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# Ontology Services for Semantic Applications in Healthcare and Life Sciences

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## Background

Recently, researchers have turned to the Semantic Web to integrate, summarize, and interpret disparate knowledge. Ontologies provide the domain knowledge to drive such data integration and information retrieval, on the Semantic Web. The successful creation of semantic applications in the health and life sciences requires services that provide software applications with access to bioontologies over the Web. The National Center for Biomedical Ontology (NCBO), one of the seven National Centers for Biomedical Computing created under the NIH Roadmap, has developed BioPortal, which provides access to one of the largest repositories of biomedical ontologies both via Web browsers and Web services (via RESTful services).<sup>1</sup> BioPortal enables ontology users to visualize, browse and search ontologies. The BioPortal Web services allow programmatic access, download and traversal of ontologies in software applications, such as in the recently released Microsoft Word 2007 Ontology add-in. Researchers can use the BioPortal Web services to “tag” any text automatically with terms from BioPortal ontologies and to use ontology terms to access public data resources.

## System Description

In this demonstration, we will highlight key BioPortal REST services, along with examples of how to use the services in applications. Our demonstration at the AMIA 2008 meeting highlighted the user-interface capabilities of BioPortal.

In the BioPortal user interface, users can see a list of all ontologies, their characteristics, and information about different versions, download the ontologies, navigate the class hierarchy and see details of each class. Developers can access all the information that drives these actions via *Ontology Navigation* Web services, allowing a user to embed this functionality in their software applications. Software applications, such as Microsoft Word 2007’s ontology add-in, can access ontologies from BioPortal to mark up a research article at the time of writing<sup>2</sup>.

The *Open Biomedical Annotator* Web service processes text that is submitted by users, recognizes relevant biomedical ontology terms and returns the list of recognized terms to the users. Users can customize the service to limit results to a particular ontology (e.g. SNOMED CT) or to a certain UMLS semantic type (e.g. T017 for ‘Anatomical Structure’). The actual concept recognition engine, called MGREP, is developed by the National Center for Integrative Bioinformatics and is combined with our ontology services to create the annotator service. The annotator service makes the task of creating ontology-based annotations—from textual data such as descriptions of experiments—accessible for any biomedical researcher.

BioPortal indexes several biomedical data repositories available online (e.g., entries in PubMed, GEO, ClinicalTrials.gov, PharmGKB) on the basis of their textual metadata, and links their records to ontology terms. These linkages take advantage of the semantic relationships in BioPortal, including subsumption relationships among ontology entities and mappings between entities in different ontologies. The *Open Biomedical Resources* Web service allows biomedical investigators to use ontology terms to search programmatically the resulting index of online public repositories. For example, one can search for all experiments and clinical trials corresponding to ‘malignant melanoma’ from GEO and ClinicalTrials.gov.

## Conclusion

BioPortal offers researchers a one-stop shop on the Web for biomedical ontologies. The access to ontologies is available both via a browser, which allows interactive exploration and via Web services, which enables the construction of ontology-enabled semantic applications, as well as enables search of public data resources using ontology terms.

The Web services provided by BioPortal are available at [www.bioontology.org/wiki/index.php/NCBO\\_REST\\_services](http://www.bioontology.org/wiki/index.php/NCBO_REST_services). The BioPortal technology is open-source and is domain-independent. Thus, other communities can reuse the software to maintain their own ontology repositories and services.

<sup>1</sup> <http://biportal.bioontology.org>

<sup>2</sup> Microsoft Word Add-in for Ontology Recognition  
<http://ucsdbiolit.codeplex.com/>