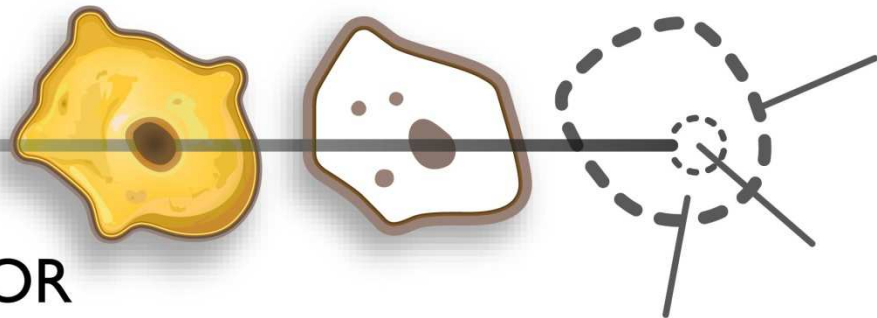




NCBO BioPortal 2.0

*Advancing biology and medicine with tools and methodologies
for the structured organization of knowledge.*

Benjamin Dai
Chief Software Architect
September 22, 2008



NATIONAL CENTER FOR
BIOMEDICAL ONTOLOGY




BioPortal and Related Technologies

- **BioPortal 2.0**
 - *Browsing Biomedical Ontologies*
- **Open Biomedical Resources**
 - *Using Ontologies to Access Public Data*
- **Open Biomedical Annotator**
 - *Using Ontologies to Annotate Your Data*
- **NCBO Fabric and REST Services**
 - *Embedding Our Services in Your Tools*
- **NCBO PURL Server**
 - *Providing URIs for Biomedical Concepts*

BioPortal 2.0: Browse Ontologies

THE NATIONAL CENTER FOR BIOMEDICAL ONTOLOGY

 BioPortal 2.0

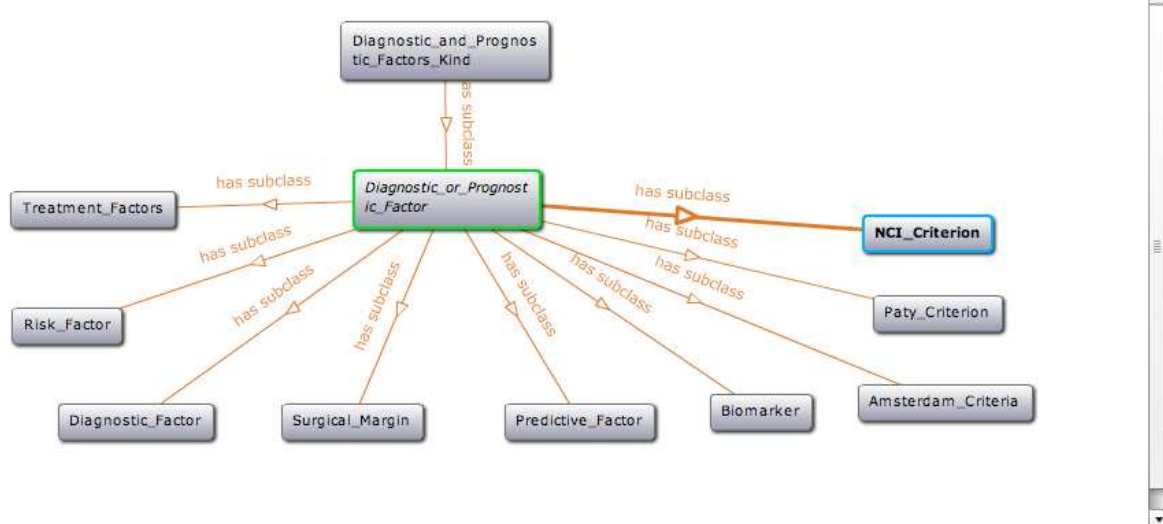
Logged In As ngriff [My Projects](#) | [My Account](#) | [Log Out](#)

Home Browse Search All Mappings **NCI Thesaurus** Biomedical Resource Ontology Mouse adult gross anatomy

