Updates to the AberOWL ontology repository

Miguel Ángel Rodríguez-García [1]*, Luke T Slater [2], Imene Boudellioua [1], Paul N Schofield [2], Georgios V Gkoutos [3], Robert Hoehndorf [1]

[1]Computational Bioscience Research Center, King Abdullah University of Science and Technology, Thuwal 23955-6900, KSA
[2]College of Medical and Dental Sciences, Institute of Cancer and Genomic Sciences, Centre for Computational Biology, University of Birmingham, B15 2TT, United Kingdom
[3]University of Cambridge, Downing Street, CB2 3EG, England, UK

ABSTRACT

A large number of ontologies have been developed in the biological and biomedical domains, which are mostly expressed in the Web Ontology Language (OWL). These ontologies form a logical foundation for our knowledge in these domains, and they are in widespread use to annotate biomedical and biological datasets. The use of the semantics provided by ontologies requires the use of automated reasoning – inferring new knowledge by evaluating the asserted axioms. AberOWL is an ontology repository which utilises an OWL 2 EL reasoner to provide semantic access to classified ontologies. Since our original presentation of the AberOWL framework, we have developed several additional tools and features which enrich its ability to integrate and explore data, make use of the semantic and inferred content of ontologies. Here we present an overview of AberOWL and the enhancements and new features which have been developed since its conception. AberOWL is freely available at `http://aber-owl.net`.

1 INTRODUCTION

In recent years, several biological and biomedical ontology repositories have been developed, such as BioPortal [5], Ontobee [7] and the Ontology Lookup Service [2]. These provide web services and front-end interfaces for users to query and explore the content of ontologies. AberOWL [3] is an ontology repository which utilises automated reasoning to allow users to access the semantic content of the ontologies. AberOWL provides both a web-based interface for the exploration and browsing of ontologies and a set of REST services which make the core functionality of AberOWL available using the JSON standard [1].

1.1 Updates to AberOWL

Ontology Acquisition, Curation and Statistics: When AberOWL was originally presented in 2013, it contained 328 loadable ontologies. Since then, our repository has grown to a total of 522 ontologies. The amount of ontologies in AberOWL has increased due to the growing number of ontologies in the biological and biomedical domains, improved coverage of synchronization with other ontology portals, and manual uploads of ontologies by users. Manually uploaded ontologies in AberOWL primarily serve the purpose of making fully axiomatised versions of ontologies available so that the AberOWL webservices can be used to classify and query these ontologies (i.e., AberOWL is used as a "Reasoning as a Service" provider).

1.2 Manual curation of ontologies:

We have also manually curated the ontologies in AberOWL, assigning a set of 'topics' to them and allowing users to browse the ontologies through these means. The set of topics were extracted from the ontology EMBRACE Data and Methods (EDAM) [4] which is essentially a taxonomy of well established terms with synonyms and definitions related primarily within bioinformatics. The annotations covered 177 different EDAM topics spanning all EDAM top-level topics such as: Medicine, Biology, Data management, Laboratory techniques, Computer science, Chemistry, Mathematics, Physics, Ontology and terminology and Literature and reference. For instance, the Amphibian Gross Anatomy Ontology (AAO) was classified with the topics *eukaryotes*, *anatomy*, and *amphibians*, and the Ascomycete Phenotype Ontology (APO) was annotated with *fungi*, *phenomics* and *ascomycetes*. The figure 1 shows a list of annotated ontologies in AberOWL.

1.3 Ontology Browsing and Visualisation:

We have improved the tools available for browsing and exploring ontologies. The class view in the ontology browser now shows the definition of the class in Manchester OWL Syntax. Additionally, the visualization module has been completely redesigned and we plan to further integrate a new library called Dagre [6], which provides another way of representing ontologies by graphs instead of trees. Thus, while the current visualization module represents cycles as a repeated subtree, the new module can easily include cycles without any repeated structure. Moreover, we plan to improve the performance of this module by transforming the ontologies into RDF graphs which will contain the inferred model of each ontology. Thus, we will be able to significantly reduce the delay involved in subclass computation.

