Latest Developments to LODE

Silvio Peroni[1], David Shotton[2], and Fabio Vitali[1]

[1] Department of Computer Science, University of Bologna (Italy)
[2] Department of Zoology, University of Oxford (UK)
essepuntato@cs.unibo.it, david.shotton@zoo.ox.ac.uk, fabio@cs.unibo.it

Abstract. LODE, the *Live OWL Documentation Environment*, is a service for the generation of human-readable documentation of OWL ontologies and RDFS vocabularies. It automatically extracts classes, object properties, data properties, named individuals, annotation properties, meta-modelling (punning), general axioms, SWRL rules and namespace declarations and renders them as an HTML page designed for easy browsing and navigation by means of embedded links. In this paper, we present an overview of the tool, in particular focusing on the features introduced in the latest available version.

Keywords: LODE, OWL ontologies, Web GUI, Web tools, ontology documentation, structural reasoner

1 Introduction

Consulting its human-readable documentation is among the first activities to perform on an ontology so as to understand its domain, and whether it describes this domain appropriately. Although most ontologies developed for Linked Data usage are accompanied by a comprehensive set of Web pages describing their theoretical backgrounds and the features of their developed entities, problems arise when we look at partially-developed models[3]. Writing proper documentation manually requires effort, and re-writing it every time an ontology under development is modified is hardly practical and thus very seldom performed. Rather, the natural language documentation of ontologies is normally only published once the ontologies have become stable.

To address this issue, tools have recently been developed for the automatic generation of documentation from the axioms and annotations of an ontology. These include *Neologism*[4] [1], *OWLDoc*[5] and Parrot[6] [4]. Similarly, we have developed *LODE*, the *Live OWL Documentation Environment*[7], an online service that takes any well-formed OWL ontology, and generates a single human-readable HTML page providing for browsing and navigation by means of embedded links. In our EKAW 2012 in-use paper [3], we described in detail the

[3] W3C PROV WG ISSUE-270: http://www.w3.org/2011/prov/track/issues/270.

[4] Neologism: http://neologism.deri.ie.

[5] OWLDoc: http://code.google.com/p/co-ode-owl-plugins/wiki/OWLDoc.

[6] Parrot: http://ontorule-project.eu/parrot/parrot.

[7] LODE: http://www.essepuntato.it/lode.

features of LODE and assessed its usability through an empirical evaluation with test users. During that evaluation, we gathered relevant feedback about usability and missing features which would improve its usefulness. Following these suggestions, we created a new improved version (v. 1.1, dated 1 July 2012) of LODE that is available on the Web and described in this paper.

The rest of the paper is structured as follows. In Section 2 we briefly introduce LODE, while in (SectionNewFeatures) we introduce in detail the new features implemented in the latest version (v. 1.1). Finally, in Section 4 we sketch out some conclusions and some future developments.

2 LODE: the rationale

LODE is a Web service developed in Java and mainly based on XSLT technology. It takes an RDF/XML linearisation of an OWL ontology created by the OWL API[8] [2], and applies an XSLT transformation that returns a human-readable HTML page containing the ontology documentation. LODE is currently used in different projects such as *SPAR*[9], *PROV-O*[10], *VIVO*[11] and *Tipalo*[12].

The following pseudo-URL describes how to call LODE:

http://www.essepuntato.it/lode/optional-parameters/ontology-url

LODE provides different configurations, actionable through particular parameters (the slash-separated *optional-parameters* in the pseudo-URL), in order to satisfy different needs, e.g. to process *ontology-url* when it is linearised in a format such as Turtle (parameter *owlapi*), to document the axioms of its imported ontologies (parameter *imported*) or of its closure (parameter *closure*), additionally to document the inferred axioms of *ontology-url* (parameter *reasoner*), and to generate the *ontology-url* documentation in a language different form English (parameter *lang*). The usage of all these parameters is introduced in [3].

3 New features

In what follows, we briefly list the main new features implemented in the latest version of LODE (v 1.1). These features improve the existing documentation and also make possible new user actions.

XSLT structural reasoner. LODE has been extended with an additional XSLT module[13] that implements a preliminary version of an OWL structural reasoner. This infers new axioms directly from the RDF/XML ontology source, in particular the symmetric inferences of the following properties: *owl:disjointWith*,

[8] The OWL API: http://owlapi.sourceforge.net.

