

CONTEXTUALIZED VISUALIZATION OF ONTOLOGIES AND ONTOLOGY NETWORKS

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ABSTRACT

Contextualized visualization of ontologies and ontology networks is addressed here via visualization of ontology and ontology mappings. The idea is to enable the user to browse through an ontology inside a context of related networked ontologies, where the context is defined through the mappings between the ontologies. The proposed visualization consists of two parts. First, a pair of ontologies is visualized in an intelligent way and second, alignment of these two ontologies is visualized as links between the related concepts. The proposed approach is implemented in cONTOext as a Flash application integrated within the Facebook plug-in architecture. The extended approach is implemented in OntoConto as plug-in to a NeOn Toolkit platform where it is seamlessly integrated with the other technologies. Namely, integration inside the existing NeOn Toolkit provides an easy access to the loaded ontologies, a possibility to edit them and, enables the user to access several different alignments between the ontologies.

1 INTRODUCTION

Networked ontologies in general can be a very complex structure. There are many ways how the knowledge stored inside them can be obtained. One possible way is to focus on a part of the networked ontologies i.e. a pair of related ontologies and in this setting try to understand the context that one ontology provides for the other.

The proposed approach is, with some variation, implemented in two demos: cONTOext plug-in to Facebook social networking platform [1] and, OntoConto plug-in to NeOn Toolkit platform for networked ontologies [2].

cONTOext emphasizes contextual visualization of ontologies to support collaborative editing of network ontologies. The main idea is to leverage efforts of multiple individuals editing similar domains (in the form of ontologies) at the same time via sharing knowledge by introducing mappings between ontologies. The obvious

practical benefit is in the situation when other users provides context through the ontologies they have created.

OntoConto emphasizes contextual visualization of ontologies by providing context for a selected ontology via showing the related parts of another ontology (here also referred to as context ontology). This is achieved by visualizing and manipulating the target ontology and context ontology side by side, with mappings connecting nodes of the two ontologies. Namely, for each concept in the chosen ontology the context is defined by an aligned concept in the context ontology and its neighbourhood of concepts. The user can simply switch contexts by either change the context ontology or by changing the alignment (i.e., selecting another method for the alignment) connecting the two ontologies.

The rest of this paper first describes the proposed approach and related work (Section 2) and next it demonstrates OntoConto, the NeOn Toolkit plug-in (Section 3).

2 APPROACH DESCRIPTION

The main idea behind the proposed approach is to provide a context of a concept in one ontology by providing a part of the related ontology that is similar/related to this concept. This is knowledge that is inherently present in every network of ontologies and harnessing it can be beneficial in several ways. Ontology creator/editor gains help by finding out how certain parts of an ontology are presented in a different ontology and this can help with making editing decisions. An ontology user on the other hand, is presented with a tool that can help in understanding an ontology or a collection of ontologies. For example if the user has a task of annotating some data, the presented approach and the developed plug-in can help to understand each specific concept in the ontology by providing a context in another, maybe more familiar ontology.

Notion of context is defined here similar as in [3] by relating individual concepts of one ontology to the concepts of another ontology. Due to our emphases on visualization we have extended that original notion of context by including concept neighbourhood as follows. If a concept A in the first ontology is aligned to the concept B in the second, then since the "near" concepts of B are in some

way related or similar to B, this provides context for A. To define the "near" concepts of B, different approaches could be used. For example any type of a relation in side of an ontology could be used to define a unique metric between concepts, by counting how many hops over specified relation are needed to get from one concept to another. Every such metric would provide a specific neighbourhood defined by the relation used. This notion of context can be also illustrated by the idea of presenting an ontology through "semantic lenses" defined by the other ontology that is giving the context [4]. We are using the most basic SubConceptOf relation of the ontologies to define neighbourhood of the concept, as it is present in most if not all ontologies. Apart from this, SubConceptOf relation defines an underlying tree structure which can be very easily and intuitively visualized.

In our approach the two selected ontologies are visualized side by side, and the aligned concepts are visually linked across the ontologies. This supports the user in several different tasks. Most notably the user can edit ontologies inside an automatically generated context of another ontology. Apart from that, visualization also provides means that help with the evaluation and manipulation of the mappings. For an example see Figure 1.

The visualization used in the proposed approach can be broken into three parts: visualization of an ontology, visualization of the mappings and user interface.

2.1 Visualization of an ontology

Visualization of an ontology as proposed here is based on visualizing concepts ordered by an underlying tree structure stemming from SubConceptOf relation. Due to the demand to visualize a context for a selected concept and also due to the limitation of how many concepts can be distinctly visualized at the same time our approach visualizes only four layers of the ontology.

Often visualizing four layers at one time still proves too much information to visualize distinctly, thus additional visualization techniques are used. First concepts on the same level are vertically displaced in order to enhance the visibility of a single concept. Next we propose a visualization technique that is somewhat similar to using lens. Visual entities near the centre of the screen are enlarged, on account of reduced entities that are closer to the borders. This technique enables the user to clearly see the detail of interest, while retaining the big picture.

