Web Services and Development of Semantic Applications

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Outreach Coordinator
Introductions

- Who you are
- What organization are you from
- What projects do you work on
- How do you want to incorporate the Web services into your project
National Center for Biomedical Ontology

• Mission
  – To create software for the application of ontologies in biomedical science and clinical care

• NCBO Partners
  – Stanford University - Dr. Mark A. Musen
  – Mayo Clinic - Dr. Christopher G. Chute
  – University of Buffalo - Dr. Barry Smith
  – University of Victoria - Dr. Margaret-Anne Storey
National Centers for Biomedical Computing
(http://www.ncbc.org)
NCBO Key Activities

• We *create and maintain a library* of biomedical ontologies
• We *build tools and Web services* to enable the use of ontologies
• We *collaborate with scientific communities* that develop and use ontologies
Links of Interest

• Web service tutorial document:
Outline

• Learning Objectives
• REST Web services
• BioPortal
• NCBO Web Services
Learning Objectives

• Learn what Web services are available from NCBO
• Learn how to programmatically use these Web services
• Learn how to combine these Web services to perform tasks
REST Web Services

• Accessed via HTTP
  – http://rest.bioontology.org/{parameters}
• Each unique URL is a representation of some object
• Operations include GET, POST, PUT, DELETE
• Lightweight, easy to build
Outline

• REST Web services
• BioPortal
• NCBO Web Services
• BioPortal SPARQL Endpoint
Welcome to BioPortal! For help using BioPortal, click on this icon: 

Most Viewed Ontologies (October, 2011)

<table>
<thead>
<tr>
<th>Ontology</th>
<th>Views</th>
</tr>
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<tbody>
<tr>
<td>National Drug File</td>
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<tr>
<td>NCI Thesaurus</td>
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</table>

Latest Notes

RE: what's the difference between this note and notes on mappings? (Biomedical Resource Ontology) about 1 month ago by whetzel
The Term Notes refer to comments or actions requested on Terms in the ontology. The Mapping Notes...

what's the difference between this note and notes on mappings? (Biomedical Resource Ontology) 2 months ago by imposimon
Would you guys please answer this for me?

Re: Why have you deprecated this? (Biomedical Resource Ontology) 4 months ago by whetzel
This term was deprecated because there was a typo in the term name.

Why have you deprecated this? (Biomedical Resource Ontology) 4 months ago by whetzel

http://bioportal.bioontology.org
Outline

• REST Web services
• BioPortal
• NCBO Web Services
• BioPortal SPARQL Endpoint
ONTIOLOGY WEB SERVICES

Accessing, browsing, searching and traversing ontologies in *Your* application
Ontology Web Services

• List All Ontologies
  – List all ontologies in BioPortal
One ontology id has many ontology version ids

Ontology version id

Ontology id

<success>
    <accessedResource>/bioportal/ontologies</accessedResource>
    <accessDate>2011-12-04 22:01:39.603 PST</accessDate>
- <data>
  - <list>
    + <ontologyBean></ontologyBean>
    + <ontologyBean></ontologyBean>
    + <ontologyBean></ontologyBean>
    - <ontologyBean>
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    Medical Subject Headings (MeSH); National Library of Medicine; February, 2009; Bethesda, MD; ENG
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Ontology Web Services cont.

• Search
  – Search by term or term identifier across all ontologies in BioPortal


• GoogleDoc Excel example:

• Example clients
Ontology Web Services cont.

- **Term**

- **Hierarchy**
RightField

http://www.sysmo-db.org/rightfield
ECG Gadget

http://wiki.cvrgrid.org/index.php/ECGGadget
ISAcreator

http://isatab.sourceforge.net/isacreator.html
DOG4DAG Ontology Generation Tool for OBO-Edit and Protégé
Background

Tuberculosis (TB) remains a major cause of mortality in developing countries, and in these countries diabetes prevalence is increasing rapidly. Diabetes increases the risk of TB. Our aim was to assess the potential impact of diabetes as a risk factor for incident pulmonary tuberculosis, using India as an example.

