

# Use Cases for the Interoperation between an Ontology Repository and an Ontology Editor

## System Description

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**Abstract.** Ontology repositories provide the crucial infrastructure for publishing and sharing ontologies in an increasing number of domains. Some of these ontology repositories expose the metadata and the ontology content using APIs or Web services that enable the mashing up of applications in a straightforward way. In this paper, we describe two use cases in which the interoperation of an ontology repository and an ontology editor support two common tasks in the ontology-development cycle: reuse and collaboration. We present specific examples of how we benefited from the mashing up of BioPortal—a Web-based ontology repository for biomedical ontologies—and WebProtégé—a Web-based ontology editor—in the development of real-world biomedical ontologies.

## 1 Introduction

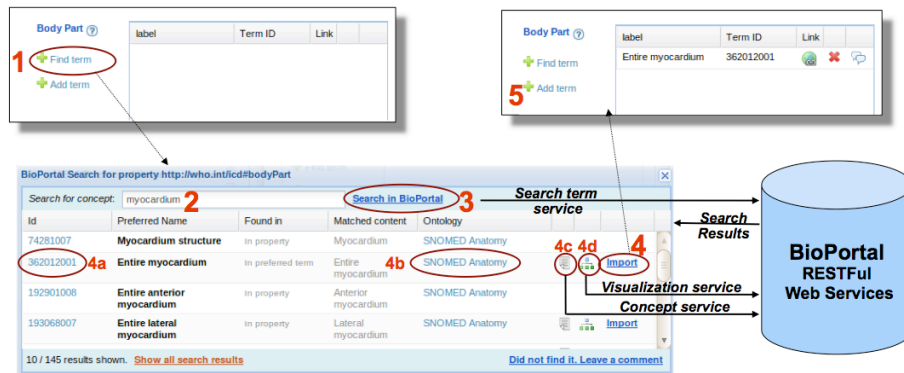
Recent years have brought a large number of new ontologies and ontology-driven applications. As ontologies become more numerous, providing infrastructure for publishing, finding, and mapping them becomes ever more important. A number of ontology repositories, such as BioPortal[3], Cupboard [1], and ONKI [6] provide software solutions and methodologies that are suitable for a more mature phase of the Semantic Web, in which more ontologies are available for reuse and ontology building is collaborative.

At the current time, the landscape of ontology tools is separated into **ontology repositories** that are still recent developments, and **ontology editors**, which have been in use for over two decades. Both infrastructures provide critical functionality for different stages in the ontology lifecycle. Ontology editors support the development of ontologies, while ontology repositories enable their publishing and sharing. However, there has been little research on bringing the two infrastructures together to provide enhanced support throughout the ontology lifecycle and to streamline the processes that require the transitioning from one infrastructure to the other. We describe two use cases that show how an ontology repository (BioPortal) and an ontology editor (WebProtégé) can work together to create an improved integrated environment for the users.

BioPortal<sup>1</sup> is a repository of biomedical ontologies. It uses social approaches to bring structure and order to its collection. It enables users to provide a wide array of knowledge components, from submitting the ontologies themselves, to commenting on and discussing classes in the ontologies, to reviewing ontologies in the context of their own ontology-based projects, to creating mappings between overlapping ontologies [2].

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



**Fig. 1.** Importing a BioPortal term as the value for the property *bodyPart*: (1) The *BioPortal Reference Widget* for filling in the *bodyPart* value. The user clicks on *Find term*; types the search string (2) and then clicks on the *Search* button (3). The search results are retrieved from BioPortal using a Web service invocation. The user has different options to get details about the results on (4a,b,c,d) that trigger other BioPortal service calls. To perform the import of the property value, the user clicks the *Import* button (4). The result of the import is shown in (5).

As of August 2010, BioPortal hosts more than 200 ontologies with more than 2.5 million classes and over 4 million mappings. All the information in BioPortal is accessible via RESTful Web services<sup>2</sup>, which enables the use of its content in other applications.

WebProtégé<sup>3</sup> is a Web-based client for Protégé that supports browsing and collaborative editing of ontologies [4]. The collaborative features are directly integrated in the editing process and allow the addition of notes and proposals to entities in the ontology, change tracking, and setting the access policies for different user roles [5].

In this paper, we present two use cases that show the benefits of the interoperation of BioPortal and WebProtégé for ontology reuse (Section 2) and collaboration (Section 3). We discuss this interoperation in the context of the development of the 11th revision of the International Classification of Diseases (ICD-11) that has been initiated by the World Health Organization (WHO).