2.2 Visualization of the mappings

For the visualization of the mappings two selected ontologies are visualized side by side. This enables the user to acquire contextual information in networked ontologies across the two selected ontologies. The basic idea is rather simple: a simple link is visualized spanning the space between the mapped concepts.

Important functionality is provided by allowing the users to obtain third party auto-generated alignments. Currently our

approach is integrated with OntoLight (in cONTOext) and with the NeOn Toolkit Alignment Server (in OntoConto). Other such services could be added easily. Moreover, in OntoConto it is possible to store and load alignments inside the Neon Toolkit's workspace. This enables interoperability with other plug-ins.

2.3 Graphical User Interface

The proposed approach was developed with great care to simplify user interface with very simple actions to select and browse ontologies and alignments. The user is not required to understand ontology and mapping notation nor existing ontology editing software. This is inspired by the usage scenario of United Nations Food and Agriculture Organization (UN FAO) [5], where a group of users named "subject experts" is defined. Subject experts know about the domain to be modelled, but usually know little or nothing about ontology design issues or software for ontologies.

The user is enabled to easily load and then browse through two ontologies. Clicking on any concept selects it as the selected node, and the whole ontology gets dynamically redrawn in to the new position, with selected node on the top.

Editing of ontologies is supported either by the plug-in (cONTOext) or by the platform (OntoConto). Editing of the mappings is performed by selecting a mapping via clicking on it and then, editing its weight, the two concepts it links or deleting it altogether. It is also possible to create a new mapping by clicking two concepts to be connected while holding the key "m".

3 ONTOCONTO DEMO DESCRIPTION

OntoConto is a plugin inside the NeOn Toolkit application / platform. Primarily it functions as one of the graphical user interfaces of the Toolkit, with several advanced visualization techniques and this is why it was implemented with Adobe's Flash application. Flash is one of the leading dynamic visualization development applications, allowing easy development of advanced visualization techniques.

Integration is done by first implementing a regular java plugin which connects to the Toolkit's data model and extracts all the information of the ontologies and stored alignments. Second, this plugin consumes the Alignment Server and could also easily consume any other alignment providing plugin or webservice. Last, it implements a browser which in turn includes the OntoConto's visualization part written in Flash. Non-trivial communication is required in order to fully integrate the Java plugin and Flash applet.

Alignment Server serves several different methods that automatically generate alignments [6]. To consume it, it must be called with two OWL ontologies and a method. It returns the alignment in the RDF format. This makes it a perfect tool to be used by OntoConto.

In this way, it is possible to visualize any two ontologies loaded inside the NeOn Toolkit and request different

alignments for them. The Ontology of interest can be explored and edited inside the context of another. To change the context it is enough to either change the context ontology or change the alignment linking them. Finally it is also possible to make and store changes to the current alignment.

The OntoConto plugin is available at <http://kameleon.ijs.si/ontoconto>. To install it, one should have NeOn Toolkit installed. The binary version of OntoConto then needs to be copied to the plugins directory. No additional plugins are required.

4 USAGE SCENARIOS

The proposed approach was developed with great care to simplify user interface with very simple actions to select and browse ontologies and alignments. The user is not required to understand ontology and mapping notation nor existing ontology editing software. This is inspired by the usage scenario defined by UN FAO, where several groups of users are defined one being “subject experts”, who will be in charge of the everyday editing and maintenance work of the networked ontologies. Their duties also involve the creation of multilingual versions of ontologies. Subject experts know about the domain to be modelled, but usually know little or nothing about ontology design issues or software for ontologies. In user requirements [5, page 27] it is stated: “Subject experts should be provided with more intuitive interfaces than those available to ontology experts and application developers; in particular interfaces for subject experts should conceal much of the purely ontological and engineering decisions.”

The used combo selections, one click user interface and no ontology notation fits perfectly to serve this user group. Apart from the clear need of the proposed contextual visualization for users unfamiliar with ontologies, the proposed approach and demo also provides for expert users. Visualization in general provides easy exploration, understanding of any complex model, which an ontology network definitely is.

The first simple scenario this demo fulfils [5, page 40] deals with visualizing an ontology. Ontologies are visualized distinctly with the cut of the section of interest and simple one way to navigate to other sections.

The main scenario this demo fulfils is about System-supported creation of mappings between concepts. [5, page 46]. Actual manipulation of the mappings should always be done in context to the neighbourhood of both concepts it spans, for only so can the mapping be truly understood.

Apart from the pre-thought scenarios, this demo has already proved to serve other needs as well. An example is in evaluating the algorithms for ontology mapping [6].

The experiments are usually designed to answer how good these algorithms detect alignments in comparison with an expert of the domain. The expert defines the matchings between concepts of the two respective ontologies. With this

control set precision and recall are calculated for the alignments detected by the different algorithms.

