Onto-animal tools for reusing ontologies, generating and editing ontology terms, and dereferencing ontology terms

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Abstract

Onto-animal tools are a package of web-based ontology tools developed to support efficient and integrated ontology development and application. This package of tools includes OntoFox, Ontodog, Ontorat, Ontobee, Ontobeep, and Ontobat. Each tool has specific functions; together, these tools support the extraction of a single or subset of terms and community views from existing ontologies, gen-eration and editing of ontology terms, query and visualization of ontology terms, comparison among ontologies, and instance-level data representation and analysis. Based on the Web Ontology Lan-guage (OWL) and Semantics Web technologies, these tools have widely been used by thousands of ontology developers in over 20 communities.

Introduction

Biological/biomedical ontologies are sets of computer- and human-interpretable terms and relations that represent entities and their relations in the biological/biomedical world. Biomedical ontologies have emerged as a major tool for the integration and analysis of the large amounts of heterogeneous biological data available in the post-genomics era.

To support ontology development and applications, we have developed a collection of "Onto-animal" tools, including OntoFox (Xiang et al., 2010), Ontodog (Zheng et al., 2014), Ontorat (Xiang et al., 2015), Ontobee (Xiang et al., 2011), Ontobeep (Xiang and He, 2010), and Ontobat (Xiang et al., 2015). The back-end of these Onto-animal tools is the He group's RDF triple store (http://sparql.hegroup.org), which has become the default ontology RDF triple store for the Open Biological and Biomedical Ontologies (OBO) Foundry ontologies. Fig. 1 provides a summary of these tools.

Although initially developed to meet the needs of Vaccine Ontology (VO) development (He et al., 2009;Ozgur et al., 2011), "Onto-animal" tools have been widely used by many users for various applications. According to Google Analytics, in the past five years, over 9,000 and 38,000 users from >10 countries have used the OntoFox and Ontobee web programs, respectively. According to Google Scholar, our Onto-animal tools have been cited in >200 publications.