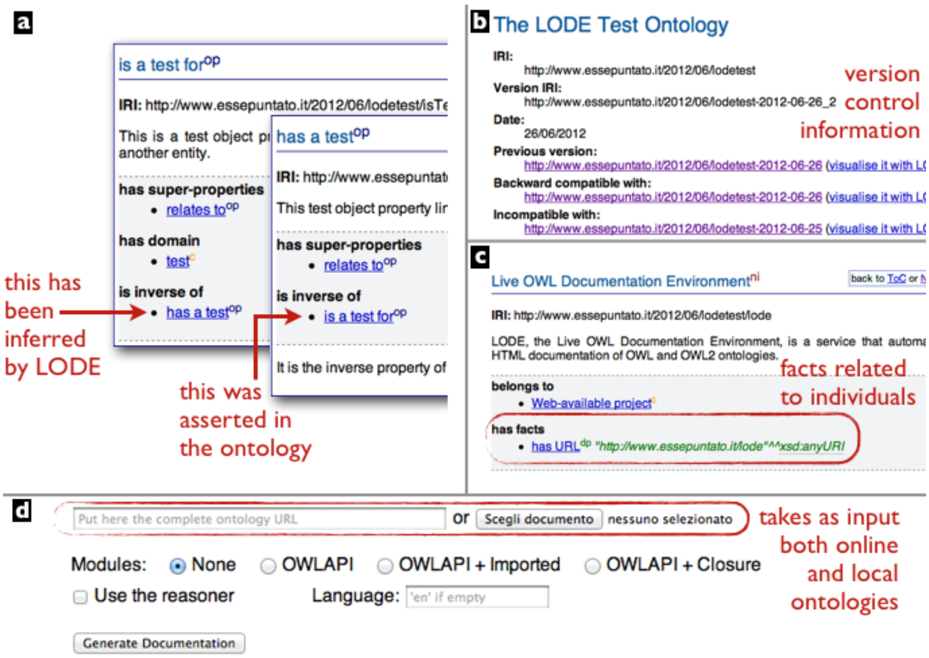
[9] Semantic Publishing and Referencing Ontologies: http://purl.org/spar.

[10] PROV-O: The PROV Ontology: http://www.w3.org/TR/prov-o.

[11] VIVO: connect, share, discover: http://vivoweb.org.

[12] STLab Tool Tipalo: http://wit.istc.cnr.it/stlab-tools/tipalo.

[13] http://speronitomcat.web.cs.unibo.it:8080/LODE/structural-reasoner.xsl



is a test for op

IRI: http://www.essepuntato.it/2012/06/lodetest/isTe

This is a test object pı
another entity.

has super-properties
- relates to op

has domain
- test c

is inverse of
- has a test op

has a test op

IRI: http://www.essepuntat

This test object property lir

has super-properties
- relates to op

is inverse of
- is a test for op

It is the inverse property of

this has been inferred by LODE

this was asserted in the ontology

The LODE Test Ontology

IRI:
http://www.essepuntato.it/2012/06/lodetest

Version IRI:
http://www.essepuntato.it/2012/06/lodetest-2012-06-26_2

Date:
26/06/2012

Previous version:
http://www.essepuntato.it/2012/06/lodetest-2012-06-26 (visualise it with L

Backward compatible with:
http://www.essepuntato.it/2012/06/lodetest-2012-06-26 (visualise it with L

Incompatible with:
http://www.essepuntato.it/2012/06/lodetest-2012-06-25 (visualise it with L

version control information

Live OWL Documentation Environment ni

back to ToC or N

IRI: http://www.essepuntato.it/2012/06/lodetest/lode

LODE, the Live OWL Documentation Environment, is a service that automa
HTML documentation of OWL and OWL2 ontologies.

belongs to
- Web-available project c

has facts
- has URL dp "http://www.essepuntato.it/lode"^^xsd:anyURI

facts related to individuals

Put here the complete ontology URL or Scegli documento nessuno selezionato

Modules: ● None ○ OWLAPI ○ OWLAPI + Imported ○ OWLAPI + Closure

□ Use the reasoner Language: 'en' if empty

Generate Documentation

takes as input both online and local ontologies

Fig. 1. a) The *owl:inverseOf* axiom inferred by LODE. b) Information about the current and the previous versions of the ontology. c) The facts related to individuals asserted in the ontology. d) The Web GUI to use LODE via its website.