Diagnostic_or_Prognostic_Factor ([Link To Concept](#))

Details Visualization Marginal Notes Mappings Resources

Show Network Neighborhood




```
graph TD
    DPF[Diagnostic_or_Prognostic_Factor]
    DPF -- "has subclass" --> DPK[Diagnostic_and_Prognostic_Factors_Kind]
    DPF -- "has subclass" --> TF[Treatment_Factors]
    DPF -- "has subclass" --> RF[Risk_Factor]
    DPF -- "has subclass" --> DF[Diagnostic_Factor]
    DPF -- "has subclass" --> SM[Surgical_Margin]
    DPF -- "has subclass" --> PF[Predictive_Factor]
    DPF -- "has subclass" --> B[Biomarker]
    DPF -- "has subclass" --> AC[Amsterdam_Criteria]
    DPF -- "has subclass" --> PC[Paty_Criterion]
    DPF -- "has subclass" --> NC[NCI_Criterion]
```

Full Version

BioPortal 2.0: Multiple Ontology Navigation

THE NATIONAL CENTER FOR BIOMEDICAL ONTOLOGY

 BioPortal 2.0

Logged In As ngriff [My Projects](#) | [My Account](#) | [Log Out](#)

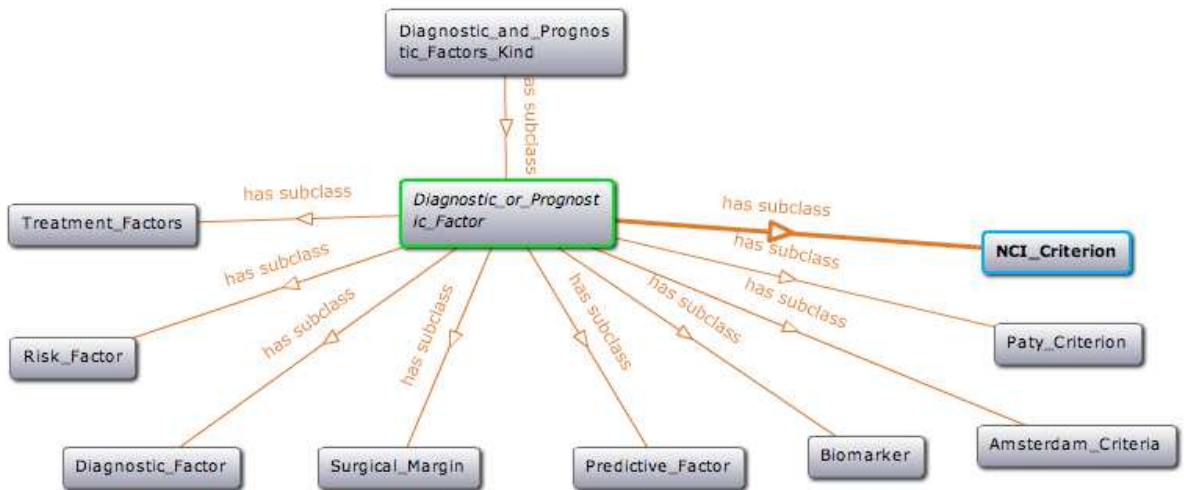
Home Browse Search All Mappings **NCI Thesaurus** Biomedical Resource Ontology Mouse adult gross anatomy

Diagnostic_or_Prognostic_Factor ([Link To Concept](#))

Details Visualization Marginal Notes Mappings Resources

Show Network Neighborhood

Full Version




```
graph TD; DPFK[Diagnostic_and_Prognostic_Factors_Kind] -- "has subclass" --> DOPF[Diagnostic_or_Prognostic_Factor]; DOPF -- "has subclass" --> TF[Treatment_Factors]; DOPF -- "has subclass" --> RF[Risk_Factor]; DOPF -- "has subclass" --> DF[Diagnostic_Factor]; DOPF -- "has subclass" --> SM[Surgical_Margin]; DOPF -- "has subclass" --> PF[Predictive_Factor]; DOPF -- "has subclass" --> B[Biomarker]; DOPF -- "has subclass" --> AC[Amsterdam_Criteria]; DOPF -- "has subclass" --> NCI[NCI_Criterion]; DOPF -- "has subclass" --> PC[Paty_Criterion];
```

