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VOAR 3.0 : a configurable environment for manipulating multiple ontology alignments

Bernardo Severo[1], Cassia Trojahn[2], and Renata Vieira[1]

[1] Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, Brazil
[2] Université Toulouse 2 & IRIT, Toulouse, France

Abstract. This paper presents a Web-based environment for visualizing, editing and evaluating multiple ontology alignments. Users can configure their environment according to their needs and tasks, choosing different visualization modes and creating different profiles. They can apply a set of operations on the alignments (filtering, merge, etc.) and evaluate them against a reference one, using classical metrics. Ontology and alignment libraries allow for users storing and searching them in the system. In this demo, these functionalities will be demonstrated.

1 Introduction

Ontology matching is an essential task for the management of the semantic heterogeneity 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 fifteen years in the context of the OAEI campaigns [3]. While most efforts in the field are dedicated to the development of matching approaches, less has been done in terms of the alignments visualization. Existing solutions are often limited to the visualization of one single alignment and offer a limited support to evaluation analyses. These are important aspects in the tasks of analyzing and comparing alignments. Many solutions are provided as part of specific standalone matching systems [1, 11], with few Web-based user interfaces [8, 15]. Alternative solutions include Protegé plugins [12] or Web-based interfaces for manipulating and storing alignments with limited support for graphical visualization [2] or allowing the visualization of single alignments [6], although some of them provide different visualization contexts [9]. Other solutions are dedicated to visualizing alignments between different kinds of sources, as relational schemes and ontologies [14].

This paper presents VOAR 3.0 (**V**isual **O**ntology **A**lignment Envi**R**onment)[1], a configurable environment for manipulating multiple alignments. It provides an open Web-based environment that is not bound to any specific system and that offers a GUI for assisting users in the tasks of alignment visualization, manipulation, and evaluation. The major contribution of this version with respect to [13] is the possibility of choosing different visualization modes of multiple alignments, both at schema and instance levels, together with the possibility of storing and

[1] `http://voar.inf.pucrs.br/` (recorded video at `https://youtu.be/wq-yPBOFN_I`)

searching them. Users can configure their environment according to their needs and tasks, creating different profiles. VOAR is presented below.

2 VOAR 3.0: Visual Ontology Alignment Environment

An ontology matching process takes two ontologies as input and generates, as output, an alignment, which is a set of correspondences between their entities. Each correspondence expresses a relation (e.g., $\equiv$, $\sqsupseteq$, etc.) between two entities, together with a confidence in the fact that the relation holds, typically in the [0,1] 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 RDF format[2] adopted in the OAEI campaigns). Alignments and ontologies (RDFS or OWL) can be stored in the system. VOAR has been developed on the top of the Alignment API[3] and the OWL API[4]. The main modules of VOAR are briefly presented in the following.

Profiles This module allows for users to configure the user interface and to create *profiles* with different configurations. For each profile, users can choose the kind of visualization approach to adopt (and that better fits their needs and task), as described below, the kinds of ontology entity to display (concepts, relations, instances), and the orientation of the windows (vertical or horizontal). In each window, a different visualization strategy can be set up. An user can create different *profiles*.

Alignment visualization This module allows for visualizing multiple alignments together, according to the *profiles* defined by the user. The alignments (and ontologies) can be visualized with the help of intended trees, graphs, and lists of correspondences, where the set of correspondences of a given alignment is represented by a different colour. Users are able to configure the properties of the correspondences to be shown (e.g., kind of relation and confidence) and apply filters on those properties in order to visualize a subset of correspondences. Figure 1 presents the alignment evaluation interface. The alignments have been generated by Aroma, LogMap and RiMOM systems on the OAEI Benchmark test case 304[5].

Alignment manipulation Multiple alignments can be manipulated using a set of operations, for instance, *union*, *intersection* and *difference*. Auxiliary operations involve *trimming* correspondences under a given threshold and *inverting* the alignment direction.