To be able to detect concepts which represent the same aspect of the real world it is necessary to take the whole context into account. Concepts labelled with the same name do not necessarily have to describe exactly the same element; one concept might be more general or might describe a different part. To detect such ambiguities one has to check the concept with its neighbourhood, and that is enabled by the proposed demo.

The proposed demo also simplifies the qualitative analysis of the mapping algorithms. Some ontology mapping algorithms proposes semantic relations and the user has to choose the correct ones. For algorithms of this kind the strict quantitative analysis calculating recall and precision is not sufficient. The proposed context visualization enables to check the matching proposals and compare the different possibilities for each mapped concept. Moreover it helps to get a quick first impression of the available algorithms.

5 ACKNOWLEDGEMENTS

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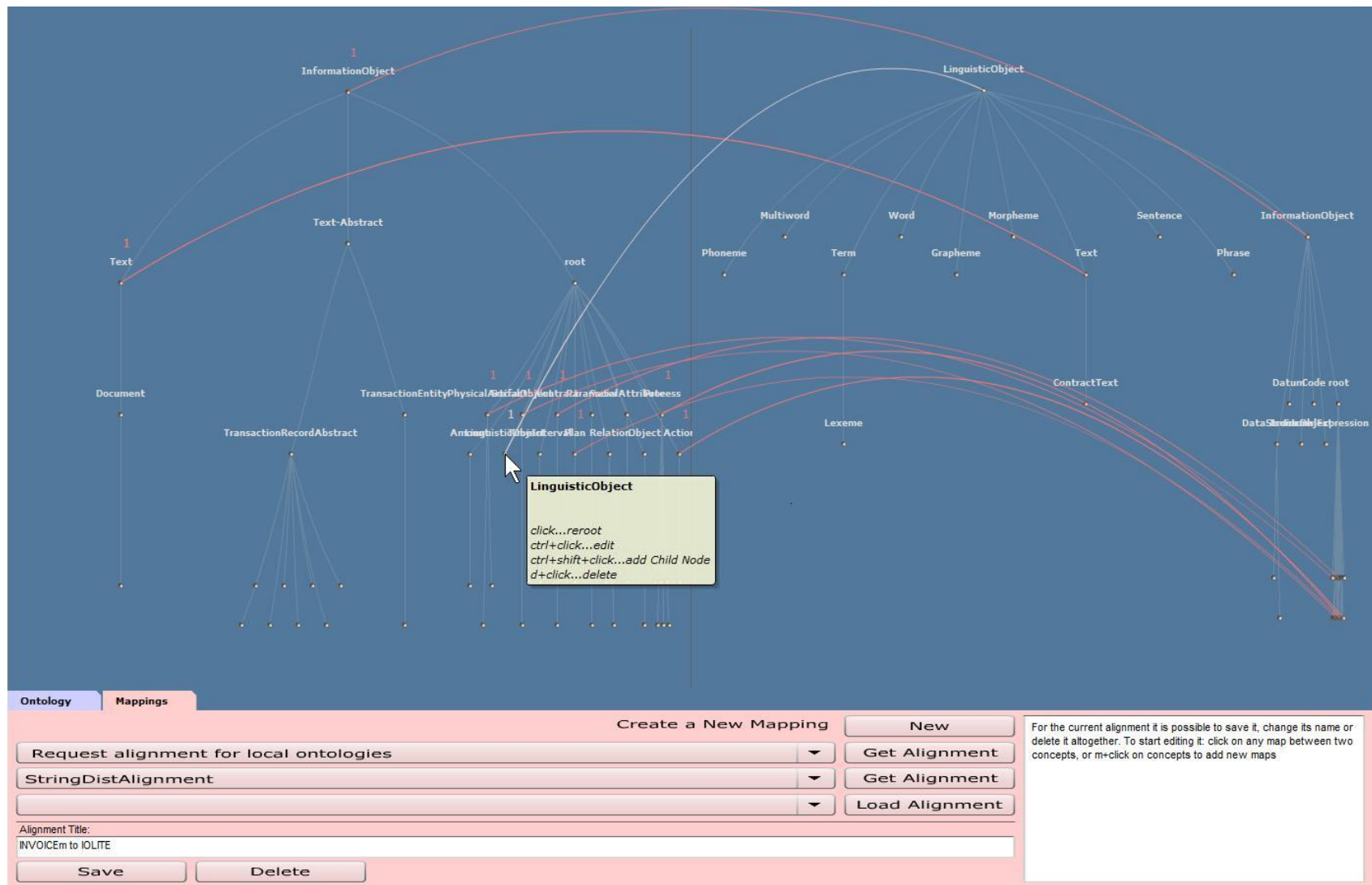


Figure 1. Two ontologies are loaded and visualized side by side. StringDistAlignment method was called for the alignment. Ontology of interest (left) can be studied in the context ontology (right). There the concept “LinguisticObject” lays in between “InformationObject” and “Text”. It might make sense to redesign the corresponding concept in the starting ontology.