The diagram illustrates the hierarchical structure of the NCI Thesaurus ontology. The central concept, **Diagnostic_or_Prognostic_Factor**, is highlighted with a green border. It is a subclass of **Diagnostic_and_Prognostic_Factors_Kind**. Below it, several other concepts are shown as subclasses: **Treatment_Factors**, **Risk_Factor**, **Diagnostic_Factor**, **Surgical_Margin**, **Predictive_Factor**, **Biomarker**, **Amsterdam_Criteria**, **NCI_Criterion**, and **Paty_Criterion**. The relationships are indicated by orange arrows labeled "has subclass".

BioPortal 2.0: Mappings between Ontologies

THE NATIONAL CENTER FOR BIOMEDICAL ONTOLOGY

 **BioPortal_{2.0}**

[Home](#) [Browse](#) [Search](#) [All Mappings](#) [NCI Thesaurus](#) [Biomedical Resource Ontology](#) [Mouse adult gross anatomy](#) [Sign In](#) [Register](#)

View Ontology Metadata

- mouse anatomy
 - adult mouse
 - anatomic region
 - organ system
 - integumental system
 - hemolymphoid system
 - endocrine system
 - immune system**
 - connective tissue
 - musculoskeletal system
 - cardiovascular system
 - sensory organ system
 - exocrine system
 - visceral organ system
 - nervous system
 - body fluid/substance

immune system ([Link To Concept](#))

[Details](#) [Visualization](#) [Marginal Notes](#) [Mappings](#) [Resources](#)

[New Point-to-Point Mapping](#)

Mapping To	Source	Mapped By	Mapped On	Notes
Immune System (NCI Thesaurus)	NCICB	TerryHayamizu	04/23/08	View Notes
Immune System (NCI Thesaurus)	NLM	SongmaoZhang	04/23/08	View Notes
Immune system (FMA)	exact match or synonym match	nigam	05/08/08	View Notes
immune system (Zebrafish anatomy and development)	exact match or synonym match	nigam	05/08/08	View Notes



	Mapped On	Notes
	04/23/08	View Notes
	04/23/08	View Notes
	05/08/08	View Notes
	05/08/08	View Notes



BioPortal 2.0: Marginal Notes

THE NATIONAL CENTER FOR BIOMEDICAL ONTOLOGY



Logged In As ngriff [My Projects](#) | [My Account](#) | [Log Out](#)

[Home](#) [Browse](#) [Search](#) [All Mappings](#) [NCI Thesaurus](#) [Biomedical Resource Ontology](#) [Mouse adult gross anatomy](#)

View Ontology Metadata

- + desc:Staging_Area
- + desc:Biositemaps_Information
- **BRO:Resource**
 - + BRO:Portals
 - + BRO:Data_Resource
 - + BRO:Bibliographic_Resource
 - + BRO:Service
 - + BRO:Funding_Source
 - + BRO:Research_Supplies
 - + BRO:Software

BRO:Resource ([Link To Concept](#))

[Details](#) [Visualization](#) **[Marginal Notes](#)** [Mappings](#) [Resources](#)

Comment: Resource \Rightarrow Computational resource or **DavidStates at 08/08/08 13:07**

Comment: Provenance and Intellectual Property **DavidStates at 08/08/08 13:15**


Data provenance and intellectual property are critical meta data about all kinds of biomedical information and software. But the meta data objects are in fact data objects themselves. Therefore a high level ontology class is needed to represent this information.