Correspondence edition This module allows for manipulating the correspondences from a single alignment. They can be added, suppressed or edited (e.g, modifying the kind of relation or confidence). Users can select specific ontology

[2] `http://alignapi.gforge.inria.fr/format.html`
[3] `http://alignapi.gforge.inria.fr`
[4] `http://owlapi.sourceforge.net/`
[5] `http://oaei.ontologymatching.org/tests/`

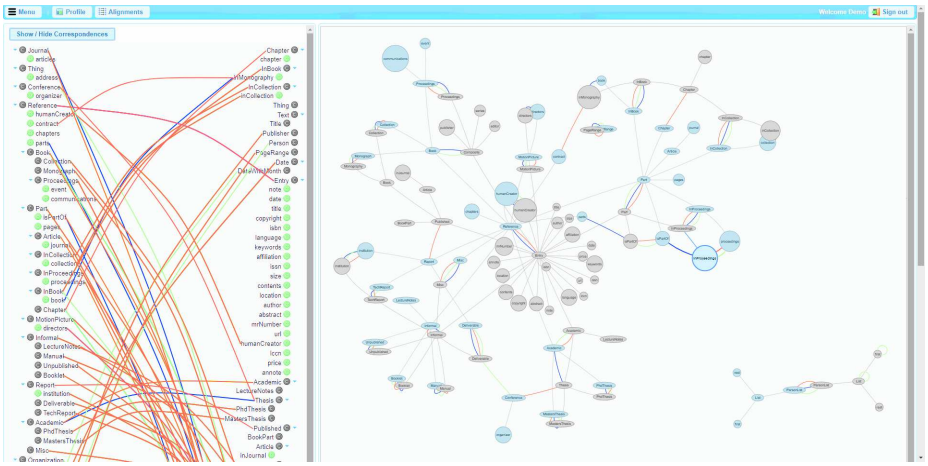

Fig. 1. Visualization of multiple alignments for the OAEI Benchmark test case 304, using intended trees (left) and graph (right).

entities for visualizing the correspondences involving them. They can also filter out the entities whose naming and annotations (labels, comments) correspond to a criterion, what is especially useful when dealing with large ontologies.

Alignment evaluation Users can compare multiple alignments with respect to a reference, using precision, recall, and F-measure. VOAR allows the visualization of the results in a tabular view and displays the status of each correspondence (correct, incorrect, missing) in the given alignment. Figure 2 presents the screenshot of the evaluation interface.

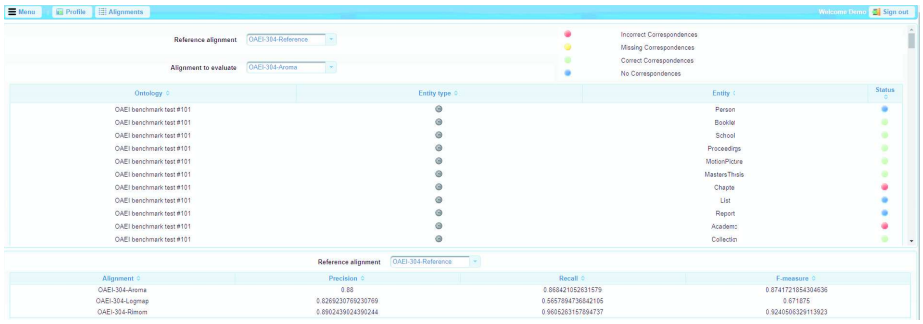

Fig. 2. List of correspondences and their status (top) and evaluation results (bottom).

3 Conclusions and Future Work

This paper presented VOAR 3.0, a configurable Web-based environment for visualizing and manipulating ontology alignments. VOAR 3.0 was assessed through

a questionnaire submitted to users involved in matching tasks. As future work, we plan to improve VOAR according to the feedback from the questionnaire and improve this first user evaluation, better considering usability aspects as in [5] (i.e., asking users to complete specific tasks using the tool). We plan as well to deal with the scalability of VOAR in terms of large ontologies and alignments [10] and to evaluate how it satisfies a set of requirements [7] for user support in large-scale matching. We intend as well to consider comparative evaluation of multiple alignments without a reference one, as reference alignments are not always available. Finally, we plan to work on collaborative aspects and on the visualization of complex correspondences.

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