A GUI for visualising and manipulating multiple ontology alignments

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Abstract. This paper presents a Web-based environment for visualising and manipulating multiple ontology alignments at schema-level. While most solutions are limited to the visualisation of single alignments and are still provided as part of specific standalone matching systems, we propose an open environment that is not bound to any specific system. Within this graphical environment, users can manually create, suppress and edit correspondences and apply a set of operations on alignments (filtering, merge, difference, etc.). Evaluating multiple alignments, against a reference one, can also be carried out using classical evaluation metrics. In this demo, all these tasks will be demonstrated.

1 Introduction

Ontology matching has become an essential task in the management of the semantic heterogeneity problem in open environments. Diverse matching approaches have been proposed in the literature [4] and systematic evaluation of them has been carried out over the last ten years [3]. Despite the progress in the field, visualisation of ontology alignments is still an open question. Nowadays, most solutions for (graphical) alignment visualisation are limited to the visualisation of single alignments and are still provided as part of specific standalone matching systems [1, 8]. Few systems expose their functionalities as Web-based user interfaces [7, 11]. Alternative solutions include Protegé plugins [9] or Web-based interfaces for creating, manipulating and storing alignments (with limited support for graphical visualisation) [2].

In this paper, we present an extended version[1] of VOAR (**V**isual **O**ntology **A**lignment Envi**R**onment) [10] that implements the graphical visualisation of multiple alignments at schema-level. VOAR provides a Web-based environment that is not bound to any specific system and that offers a GUI for assisting users in the tasks of (multiple) alignment visualisation, manipulation, and evaluation. With this new feature, users can better compare and analyse alignments (i.e., parts of the ontologies which are covered for most alignments and those which are not, consensus between alignments, etc.). The main modules of VOAR are presented in the following.

[1] `http://voar.inf.pucrs.br/`

2 VOAR : Visual Ontology Alignment Environment

The matching process takes two ontologies o and o' as input and generates, as output, a set of correspondences (i.e., an alignment) between them. Each correspondence expresses the relation r (e.g., $\equiv$, $\sqsupseteq$, etc.) between the entities e and e', with a confidence in the fact that the relation holds, typically in the [1,0] range. In VOAR, alignments can either be created from scratch (by informing the URIs of the two ontologies to be aligned) or loaded from an external file (in a well-known RDF format[2]), which describes a set of metadata, including the URIs of the aligned ontologies. The generation of alignments by matching systems is out of the scope of this demonstration. VOAR does not store any alignment and works on the notion of a 'working alignment', an in-memory alignment in which the results of the operations are reported (for instance, multiple alignments can be merged together and the result of this operation is stored on the working alignment). In the current version of VOAR, ontologies have to be in RDFS or OWL and alignments are limited to correspondences involving concepts.

One important aspect in alignment visualisation refers to the visualisation of the ontologies themselves. VOAR adopts a commonly used technique that consists in presenting the ontologies as indented trees, where indentation represents the hierarchical relations between concepts (concepts and their subconcepts can be expanded and retracted, in order to adjust the detail of information shown). Although this kind of technique has advantages and disadvantages [5], it is known to be familiar to most users and offers a clear view of the hierarchy[3]. The correspondences are then shown as lines between the two trees.

VOAR has been developed on the top of well-know and largely used APIs in the field of ontology matching, such as the Alignment API[4] and the OWL API[5], and it is built with JavaServer Faces (JSF) technology, compatible with most current browsers. Alignments in VOAR can be manipulated through four main modules, which are briefly presented in the following.

Correspondence edition This module allows for manipulating the correspondences from one single working alignment. They can be added, suppressed or edited (e.g, the kind of relation or confidence can be modified). The user can select specific ontology entities for visualising the correspondences involving them. A new correspondence can be created by selecting entities in both ontologies. In each tree, users can also filter out the entities whose naming and annotations (labels, comments) correspond to a search criteria, what is especially useful when dealing with large ontologies.