[Reply](#)

Comment: Additional concepts needed in the BRO **DavidStates at 08/09/08 07:20**

BioPortal 2.0: Open Biomedical Resources

THE NATIONAL CENTER FOR BIOMEDICAL ONTOLOGY






 BioPortal 2.0

Logged In As ngriff [My Projects](#) | [My Account](#) | [Log Out](#)

Home Browse Search All Mappings **NCI Thesaurus** Biomedical Resource Ontology Mouse adult gross anatomy

Malignant_Skin_Neoplasm ([Link To Concept](#))

Details Visualization Marginal Notes Mappings **Resources**


 ClinicalTrials.gov	ClinicalTrials.gov provides regularly updated information about federally and privately supported clinical research in human volunteers. ClinicalTrials.gov gives you information about a trial's purpose, who may participate, locations, and phone numbers for more details. The information provided on ClinicalTrials.gov should be used in conjunction with advice from health care professionals. Before searching, you may want to learn more about clinical trials.	Annotations:796
 Gene Expression Omnibus Omnibus DataSets	A gene expression/molecular abundance repository supporting MIAME compliant data submissions, and a curated, online resource for gene expression data browsing, query and retrieval.	Annotations:9
 ArrayExpress	ArrayExpress is a public repository for microarray data, which is aimed at storing MIAME-compliant data in accordance with MGED recommendations. The ArrayExpress Data Warehouse stores gene-indexed expression profiles from a curated subset of experiments in the repository.	Annotations:16
 ARRS GoldMiner	ARRS GoldMiner provides instant access to images published in selected peer-reviewed radiology journals. This new, web-based system allows viewers to search for images by findings, anatomy, imaging technique, and patient age and sex.	Annotations:131
 NextBio	NextBio's data and literature search engine makes massive amounts of disparate biological, clinical and chemical data from public and proprietary sources searchable, regardless of data type and origin, empowering researchers to quickly understand their own experimental results within the context of other research.	Annotations:0

Left Sidebar (Selected):

- Disorder
- Cancer-Related Condition
- Development-Induced Abnormalities
- Disorder by Site
- Reproductive_System_Disorder
- Eye_Disorder
- Nervous_System_Disorder
- Breast_Disorder
- Endocrine_Disorder
- Skin_Disorder
 - + Cutaneous_Precancerous_Condition
 - + Non-Neoplastic_Skin_Disorder
 - + Hair_Disorder
 - + Skin_Vascular_Disorder
 - Skin_Neoplasm
 - + Dermal_Neoplasm
 - + Epithelial_Skin_Neoplasm
 - + Cutaneous_Hematopoietic_Disorder
 - + Malignant_Skin_Neoplasm
 - + Scrotal_Neoplasm
 - + Melanocytic_Skin_Neoplasm

BioPortal 2.0: Open Biomedical Resources

THE NATIONAL CENTER FOR BIOMEDICAL ONTOLOGY





Logged In As ngriff [My Projects](#) | [My Account](#) | [Log Out](#)

Home Browse Search All Mappings **NCI Thesaurus** Biomedical Resource Ontology Mouse adult gross anatomy

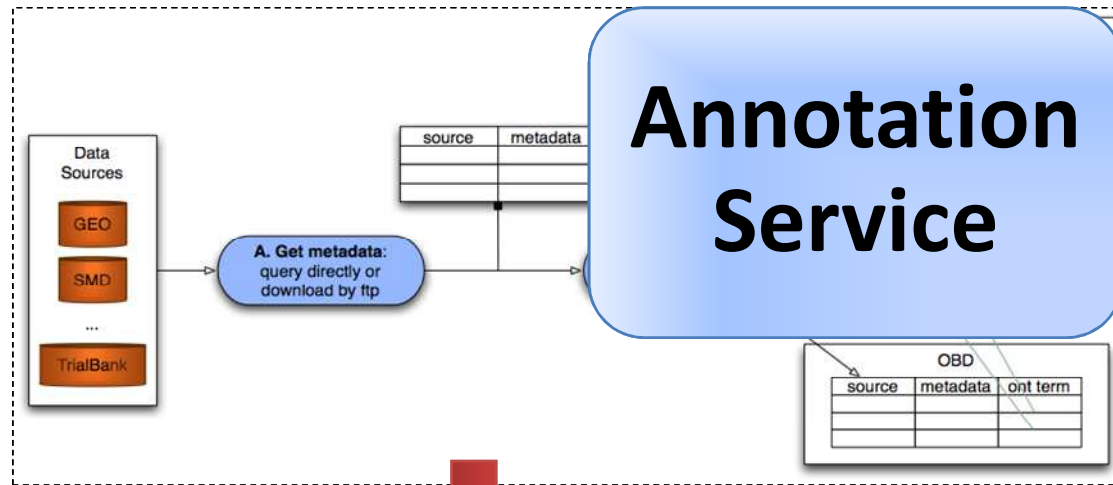
Malignant_Skin_Neoplasm (Link To Concept)

