_organ
- Organ\_component\_of\_deferent\_duct
- Organ\_component\_of\_eyeball
- Organ\_component\_of\_fibrous\_mass
- Organ\_component\_of\_ganglion
- Organ\_component\_of\_gland\_organ
- Organ\_component\_of\_kidney
- Organ\_component\_of\_membrane\_organ
- Organ\_component\_of\_membranous\_organ
- Organ\_component\_of\_muscle\_organ
- Organ\_component\_of\_neuraxis
- Area\_of\_neuraxis
- Body\_of\_neuraxis
- Cingulate\_gyrus
- Circumventricular\_organ\_of\_neuraxis
- Commissure\_of\_neuraxis
- Culmen\_of\_neuraxis
- Cuneus
- Declive\_of\_neuraxis
- Flocculus\_of\_neuraxis
- Folium\_of\_neuraxis
- Formation\_of\_neuraxis
- Frenulum\_of\_superior\_medullary\_tract
- Gray\_matter\_component\_of\_neuraxis
- Gyrus\_of\_neuraxis
- Hemisphere\_of\_neuraxis
- Layer\_of\_neuraxis
- Lingula\_of\_neuraxis
- Lobe\_of\_neuraxis
  - Anterior\_lobe\_of\_cerebellum
  - Flocculonodular\_lobe\_of\_cerebellum
  - Lobe\_of\_cerebral\_hemisphere
    - Frontal\_lobe
    - Insula
    - Limbic\_lobe
    - Occipital\_lobe
    - Parietal\_lobe
    - Temporal\_lobe
  - Neural\_lobe\_of\_neurohypophysis
  - Posterior\_lobe\_of\_cerebellum

Annotations

Property	Value	Lang
definition	Frontal_lobe_is_the_anterior-most...	
UWDAID	61824	

Properties

- arterial\_supply (multiple Arterial\_plexus, Set\_of\_arteries)
- bounded\_by (multiple Physical\_anatomical\_entity)
- constitutional\_part (multiple Physical\_anatomical\_entity)
- constitutional\_part\_of (multiple Physical\_anatomical\_entity)
- continuous\_with (multiple Physical\_anatomical\_entity)
- continuous\_with\_distally (multiple Anatomical\_structure)
- continuous\_with\_proximally (multiple Anatomical\_structure)
- custom\_partonomy (multiple Physical\_anatomical\_entity)
- custom\_partonomy\_of (multiple Physical\_anatomical\_entity)
- dimension (single {individual\_d1-dimension individual\_d2-dimension})
- general\_part (multiple Set\_of\_nerves, Anatomical\_structure)
- has\_boundary (single boolean)
- has\_dimension (single boolean)
- has\_inherent\_3-D\_shape (single boolean)
- has\_mass (single boolean)
- inherent\_3-D\_shape (single Volume)
- lymphatic\_drainage (multiple Subdivision\_of\_organ)
- member\_of (multiple Anatomical\_set)
- nerve\_supply (multiple Set\_of\_nerves, Subdivision\_of\_organ)
- part (multiple Anatomical\_entity\_template)
- part\_of (multiple Anatomical\_entity\_template)
- regional\_part (multiple Anatomical\_structure, Subdivision\_of\_organ)
- regional\_part\_of (multiple Anatomical\_structure, Subdivision\_of\_organ)
- segmental\_supply (multiple Segmental\_inner\_supply)
- surrounded\_by (multiple Anatomical\_structure)
- systemic\_part (multiple Anatomical\_structure, Subdivision\_of\_organ)
- systemic\_part\_of (multiple Anatomical\_structure, Subdivision\_of\_organ)
- venous\_drainage (multiple Subdivision\_of\_venous\_system)
- has\_physical\_state (single {individual\_Solid individual\_Liquid individual\_Gas})
- primary\_site\_of

Asserted Conditions

NECESSARY & SUFFICIENT

- Lobe\_of\_cerebral\_hemisphere
- Lobular\_organ\_component
- arterial\_supply (Subdivision\_of\_arterial\_tree\_organ U Tissue)
- part Lateral\_orbital\_gyrus
- part Posterior\_orbital\_gyrus
- part Precentral\_gyrus
- part Superior\_frontal\_gyrus
- part Medial\_orbital\_gyrus
- part Inferior\_frontal\_gyrus
- part Intermediate\_orbital\_gyrus
- part Straight\_gyrus
- part Middle\_frontal\_gyrus
- part\_of Cerebral\_hemisphere
- regional\_part Superior\_frontal\_gyrus
- regional\_part Middle\_frontal\_gyrus
- regional\_part Inferior\_frontal\_gyrus
- regional\_part Precentral\_gyrus
- regional\_part Straight\_gyrus
- regional\_part\_of Cerebral\_hemisphere

INHERITED

- arterial\_supply (Arterial\_plexus U Set\_of\_arteries U Arteriole U Artery)
- arterial\_supply (Systemic\_artery U Subdivision\_of\_arterial\_tree\_organ U Tissue)
- bounded\_by (Subdivision\_of\_organ\_surface U Surface\_of\_subdivision\_of\_organ)
- bounded\_by Physical\_anatomical\_entity [from Anatomical\_structure]
- constitutional\_part Physical\_anatomical\_entity [from Anatomical\_structure]
- constitutional\_part\_of Physical\_anatomical\_entity [from Anatomical\_structure]
- continuous\_with Physical\_anatomical\_entity [from Material\_physical\_anatomical\_entity]
- continuous\_with\_distally Anatomical\_structure [from Anatomical\_organ\_component]
- continuous\_with\_proximally Anatomical\_structure [from Anatomical\_organ\_component]
- custom\_partonomy (Physical\_anatomical\_entity U Non-physical\_anatomical\_entity)
- custom\_partonomy\_of Physical\_anatomical\_entity [from Anatomical\_structure]
- dimension  $\exists$  individual\_d3-dimension [from Anatomical\_structure]
- general\_part (Set\_of\_nerves U Organ\_part U Fiat\_organ\_system\_subdivision U Anatomical\_structure)
- general\_part (Set\_of\_nerves U Anatomical\_structure U Body\_substance U Anatomical\_structure)

Disjoints

Logic View Properties View