Latest Developments in KC-Viz

Enrico Motta[1], Silvio Peroni[2], Mathieu d'Aquin[1]

[1] Knowledge Media Institute, The Open University, MK7 6AA, Milton Keynes, UK
{e.motta, m.daquin}@open.ac.uk
[2] Dept. of Computer Science, University of Bologna, 40127 Bologna, Italy
speroni@cs.unibo.it

Abstract. KC-Viz is a novel tool for visualizing and navigating ontologies, realised as a plug-in of the NeOn Toolkit. KC-Viz provides a comprehensive set of features to support ontology visualization and navigation, including an innovative mechanism for generating overviews of very large ontologies, which is based on an empirically validated ontology summarization algorithm. In this paper, we present an overview of the tool, in particular focusing on the features introduced in the latest version (v1.3.1).

Keywords: Ontology Visualization, Ontology Navigation, User Interface

1 Introduction

In recent years ontologies have moved out of computer science and have been taken up in a variety of research communities, from biologists to humanists. To some extent, this step forward has been made possible by the advent of editors and ontology engineering tools, which attempt to hide the complexity of the formalisms used for modeling ontologies behind a user-friendly interface.

Nevertheless, the tools currently available in popular ontology engineering environments, such as Protégé[1] and TopBraid Composer[2], are rather limited in their ability to assist users in navigating and visualizing large ontologies, primarily because of their relatively poor support for creating *overviews* [1] of an ontology. Such overviews are essential to enable a user to abstract from hundreds or thousands of ontological entities and to help her to make sense of large ontologies.

Attempting to address these limitations, we have developed a novel solution for visualizing and navigating ontologies, *KC-Viz*, which is realized as an open-source plug-in for the NeOn Toolkit[3]. In [2], we described in detail the features of KC-Viz and assessed its performance through a rigorous empirical evaluation. During such evaluation we also gathered feedback from users about features they would like to see in the tool, which would improve its support for ontology visualization and navigation. Following this requirements gathering exercise, we then produced a new version of the tool (v1.3.1), which is presented in this paper.

---

[1] http://protege.stanford.edu/.

[2] http://www.topquadrant.com/products/TB_Composer.html.

[3] http://neon-toolkit.org.

2 KC-Viz: theoretical background

KC-Viz provides a rich set of navigation and visualization mechanisms, including flexible *zooming* into and *hiding* of specific parts of an ontology, history browsing, customized ontology views, as well as essential interface customization support, such as tree layout customization. KC-Viz builds on the *Key Concept Extraction (KCE)* algorithm [3], which allows the user to summarize an ontology, by extracting the most representative concepts (i.e., classes), which best describe the ontology itself from both a formal and a user-centric perspective. In particular, the KCE algorithm takes into account different criteria, drawn from psychology, linguistics and knowledge representation, to calculate an overall score for each class in the ontology. The score tells us how much a particular class is representative (i.e., a *key concept*) of the ontology. In KC-Viz 1.3.1, the criteria used are:

- *Natural category*. This criterion is drawn from cognitive psychology [4], to identify concepts that are information-rich in a psycho-linguistic sense.
- *Density*. This criterion privileges classes that are information-rich in a formal knowledge representation sense, i.e., they have been richly characterized with properties and taxonomic relationships.
- *Coverage*. This criterion assigns higher scores to those concepts that maximize the coverage of the ontology with respect to the hierarchy defined by *rdfs:subClassOf* relations.

The empirical evaluation described in [3] shows that the KCE algorithm produces ontology summaries that correlate with those produced by human experts.

It is important to emphasize that we no longer use the *popularity* criterion, because of its computational cost on large ontologies[4]. However, on the basis of the analytical studies described in [5], we have been able to parametrize the weights associated with the other criteria, to produce a vastly more efficient version, while at the same time maintaining the same level of compliance with respect to the available human-generated benchmarks as the version of the algorithm presented in [3].

3 KC-Viz 1.3.1: new features

In what follows we briefly list the main new features implemented in KC-Viz 1.3.1. These features are all user-centric, in the sense that they either improve the consistency of existing functionalities, or introduce new ones, which make it easier for users to explore ontologies through KC-Viz.

Customizable KCE criteria weights. All the weights of the formulas used in the KCE algorithm are now customizable by the user. In particular, the left hand side of Fig. 1 shows the preference panel which allows users to change the relative weights of the different criteria used to calculate the overall score for each class in an ontology,

---

[4] In the original version of KCE, the *popularity* criterion was computed starting from the number of results returned by querying the Yahoo! Search Engine with the name of each concept in the considered ontology. Because this criterion takes several seconds to be computed on large ontologies, it is not suitable to real-time applications of the algorithm, such as KC-Viz.

while the right hand side of the figure shows the one used to customize the density criterion. Customization options are also provided for the other two main criteria.