Details Visualization Marginal Notes Mappings **Resources**

 <p>ClinicalTrials.gov</p>	<p>ClinicalTrials.gov provides regularly updated information about federally and privately supported clinical research in human volunteers. ClinicalTrials.gov gives you information about a trial's purpose, who may participate, locations, and phone numbers for more details. The information provided on ClinicalTrials.gov should be used in conjunction with advice from health care professionals. Before searching, you may want to learn more about clinical trials.</p>	<p>Annotations:796</p>
 <p>Gene Expression Omnibus DataSets</p>	<p>A gene expression/molecular abundance repository supporting MIAME compliant data submissions, and a curated, online resource for gene expression data browsing, query and retrieval.</p>	<p>Annotations:9</p>
<p>Cutaneous malignant melanoma</p> <p>ID: 1375 Annotation Context: closure</p>		
<p>Transcription factor FoxM1 inactivation effect on breast cancer cell</p> <p>ID: 1477 Annotation Context: closure</p>		
<p>Melanoma progression</p> <p>ID: 1989 Annotation Context: closure</p>		
<p>Melanoma, cutaneous malignant, classification</p> <p>ID: 2 Annotation Context: closure</p>		
<p>Ductal carcinoma in situ to invasive ductal carcinoma progression (HG-U133A)</p> <p>ID: 2045 Annotation Context: closure</p>		
<p>Ductal carcinoma in situ to invasive ductal carcinoma progression (HG-U133 2.0)</p> <p>ID: 2046 Annotation Context: closure</p>		
<p>Non-melanoma skin cancer</p> <p>ID: 2000</p>		



Open Biomedical Annotator (OBA)



THE NATIONAL CENTER FOR BIOMEDICAL ONTOLOGY

BioPortal_{2.0}

Home Browse Search All Mappings NCI Thesaurus Sign In Register

Skin_Neoplasm

- Derma_Neoplasm
- Epithelial_Skin_Neopla
- Cutaneous_Hematopoi
- Malignant_Skin_Neopla
- Scrotal_Neoplasm
- Melanocytic_Skin_Neopla
 - Eyelid_Nevus
 - Benign_Melanocytic
 - Congenital_Melanoc
 - Cutaneous_Melanon
 - Dysplastic_Nevus
 - Breast_Nevus
 - Flexural_Skin_Nevus
 - Acrosyringial_Nevus
 - Head_and_Neck_Ne
 - Paraganglioma-Like
 - Acral_Skin_Nevus
- Skin_Appendage_Neop
- Benign_Skin_Neoplasr
- Cutaneous_Lymphoprolifer

Melanocytic_Skin_Neoplasm (Link To Concept)

Details Visualization Marginal Notes Mappings Resources

ClinicalTrials.gov
ClinicalTrials.gov provides regularly updated information about federally and privately supported clinical research in human volunteers. ClinicalTrials.gov gives you information about a trial's purpose, who may participate, locations, and phone numbers for more details. The information provided on ClinicalTrials.gov should be used in conjunction with advice from health care professionals. Before searching, you may want to learn more about clinical trials. Annotations:241

GEO
Gene Expression Omnibus
A gene expression/molecular abundance repository supporting MIAME compliant data submissions, and a curated, online resource for gene expression data browsing, query and retrieval. Annotations:4

ArrayExpress
ArrayExpress is a public repository for microarray data, which is aimed at storing MIAME-compliant data in accordance with MGED recommendations. The ArrayExpress Data Warehouse stores gene-indexed expression profiles from a curated subset of experiments in the repository. Annotations:2

ARRS GoldMiner
ARRS GoldMiner provides instant access to images published in selected peer-reviewed radiology journals. This new, web-based system allows viewers to search for images by findings, anatomy, imaging technique, and patient age and sex. Annotations:42