Methods

We constructed an epidemiological model using data on tuberculosis incidence, diabetes prevalence, and diabetes with diabetes. We used this model to calculate the difference in incidence between populations with and without diabetes. We estimated the increase in diabetes prevalence in urban areas associated with a 15.2% greater smear-positive tuberculosis incidence in urban than rural areas – over a fifth of the
cgMDR

http://cancergrid.org/index.php
openMDR

http://citih.osumc.edu/projects/project&r=1032
eleMap

https://victr.vanderbilt.edu/eleMAP/
BioPortal Import Plugin

WIDGETS

Using NCBO technology on your web pages
Widgets

• Form auto-complete – auto-complete function and can return term URI, term ID or term name
• Jump To – auto-complete function to select term and Jump To BioPortal to view term details
• Visualize widget – view the ontology structure and relations
• Tree widget – view the ontology tree

Code for widgets is available on BioPortal
Widgets

Form auto-complete

Jump To

RSS feed
Widgets

Visualization

Tree widget
RedFly

http://redfly.ccr.buffalo.edu/index.php
Radiological Society of North America

RadLex Tree Browser

Preferred Name: Interventional radiology procedure
RadLex ID: RID10367
PURL: http://www.radlex.org/RID/RID10367
Definition: Subspecialty of radiology that combines organ system radiography, catheter techniques and sectional imaging. [MeSH]

Synonyms: interventional radiology

Subtypes: stent placement, balloon dilation procedure, temporary occlusion, dilation of structure
Is a: treatment

http://radlex.org/
GMiner

http://gminer.mcw.edu/
Knowledge Egg

http://www.kunnskapsegget.no/
NOTES WEB SERVICES

Propose new terms and comment on ontologies
Notes Web Service

• Add term proposals and comments on ontology terms
• Documentation:
### Biomedical Resource Ontology

**New Term Proposal: Exercise Study Facility**

New Term Proposal submitted by Mette over 1 year ago on Physiology Facility in Biomedical Resource Ontology

<table>
<thead>
<tr>
<th>Subject</th>
<th>Author</th>
<th>Type</th>
<th>Target</th>
<th>Created</th>
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<tr>
<td>Exercise Study Facility</td>
<td>Mette</td>
<td>New Term Proposal</td>
<td>Physiology Facility (Class)</td>
<td>06/15/2010</td>
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</tbody>
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**Preferred Name:** Exercise Study Facility

**Provisional ID:**

**Parent:** http://bioontology.org/ontologies/BiomedicalResourceOntology.owl#Physiology_Facility

**Reason for Change:** Physiology

**Facility child**

**Synonyms:**

**Definition:** A facility or core devoted to exercise studies

### Responses

**RE: New Term Proposal: Exercise Study Facility** by whetzl over 1 year ago

Can you expand on what an exercise study is?

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**Subscribe to notes emails**
WebProtégé

http://protegewiki.stanford.edu/wiki/WebProtege
VIEWS

Custom subset of large ontologies
Views and Value Sets

• Users can submit their own derivatives of BioPortal ontologies
  – these which become first-class objects in BioPortal and can be used as all other Web services
Views in BioPortal

Views

Create new view

Expand All | Collapse All

- CORE Subset of SNOMED CT
- Neoplasm_breast_cancer
- Neoplasm_hamartoma
- SNOMED Anatomy
- SNOMED Clinical Findings
  - Description: The Clinical Finding subtree of SNOMED CT
  - Definition: Class subtree of ClinicalFinding
  - Ontology ID: 2018
  - Definition Language: Manual

<table>
<thead>
<tr>
<th>VERSION</th>
<th>BASE VERSION</th>
<th>CREATED</th>
<th>CREATED BY</th>
<th>ONTOLOGY FILE</th>
<th>DIFF FILE</th>
<th>VISIBILITY</th>
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<td>Tania Tudorache, <a href="mailto:tudorache@stanford.edu">tudorache@stanford.edu</a></td>
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<td>Download View</td>
<td></td>
<td>Public</td>
</tr>
</tbody>
</table>

- SNOMED Ethnic Group
- SNOMED Morphologically Abnormal Structure
- SNOMED Organism
- SNOMED Terminos Clinicos
- SNOMED Test Findings
Views and Value Sets

• View Extraction Web service
  – Given a root node term, extracts all child terms
    http://bit.ly/uXeh2s

• Access directly from Protégé via the BioPortal Import plugin
MAPPING WEB SERVICES

Using NCBO technology to integrate terminologies and ontologies
Mappings

Ontology A

Ontology B

Upload or Download mapping subsets
Using Mappings for query federation
Mappings

• Mappings Web service

• Functions
  – Get/Download
  – Create/Upload

• Example Perl client to Get mappings: http://bit.ly/tDKPQd
ANNOTATOR WEB SERVICE

Using Ontologies to Annotate Your Data
Annotator: The Basic Idea

- Tag textual metadata with ontology terms
Annotator Workflow

Raw Text

Entity Recognition Tool

Direct Annotations

Dictionary

Ontologies

UMLS

BioPortal

NCBI

Mgrep

MetaMap

Is a Transitive Closure

Semantic Distance

Mapping

Semantic Expansion Components

Semantically Expanded Annotations

TXT

CSV

XML

OWL
Annotator Web Service

• Tag free text with ontology terms
• Documentation: http://www.bioontology.org/wiki/index.php/Annotator_Web_service
• Example clients:
Gene Wiki