## 2 Use Case: Reusing Ontologies and Terms

Reuse of ontologies or parts of ontologies is one of the best practices in ontology development, and indeed is one of the key ways in which ontologies facilitates data integration. Ontology repositories enable reuse by allowing users to search for ontologies suitable for their projects. In our work, we identified two use cases for ontology reuse: (1) reusing an ontology or part of it, and (2) reusing specific entities (e.g., classes).

To enable the first use case (ontology reuse), BioPortal provides a user interface and Web services for retrieving the list of available ontologies, and their metadata, and to search across the ontologies to find ontologies with relevant terms. An ontology editor can then enable users to search for the ontology of interest directly from the editing environment and to import this ontology into the ontology that they are developing. For

<sup>2</sup> [http://www.bioontology.org/wiki/index.php/NCBO\\_REST\\_services](http://www.bioontology.org/wiki/index.php/NCBO_REST_services)

<sup>3</sup> <http://protegewiki.stanford.edu/wiki/WebProtege>

example, Protégé 4 allows users to open an ontology directly from BioPortal and to import the ontology directly into their ontology. The NeON toolkit has similar functionality by providing access to ontologies indexed by Watson. What makes the import from BioPortal particularly powerful is the fact that BioPortal also enables users to add parts of the ontologies, such as specific branches, to the repository. These components—*views* in BioPortal terms—then also become available for reuse. Thus users can extract the portions of the ontologies that they plan to reuse, publish them in BioPortal, thus getting them indexed along with other ontologies and getting the Web service access to them, and then import these portions into their ontologies.

Often, rather than importing the whole ontology or even a portion of it, the users want simply to refer to a term in another ontology (reuse specific entities in ontologies). For example, ICD-11 describes diseases and their properties. The values for many of the properties come from SNOMED CT, a widely used biomedical ontology. For example, the property *bodyPart* of a disease class should take as values references to terms in the *Anatomy* branch in SNOMED CT. Ontology repositories provide the infrastructure that the ontology editors need to implement this type of functionality. We describe the *BioPortal Reference Widget* in WebProtégé as an example of such integration.

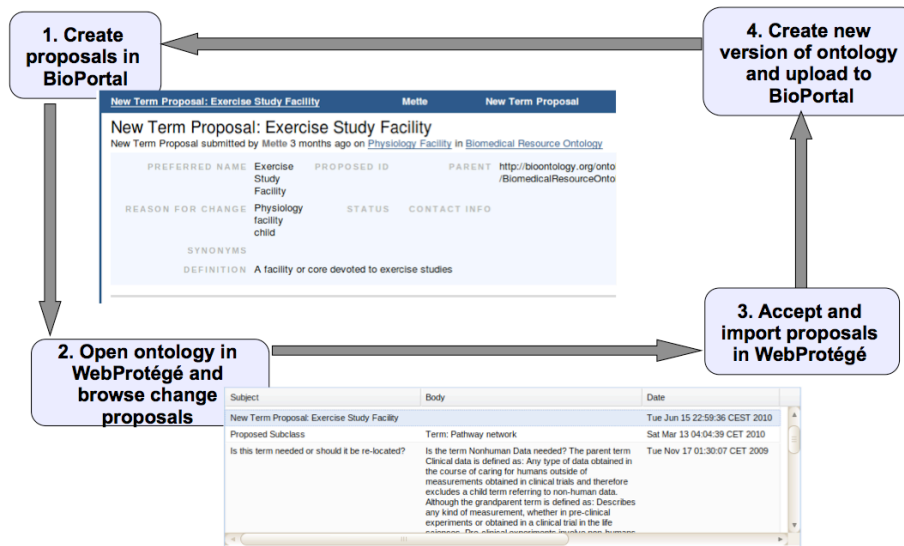
Figure 1 shows the Reference Widget for the *Myocardial Infarction* class in ICD-11 where the user wants to reference a term from the *Anatomy* ontology view as a value of the property *bodyPart*. Once the user clicks on the *Find term* link, she will get to a search panel where she can type a search term, in this case “*myocardium*”. The widget invokes a search Web service call in the *Anatomy* view that returns the results as XML. The widget displays the results as a table with multiple columns. The user has multiple options to learn more about the terms that the search returned, all realized using BioPortal Web service calls: I. Browse the term directly in BioPortal (4a), II. Browse the entire ontology in BioPortal (4b), III. Browse the details of the concept (4c), or IV. Browse an interactive graphical representation of the term neighbourhood. These helping options are extremely useful if the service returns multiple similar search results, and if the user is not very well acquainted with the ontology. Once the user has made a choice, the final import is as easy as clicking on the *Import* button. As a result of the import, the widget creates an instance in the underlying ontology that stores the BioPortal related metadata about the reference: the identifier, the source ontology name and identifier and the direct BioPortal URL for the imported term.