*To whom correspondence should be addressed: miguel.rodriguezgarcia@kaust.edu.sa

REFERENCES

[1]Tim Bray. The javascript object notation (json) data interchange format. 2014.

[2]Richard G Côté, Philip Jones, Rolf Apweiler, and Henning Hermjakob. The ontology lookup service, a lightweight cross-platform tool for controlled vocabulary queries. *BMC bioinformatics*, 7(1):97, 2006.

[3]Robert Hoehndorf, Luke Slater, Paul N Schofield, and Georgios V Gkoutos. Aber-owl: a framework for ontology-based

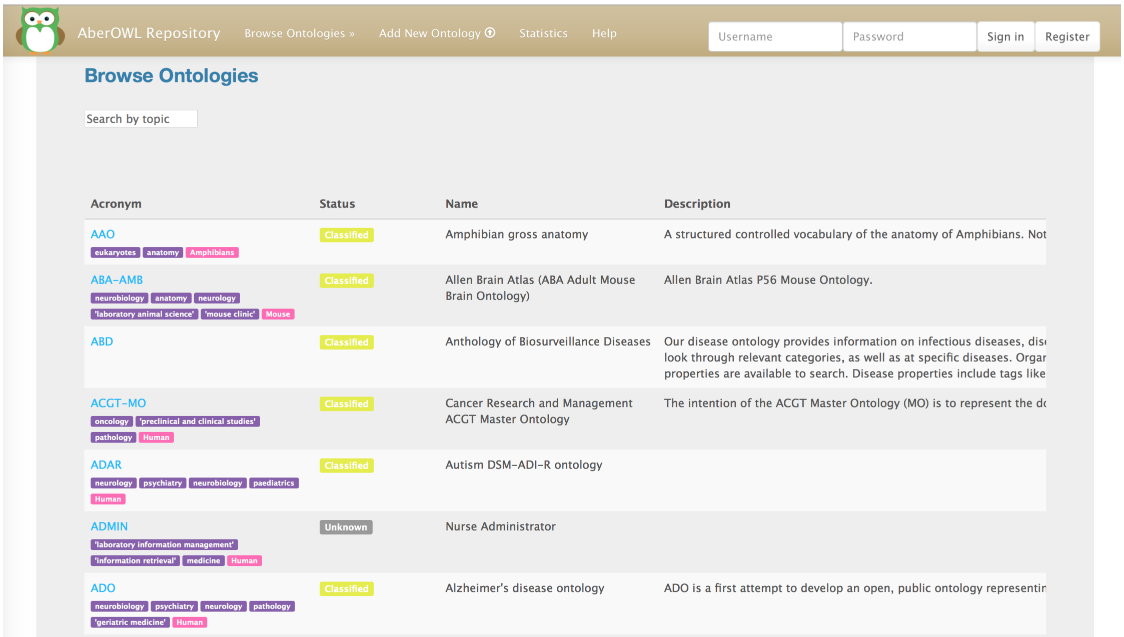

Fig. 1. Screenshot of AberOWL that shows the list of annotated ontologies by using the EDAM topics.

data access in biology. *BMC bioinformatics*, 16(1):1, 2015.

[4]Jon Ison, Matúš Kalaš, Inge Jonassen, Dan Bolser, Mahmut Uludag, Hamish McWilliam, James Malone, Rodrigo Lopez, Steve Pettifer, and Peter Rice. Edam: an ontology of bioinformatics operations, types of data and identifiers, topics and formats. *Bioinformatics*, 29(10):1325–1332, 2013.

[5]Natalya F Noy, Nigam H Shah, Patricia L Whetzel, Benjamin Dai, Michael Dorf, Nicholas Griffith, Clement Jonquet, Daniel L Rubin, Margaret-Anne Storey, Christopher G Chute, et al. Bioportal: ontologies and integrated data resources at the click of a mouse. *Nucleic acids research*, page gkp440, 2009.

[6]Chris Pettitt. dagre - graph layout for javascript, 2015.

[7]Zuoshuang Xiang, Chris Mungall, Alan Ruttenberg, and Yongqun He. Ontobee: A linked data server and browser for ontology terms. In *ICBO*, 2011.