Alignment manipulation VOAR provides different ways for manipulating a single alignment as an 'object', which can be combined together with other 'objects'. The current set of available operations are: *union* (resulting in the merge

[2] `http://alignapi.gforge.inria.fr/format.html`

[3] Here, we focus on the visualisation of concept hierarchies and alternative ways for visualising whole ontologies are being considered.

[4] `http://alignapi.gforge.inria.fr`

[5] `http://owlapi.sourceforge.net/`

of alignments), *intersection* (where only correspondences occurring in all input alignments are kept), *difference* (complement, where a subset of correspondences are removed from a given alignment). Auxiliary operations involve the possibility to *trim* correspondences under a given threshold and *invert* the direction of the alignment. These operations are available in the Alignment API and Alignment Server for a pair of alignments, in their native versions, and we have reused them here through the Alignment API. In VOAR, users can select multiple alignments at once and apply those operations on the current working alignment.

Alignment evaluation Users can compare multiple alignments with respect to a reference alignment. Measures of precision, recall, and F-measure can be computed for each alignment. The implementations available in the Alignment API have been used for generating these evaluation metrics. VOAR allows the visualisation of the results in a tabular view and displays the status of each correspondence (true negative, false negative, true positive and true negative) through icons representing the entities involved in the given correspondence.

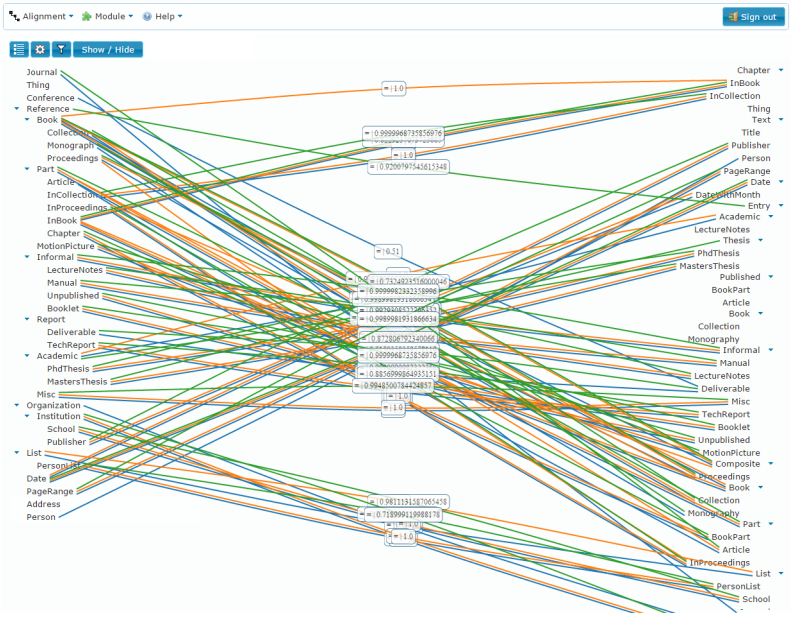

Fig. 1. Visualisation of multiple alignments in VOAR : three alignments on the OAEI Benchmark test case 304.

Alignment visualisation From a set of previously loaded or manually created alignments, this module allows for visualising multiple alignments together. The set of correspondences of a given alignment is represented by a different line colour. The user is able to configure the properties of the correspondences to be shown (e.g., kind of relation and confidence threshold) and apply filters on those properties in order to visualise a subset of correspondences. Figure 1 presents the

screenshot of the visualisation of three alignments generated by OAEI systems (Aroma, LogMap and RiMOM) on the real Benchmark test case 304[6].

3 Conclusions and Future Work

This paper has presented an extended version of VOAR, a web-based environment for visualising and manipulating ontology alignments at schema level. The major contribution of this new version is the possibility of visualising multiple alignments together. It allows for better comparing and analysing alignments (i.e., parts of the ontologies which are covered for most alignments and those which are not, consensus between alignments, etc.). As future work, we plan to take into account the visualisation of properties and entities at instance-level. We intend as well to provide an evaluation on its usability. Finally, we plan to deal with the scalability of VOAR in terms of the visualisation of large ontologies and to evaluate how it satisfies a set of requirements [6] for user support in large-scale ontology alignment task.

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[6] `http://oaei.ontologymatching.org/tests/`