NextBio
NextBio's data and literature search engine makes massive amounts of disparate biological, clinical and chemical data from public and proprietary sources searchable, regardless of data type and origin, empowering researchers to quickly understand their own experimental results within the context of other research. Annotations:0

Text to annotate:
Melanoma is a bad disease

☐ With is_a transitive closure
☐ With is_a detailed transitive closure

☐ Get results as text
☒ Get results as tab delimited text
☐ Get results as XML
☐ Get results as OWL

Annotate

Documentation:

How to know in which ontologies a conceptID is defined:

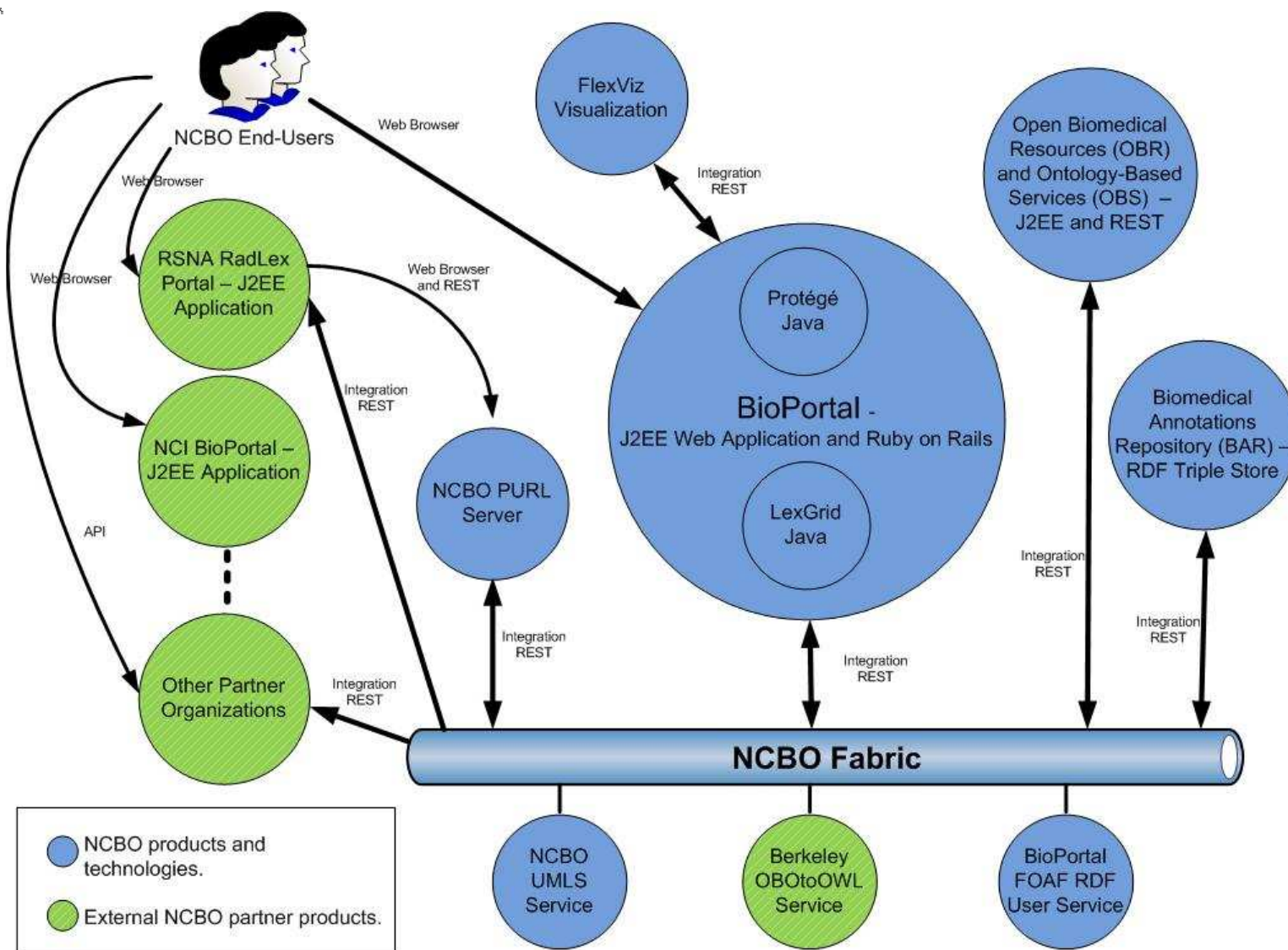
`/rest/ontologies/{conceptID}`

will return you an XML of OntologyBean.