The linking to BioPortal and the BioPortal Reference Widget provide essential functionality in the development of ICD-11, where the majority of disease properties have as value sets views in external ontologies stored in BioPortal.

### 3 Use Case: Supporting Collaboration Processes

Most of the ontologies stored in a repository are not static in nature, but are rather dynamic, and evolve over time. Very often, ontologies are developed as part of a community effort involving a large number of contributors. In such a process, the contributors must be able to comment and work together on defining concepts in the ontology. To support these type of collaboration processes, BioPortal allows users to add structured change proposals and different types of notes on classes in an ontology.

However, BioPortal, as most ontology repositories, does not directly support the actual editing of an ontology. To perform the proposed changes, a user has to use an



**Fig. 2.** Proposals workflow in BioPortal and WebProtégé. Users are creating proposals in BioPortal(1), then browse and accept the change proposals in WebProtégé (2,3). Finally they create a new version of the ontology with the new edits and upload it to BioPortal(4), and then a new proposal cycle begins.

ontology editor and to manually make the necessary edits in the ontology. To streamline this process, we integrated BioPortal with WebProtégé to allow the automatic import of structured change proposals. We use the BioPortal Web services for integration.

Figure 2 shows a proposal workflow that we plan to support in our tools in the near future. In the first step of the workflow, users add structured change proposals in BioPortal (1). The figure shows an example of a *New term* proposal with its predefined properties. When the curators of the ontology open the ontology in WebProtégé to review the existing change proposals (2), they are able to accept or reject proposals directly in WebProtégé (3). The accepted proposals are automatically imported into the ontology. For example, a *New term* proposal, if accepted, will automatically create a new class in the ontology using the information in the properties of the proposal. The status of the proposal is then changed using the BioPortal Web services. After reviewing the current proposals in WebProtégé and possibly performing additional edits, the curator creates a new version of the ontology and uploads it into BioPortal(4). Then, a new workflow cycle begins on the new version of the ontology.

## 4 Discussions

The two use cases show real-world scenarios in which the combination of features of BioPortal and WebProtégé provide crucial functionality in ontology development.

We have developed the *BioPortal Reference Widget* as part of our collaboration with WHO to support the reuse of terms from ontologies stored in BioPortal in the ICD-11 ontology. This widget is available both in WebProtégé and in the Protégé 3 desktop client. This widget is configurable and is used also in other projects to create references to terms in external ontologies. While importing references is a common task, other

projects have additional requirements: Rather than creating a reference to an external term, we should import the term with its original URI and possibly with some of its properties. This requirement may raise additional challenges. For example, if we should also import instance property values or axioms of a class, how far should we follow the references? We are working on a prototype in which we can import a term or a branch in an ontology directly in an ontology.

The proposal workflow is driven by several of our collaborators who want to take advantage of the BioPortal infrastructure, but also need to revise and publish new versions of their ontologies. We have already implemented several of the steps in this workflow, and we are currently working on providing a seamless integration of the two tools. For example, we have already implemented the browsing of BioPortal proposals in WebProtégé, but have only a partial implementation of the automatic import of the proposal content. In a similar way, we have implemented the uploading of a new ontology version from WebProtégé to BioPortal, but this feature is not yet exposed in the user interface. The next phase of the ICD-11 development will be the most visible project of large scale that will use this proposal workflow in a production setting.

## 5 Conclusion

We have presented two real-world use cases that show the close interoperation of BioPortal—a biomedical ontology repository—and WebProtégé—a Web-based ontology editor. The first use case describes how ontology terms in BioPortal can be reused in other ontologies in WebProtégé. The second use case presents a proposal workflow in which the ontology repository provides the infrastructure for publishing and creating proposals in an ontology, and the ontology editor is used to import the structured proposals in the ontology. The requirements of these use cases are driven by several large scale biomedical projects and serve as a guide for our future developments.

## Acknowledgments

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