owl:sameAs, *owl:equivalentProperty, owl:equivalentClass* (currently without handling restrictions)and*owl:inverseOf* (the latter shown in Fig. 1 (a)[14]). The XSLT structural reasoner temporarily stores the asserted axioms of the ontology about disjointness, sameness, equivalence and inversion so as to allow the checking and retrieval of both the asserted axioms (e.g. *x owl:inverseOf y*) and the related symmetric ones (e.g. *y owl:inverseOf x*) during the generation of the documentation. These features rely on functions that can be used for more general and parametric purposes, thereby enabling a quick and easy way to extend the structural reasoner to verify additional symmetric inferences.

Additional information about the ontology. OWL 2 introduces new built-in annotation properties to record the various versions of an ontology, in particular: *owl:versionIRI*, *owl:priorVersion*, *owl:backwardCompatibleWith*, *owl:incompatibleWith*. As shown in Fig. 1 (b), the new version of LODE shows all this information. In addition, it now also displays *dc:publisher* and *dcterms:publisher* annotations whenever these are present in the ontology.

Facts about individuals. The documentation produced by LODE has been extended to add assertions that involve individuals (i.e. instances of classes)

[14] The ontology used in the examples is the *LODE Test Ontology*, available at http://www.essepuntato.it/2012/06/lodetest.

within the ontology. To this end, a new field labelled "has facts" has been added, as shown in Fig. 1 (c), where the statement `lodetest:lode lodetest:hasURL "http://www.essepuntato.it/lode"^^xsd:anyURI` has been documented.

Web GUI. As displayed in Fig. 1 (d), the LODE homepage now contains a simple form that allows users to access the service directly from the web page. In addition to permitting use of all the functions introduced in Section 2 when specifying the URL of an ontology accessible from the Web, the form can also be used to generate documentation of ontologies stored locally, by browsing for them on the local hard drive and then uploading them to the LODE server.

4 Conclusions

In this paper we introduced some features that have been implemented in LODE, a Web application that automatically creates human-readable HTML ontology documentation on-the-fly from an OWL file of ontological axioms and annotations. These new capabilities enable the generation of more complete documentation – now enriched by inferred axioms, version control information and facts about individuals within the ontology – and simplify the use of the tool through a form-based Web interface. In future, we plan to further improve LODE. High on our list of proposed improvements are the inclusion of a search function, inclusion of additional information defined according to other annotation schemas, e.g. *Content Pattern Annotation Schema*[15] and *VANN*[16], and extension of the structural reasoner, e.g. to infer the domain/range classes for inverse properties and the equivalence/subclass relations for classes even in presence of restrictions.

References

1. Basca, C., Corlosquet, S., Cyganiak, R., Fernández, S., Schandl, T. (2008). Neologism: Easy Vocabulary Publishing. In Proceedings of the 4th Workshop on Scripting for the Semantic Web. http://ceur-ws.org/Vol-368/paper10.pdf (last visited June 27, 2012).
2. Horridge, M., Bechhofer, S. (2011). The OWL API: A Java API for OWL ontologies. In Semantic Web – Interoperability, Usability, Applicability, 2 (1): 11-21. DOI: 10.3233/SW-2011-0025.
3. Peroni, S., Shotton, D., Vitali, F. (2012). The Live OWL Documentation Environment: a tool for the automatic generation of ontology documentation. To appear in Proceedings of the 18th International Conference on Knowledge Engineering and Knowledge Management (EKAW 2012). http://palindrom.es/phd/wp-content/uploads/2010/07/lode_ekaw2012_cr.pdf (last visited June 27, 2012).
4. Tejo-Alonso, C., Berrueta, D., Polo, L., Fernandez, S. (2011). Metadata for Web Ontologies and Rules: Current Practices and Perspectives. In Proceeding of the 5th Interational Conference on Metadata and Semantic Research (MTSR 2011). DOI: 10.1007/978-3-642-24731-6_6.

[15] http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl

[16] http://purl.org/vocab/vann