Done



NCBO Fabric and REST Services





NCBO Fabric and REST Services

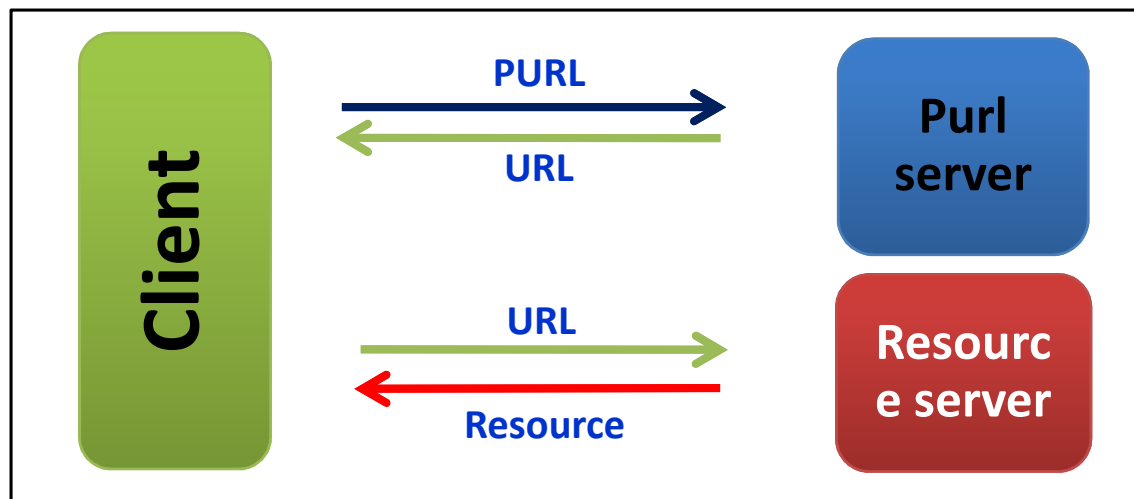
- NCBO Fabric (NetKernel)
- UMLS Services (leverages URI Security Gating)
 - ./umls
 - ./umls/{SAB}
 - ./umls/{SAB}/{AUI or CUI}
 - ./umls/{SAB}/{AUI or CUI}/children
 - ./umls/{SAB}/{AUI or CUI}/parents
 - ./umls/{SAB}/{AUI or CUI}/path
 - ./umls/{SAB}/search/{keyword}
 - ./umls/{SAB}/search/{keyword}/{index}/{count}
- OBOWtoOWL Converter Service – (leverages Throttling/Queuing)
- BioPortal FOAF RDF User Service



NCBO PURL Server

- PURL = Persistent URL
- Example
 - <http://purl.org/obo/owl/MA#MA:0000072>
 - <http://berkeleybop.org/ontologies/owl/MA#MA:0000072>
 - **<http://bioportal.bioontology.org/MA:0000072>**

The identifiers above represent the same thing.





Recap

- **BioPortal 2.0**
 - *Browsing Biomedical Ontologies*
- **Open Biomedical Resources**
 - *Using Ontologies to Access Public Data*
- **Open Biomedical Annotator**
 - *Using Ontologies to Annotate Your Data*
- **NCBO Fabric and REST Services**
 - *Embedding Our Services in Your Tools*
- **NCBO PURL Server**
 - *Providing URIs for Biomedical Concepts*



Next-Steps

- BioPortal 2.0: <http://bioportal.bioontology.org>
- NCBO Web Site: <http://www.bioontology.org>
- Q&A
- Contact