Annotator

<table>
<thead>
<tr>
<th>Gene</th>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RELN</td>
<td>GO: Biological Process</td>
<td>Brain Development</td>
</tr>
<tr>
<td>RELN</td>
<td>DO: Related Disease</td>
<td>Alzheimer’s</td>
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</table>

Statistical Tracking of Ontological Phrases (STOP)

http://www.mooneygroup.org/content/webtools
Ontological Discovery Environment

http://ontologicaldiscovery.org/
PATIENT NAME: X

ADMISSION DIAGNOSIS: Cervical spondylosis at C5-6 with disk herniation on the left side and left-sided C6 radiculopathy.

DISCHARGE DIAGNOSIS: Cervical spondylosis at C5-6 with disk herniation on the left side and left-sided C6 radiculopathy.

PROCEDURES PERFORMED: C5-6 anterior cervical discectomy and fusion with instrumentation, performed by Y.

REASON FOR HOSPITALIZATION: X is a 48-year-old man with left-sided neck pain and radiation down to the left side of his shoulder and upper arm with numbness of the thumb, index and middle fingers at the tips, more on the left, and ongoing for the past three months. The patient had an MRI scan of the cervical spine done in early MONTH, which revealed cervical spondylosis at C5-6 with disk herniation.

PAST MEDICAL HISTORY: Hypertension.

PAST SURGICAL HISTORY: None.

MEDICATIONS ON ADMISSION:
1. Advair Diskus one puff b.i.d.
2. Arixpin 20 mg one tablet q.a.m.
3. Flomax MDI two puffs p.o. b.i.d.
4. Abilify MDI two puffs q.4-h. p.r.n.
5. Flonase two sprays per nostril q.d.
6. Nexium 40 mg one capsule q.d.

PHYSICAL EXAMINATION ON ADMISSION: GENERAL: The patient had clear consciousness and no acute distress. NEUROLOGIC: The patient's range of motion was 70% of normal, but there was no Hermitte sign and no Spurling sign. There were no focal weaknesses present for both upper and lower extremities. BLOOD PRESSURE: 140/90 on both sides. Tricep was 1/4 to 2/4 on both sides. Knee jerk and ankle jerk were 2/4 on both sides. Posterior tibialis was 2/4 on both sides. LUNG: Clear to auscultation bilaterally. CARDIOVASCULAR: Regular rate and rhythm. ABDOMEN: Benign. EXTREMITIES: No cyanosis or edema.

HOSPITAL COURSE: The patient was admitted to the hospital on 03-03, and taken to the operating room for a C5-6 ACDF with instrumentation. The patient tolerated the procedure well. There were no complications. The patient recovered well in the PACU without any events, and the patient was transferred to the floor. While on the floor there were no acute events overnight. The patient was tolerating oral intake, and the patient's pain was under control with oral pain medications. On postoperative day #1 the patient was tolerating an oral diet, ambulating and voiding on his own, and the patient was discharged home.
DATA SERVICE

Using Ontologies to Access Public Data
Resource Index: The Basic Idea

- The index can be used for
  - Search
  - Data mining
Resources index: Example

Accessing resource elements

Concept recognition

Semantic expansion

172 closure annotations

Examples:
Cancer, concept (DOID:162) in ontology Human disease
Skin Neoplasms, concept (DOID:3165) in ontology Human disease

23 direct annotations
(4 title, 19 description)

Example:
Melanoma, concept (DOID:1909) in ontology Human disease.
Data Access

• Resource Index Web service
ODiSSSea

Clinical Trials (1146)

Results from ClinicalTrials.gov
1) Insulin Resistance and Atherosclerosis in Women With Lupus
2) Non-traditional Cardiovascular Risk Factors and Atherosclerosis in Type 2 Diabetes
4) Non-Invasive Assessment of Atherosclerosis in Patients With CGD and Other Disorders of the Immune System
5) Multi-Analyte, Genetic, and Thrombogenic Markers of Atherosclerosis
6) Understanding the Genetic and Hereditary Basis of Atherosclerosis

See all resources at NCBO
BioPortal SPARQL Endpoint

• Query interface: http://sparql.bioontology.org/
• Example queries: http://sparql.bioontology.org/examples
• Sample code: https://github.com/ncbo/sparql-code-examples
Thank you!

• Web service documentation: http://www.bioontology.org/wiki/index.php/NCBO_REST_services

• Keep in touch
  – Software support: support@bioontology.org
  – Twitter: @bioontology
  – Facebook: http://on.fb.me/bioontology
  – LinkedIn: http://linkd.in/ncbo-group

• Questions: support@bioontology.org