Overview of Onto-animal Tools

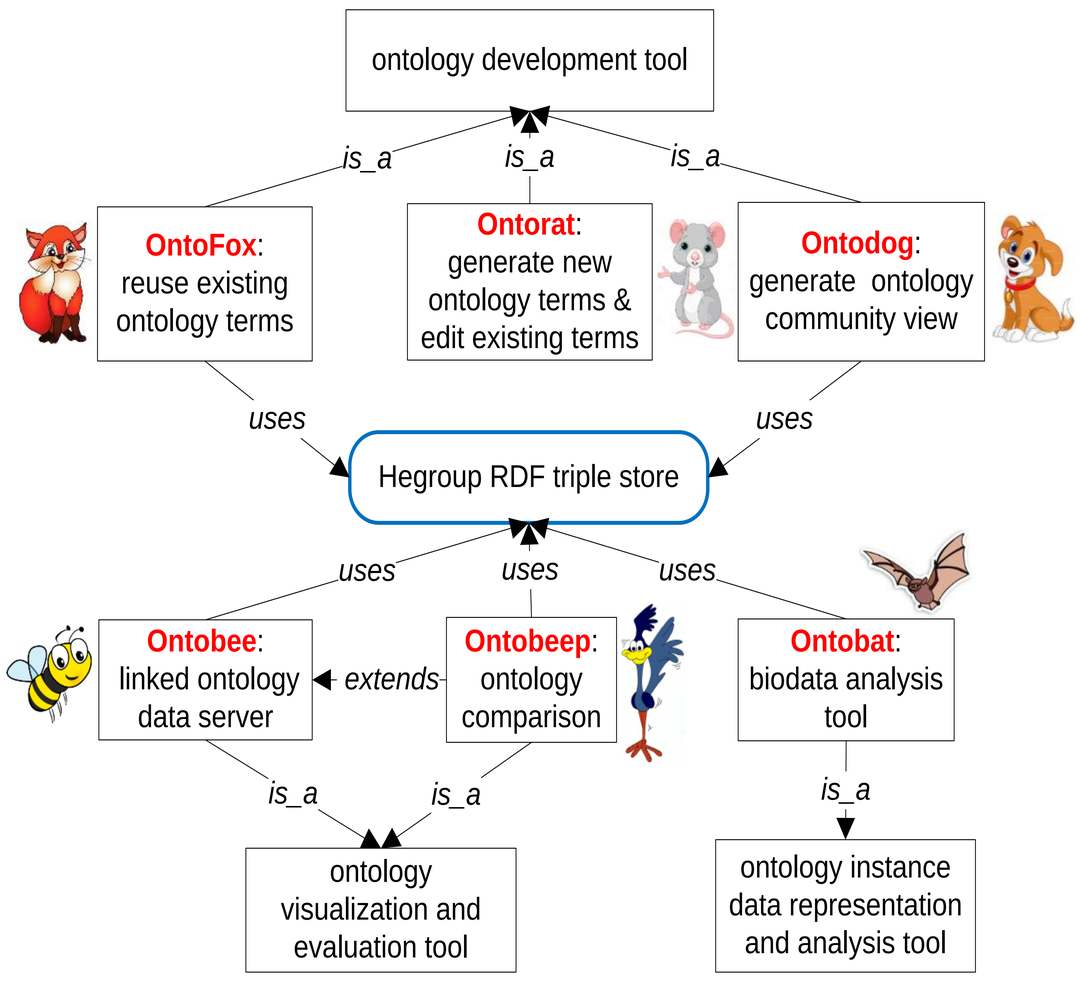

Fig. 1. Onto-animal tools and their features.

Onto-animal Tools

OntoFox: Extract ontology terms and axioms (http://ontofox.hegroup.org/)

OntoFox fetches selected classes, properties, annotations, and their related terms from source ontologies and save the results in the OWL format. OntoFox implements the Minimum Information to Reference an External Ontology Term (MIREOT) strategy by extracting minimum information of requested terms (Courtot et al., 2011). OntoFox can extract different levels of intermediate terms between the required terms and a chosen higher level or top term. Inspired by existing ontology modularization techniques (Stuckenschmidt et al., 2009), OntoFox also implements a new SPARQL-based ontology term extraction algorithm that extracts all terms and axioms related to user-provided terms.

Ontodog: Generate ontology community view (http://ontodog.hegroup.org/)

Similar to OntoFox, Ontodog is able to extract a subset of ontology terms and axioms. Unlike OntoFox, Ontodog includes two unique features: (1) Ontodog allows the generation of an ontology community view, which we have defined as "the whole or a subset of the source ontology with *user-specified annotations including user preferred labels*" (Zheng et al., 2014). (2) Ontodog uses user-friendly Excel input files to identify which terms to retrieve and to add user-specified annotations.

Ontorat: Adding new terms and new axioms to an ontology based on ontology design pattern (ODP) (http://ontorat.hegroup.org)

A specific ODP can be used to derive an Excel template of different terms/annotations and a set of rules that define the relations among those terms/annotations. An Ontorat template is similar to a QTT (Quick Term Template) (Rocca-Serra et al., 2011). Such a template can be populated with specific terms or annotations to define/annotate specific ontology terms. With Ontorat settings, the populated template spreadsheet can then be converted into OWL with newly generated ontology terms and axioms.

Ontobee: Linked data server for web displaying and dereferencing ontology terms (http://www.ontobee.org)

Ontobee loads individual page for each ontology term with detailed information. For each ontology, Ontobee generates statistics with counts of classes and different properties based on term ontology prefixes. Ontobee automatically provides an Excel document listing all terms in an ontology. Ontobee provides ontology term search and SPARQL query service supported by the He group triple store. Ontobee is a *de facto* search engine for OBO Foundry ontologies. Currently Ontobee includes 156 ontologies.

Ontobeep: Ontology comparison (http://www.ontobee.org/ontobeep/)

Ontobeep is an ontology comparison program. Ontobeep can be used to compare different ontologies by aligning them from the roots of these ontologies. The alignment identifies common terms existing in two or three ontologies. Ontobeep also provides a statistic report of the alignment analysis. Ontobeep may be utilized to detect inconsistency and term duplication in one or more ontologies.

Ontobat: Ontology-based data analysis (http://ntobat.hegroup.org)

Unlike other Onto-animal tools, Ontobat focuses on instance level ontology data generation and analysis. Ontobat aims to support Linked Open Data (LOD) generation, upload, query, browsing, and statistical analysis. Many features of Ontobat are still under development.

Summary and Discussion

The web-based Onto-animal tool package provides a set of comprehensive tools to support ontology development and applications. These tools save time and efforts for ontology developers and users, especially those who do not have or have limited software programming background.

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