

RightField: embedding ontology annotation in spreadsheets

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ABSTRACT

Motivation: In the Life Sciences, guidelines, checklists and ontologies describing what metadata is required for the interpretation and reuse of experimental data are emerging. Data producers, however, may have little experience in the use of such standards and require tools to support this form of data annotation.

Results: RightField is an open source application that provides a mechanism for embedding ontology annotation support for Life Science data in Excel spreadsheets. Individual cells, columns or rows can be restricted to particular ranges of allowed classes or instances from chosen ontologies. The RightField-enabled spreadsheet presents selected ontology terms to the users as a simple drop-down list, enabling scientists to consistently annotate their data. The result is ‘semantic annotation by stealth’, with an annotation process that is less error-prone, more efficient, and more consistent with community standards.

Availability and implementation: RightField is open source under a BSD license and freely available from <http://www.rightfield.org.uk>

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1 INTRODUCTION

The quantity and complexity of biological data produced during standard laboratory projects has increased with the availability of high-throughput technologies. Advances in areas, such as, transcriptomics and proteomics, enable scientists to produce high volumes of data in single experiments. In order to compare and reuse this data, however, rich metadata annotation is required.

The biocuration and data standards communities have been addressing this issue by providing recommendations for annotation requirements. Minimum information models (Taylor *et al.*, 2008) with associated controlled vocabularies or ontologies that define the terms that should be used to describe metadata elements are being developed. In some cases, publication submissions are not accepted unless the accompanying data is compliant with the relevant minimum information model (for microarrays, this is MIAME, the Minimum Information About a Microarray Experiment). However, despite this drive to standardization, there are few tools to help scientists manage this process. RightField was created to allow data curators (informaticians and ontologists) to augment standards

compliant spreadsheet templates with embedded ontology term selection. Once a RightField-enabled template has been prepared, laboratory scientists can use it in its native form to annotate their data using simple drop-down boxes.

RightField was produced by the SysMO-DB project. SysMO-DB is developing a platform for data management and exchange in Systems Biology, primarily for the pan-European SysMO consortium (Systems Biology of Micro-Organisms). SysMO-DB supports a consortium of over 300 scientists, from a variety of Life Science backgrounds, with little experience of metadata management, ontologies and standardization. Data is standardized by developing spreadsheet templates for different types of experiment and embedding ontology term selection, using RightField, within these templates. The combination of templates and RightField, provides an infrastructure that promotes and encourages compliance and consistent data annotation.

2 DATA ANNOTATION AND REUSE

RightField is an application developed to operate within spreadsheets since spreadsheet use is ubiquitous in laboratory sciences.

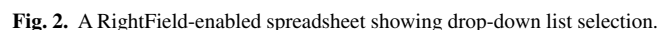
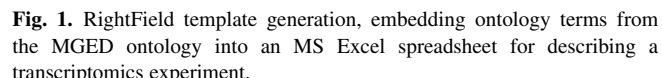
To use RightField, curators either upload an existing Excel spreadsheet, or create metadata entries in a new sheet. When the structure of the template is fixed, ranges of ontology terms can be embedded by either uploading ontologies from the BioPortal (Noy *et al.*, 2009), or from a local file in OWL, OBO, RDFS or RDF formats, Figure 1 shows a template being marked-up using RightField.

Individual cells, whole columns or whole rows can be marked up with the required ranges of ontology terms. For example, they could include all subclasses from a chosen class, direct subclasses only, all individuals, or only direct individuals. Each spreadsheet can be annotated with terms from multiple ontologies.

RightField is intended for use by informaticians and ontologists because setting up templates requires some knowledge of which ontologies to use and when. The spreadsheets, however, are intended for use by laboratory scientists as well as informaticians. Once templates are marked-up and saved, users only interact with them in the native spreadsheet form.

RightField-enabled spreadsheets display simple drop-down lists of terms in any marked-up cells (Fig. 2). Users of the spreadsheet are restricted to select from the term labels in the dropdown boxes, but no information from the ontology is lost. The terms displayed are linked to encapsulated hidden sheets that contain

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The encapsulation of ontology information into the spreadsheet is crucial. It allows users to complete annotation offline when required and it ensures that a series of experiments can be annotated with the same versions of the same ontologies, even if the live ontologies change during this time. If users wish to update to a new version, the spreadsheet must be edited in RightField.

RightField is in use in the SysMO consortium. Examples can be found at <http://www.rightfield.org.uk>. As anticipated, RightField-enabled spreadsheets showed a marked increase in the consistency of annotation and the majority of SysMO evaluators found RightField useful.

of classes (or individuals) in order to follow a community standard, perhaps this is an indication that a particular area of the ontology requires further development. RightField can address this issue from a technical perspective by providing auto-complete functionality for marked-up cells, but standardization should be encouraged by making the process straightforward. Defining more specific classes and/or splitting individuals between them would be of benefit to the whole community of ontology users.

RightField is an open-source, cross-platform Java application. It combines the use of the Apache POI library to read and manipulate spreadsheets and the Protégé OWL API to read and process ontology files. When a set of ontology terms are applied to cells, the identifiers and label for these elements of the ontology are stored within a hidden sheet in the spreadsheet file. The terms are applied to cells using data validation as provided by Apache POI. RightField-enabled spreadsheets can be opened in Microsoft Excel or in Open Office.

RightField provides a simple and unobtrusive way of using semantic web technologies to improve and standardize data annotation. The novel part of this work lies in shielding the use of ontologies from laboratory scientists, allowing them to continue working in familiar native spreadsheets. Other applications, such as the ISA Tools (Rocca-Serra *et al.*, 2010), provide similar functionality, but operate from bespoke client applications and are designed for more expert users. The Anzo commercial platform has similar goals (<http://www.cambridge semantics.com/>).

Ongoing development in RightField will explore the issues surrounding structured data extraction and greater validation of supplied annotations.

Conflicts of Interest: none declared.

Noy,N.F. *et al.* (2009) BioPortal: ontologies and integrated data resources at the click of a mouse. *Nucleic Acids Res.*, **37**, W170–W1733.

Rocca-Serra,P. *et al.* (2010) ISA software suite: supporting standards-compliant experimental annotation and enabling curation at the community level. *Bioinformatics*, **6**, 2354–2356.

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