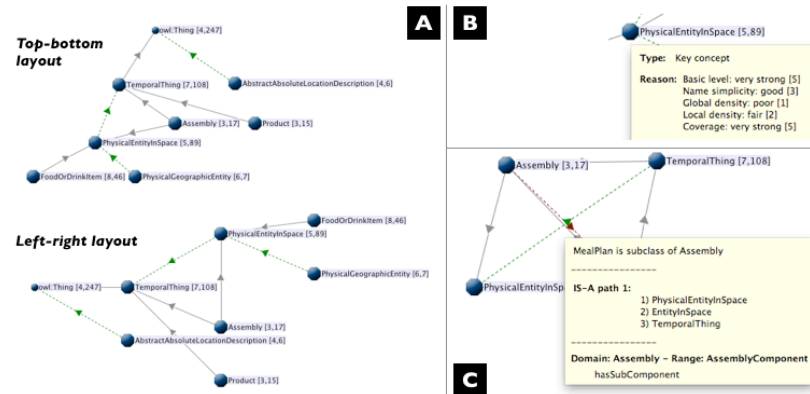**Fig. 1.** Preference panels for customizing KCE formulas weights.

Fig. 2. A) Two layout orientations (top-bottom and left-right) for disposing nodes. B) A KCE score explanation tooltip. C) A tooltip containing a description of multiple arcs (in the example, a direct rdfs:subClassOf relation, an indirect rdfs:subClassOf one and a domain-range one).

Left-right layout. After clicking on the button "Re-layout" in the KC-Viz toolbar, a sub-menu is opened, which asks the user whether she wants to redraw the current visualization using a top-bottom orientation or a (new) left-right orientation (both shown in Fig. 2A).

Macro and micro moves. The distinction between macro (extraction and hiding) and micro (re-layout, axis adjustments, node movements) moves, in relation to the

"cancel/re-apply steps" box in the KC-Viz toolbar, has been strenghtened. Now, micro moves can be canceled/re-applied only if they are not preceded/followed by macro moves in the operation history. For instance, considering the sequence "Mac_1 mic_1 mic_2 Mac_2 mic_3…" and supposing to be visualizing in KC-Viz the window after mic_2 and before Mac_2, a user can decide a) to cancel mic_2, or b) to cancel Mac_1, or c) to re-apply Mac_2.

KCE score explanation. Node tooltips, which pop up when hovering the mouse cursor over nodes in KC-Viz, now contain a section, called "Reason" (shown in Fig. 2B), which indicates how a node (i.e., a class) fares with respect to the criteria used to determine key concepts. Here, we use a 1-5 scale of labeled values (1 poor, 2 fair, 3 good, 4 strong, 5 very strong).

Refresh visualization. The pop-up obtained after right-clicking inside the KC-Viz view has a new option called "Refresh", which allows the user to re-sync the visualization with respect to changes in the model, which may have occurred since the visualization was produced.

Multiple arcs descriptions. Multiple arc descriptions, which pop up when hovering the mouse cursor simultaneously on different arcs (handled in older versions of KC-Viz with different overlapping tooltips), are now merged in a single tooltip, as shown in Fig. 2C.

3 Conclusions

The novel features realized in the latest version of KC-Viz improve the effectiveness of the support provided by the tool, in particular by providing more flexible ways for users to control the generation of ontology summaries, better explanations of its behaviour, additional control of the layout, and improved integration with other components of the NeOn Toolkit. In the future we plan to improve KC-Viz further, by investigating the integration of alternative paradigms for generating large scale views within the key-concept-centric visualization framework.

References

1. Shneiderman B (1996) The Eyes Have It: A Task by Data Type Taxonomy for Information Visualizations. In Proceedings of the 1996 IEEE Symposium on Visual Languages (VL '96). IEEE Computer Society, Washington, DC, USA.
2. Motta, E., Mulholland, P., Peroni, S., d'Aquin, M., Gomez-Perez, J. M., Mendez, V., Zablith, F. (2011). A Novel Approach to Visualizing and Navigating Ontologies. 10th International Semantic Web Conference (ISWC 2011). Bonn, Germany.
3. Peroni, S., Motta, E., d'Aquin, M. (2008). Identifying key concepts in an ontology through the integration of cognitive principles with statistical and topological measures. Third Asian Semantic Web Conference. Bangkok, Thailand.
4. Rosch, E. (1978). Principles of Categorization. Cognition and Categorization. Lawrence Erlbaum, Hillsdale, New Jersey (1978).
5. Li, N., Motta, E. and d'Aquin, M. (2010) Ontology summarization: an analysis and an evaluation. International Workshop on Evaluation of Semantic Technologies (IWEST 2010) at the 9th International Semantic Web Conference (ISWC2010)