Benjamin Dai

Chief Software Architect

benjamin.dai@stanford.edu

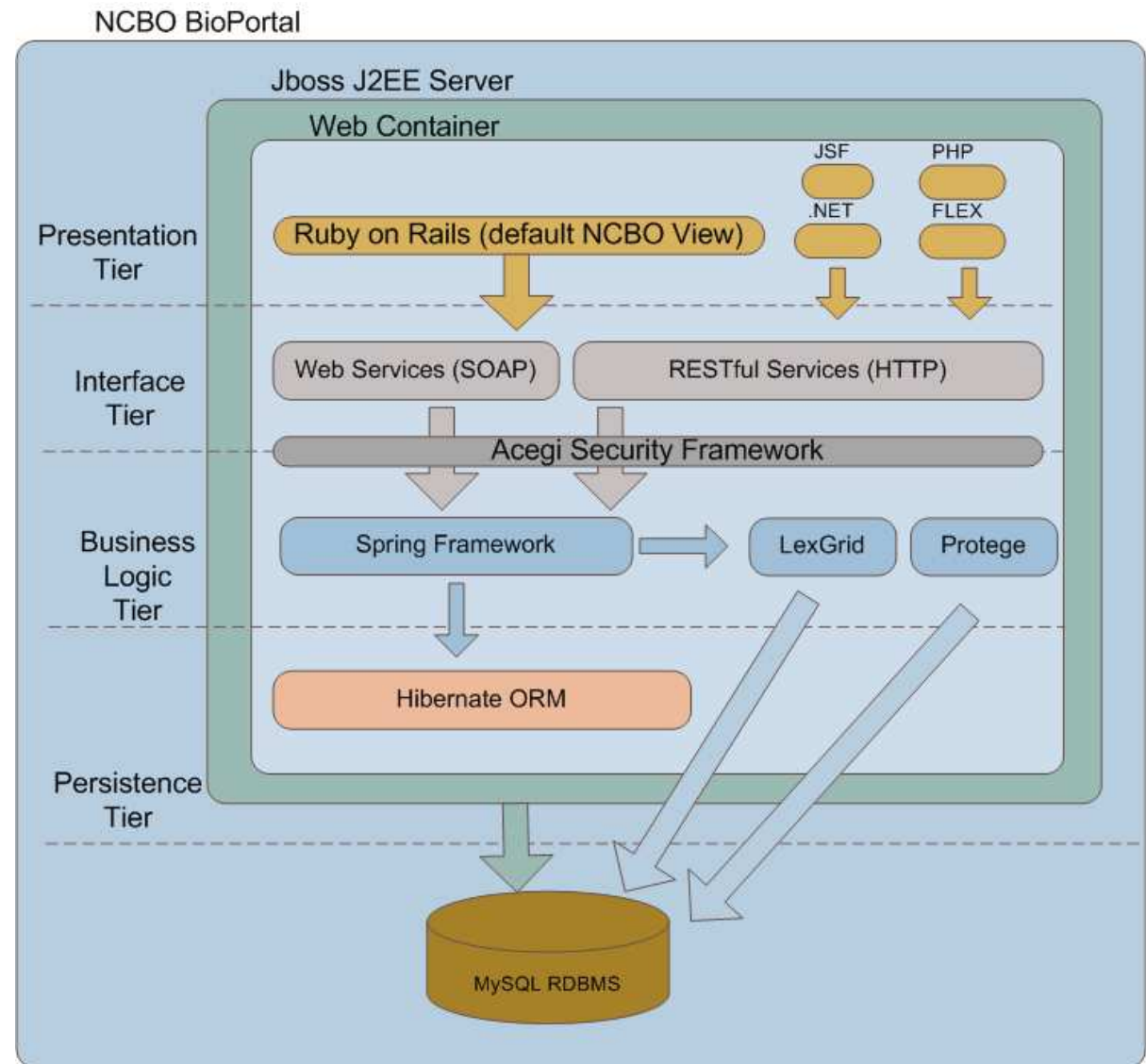


Appendix

- Additional Materials



BioPortal adopts a layered architecture





- Detailed view of BioPortal layered architecture.

