

Methods for Presenting Ontological Knowledge to the Users

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Abstract. In this article we discuss approaches of presenting formalized knowledge. We focus on knowledge represented by ontology. Ontologies are powerful for knowledge representation but are comprehensible for experts mostly, thus they need to be transformed to a human-understandable form. We discuss different alternatives such as trees, graphs or semantic web activities based on markup languages. We also describe our approach used within the scope of the Pellucid project. Our approach is based on OWL ontology, commercial standards and technologies such as XML, RDF, XSLT. The key idea is to transform knowledge in OWL to plain XML, which is then transformed to HTML by XSLT templates

1 Introduction

If knowledge is represented by ontology, naturally there are several ways how to present it. It is important in Knowledge Management Systems not only to capture, store or discover knowledge but also to return appropriate knowledge in a human understandable form.

1.1 Object Tree

The Object Tree is the base of ontology. A hierarchical object tree with properties is widely and commonly used method, for example in ontology editors such as Protégé[1] or OilEd[2]. However, this approach is mostly understandable to experts, who understand ontology. As an evidence of this fact can serve our experience with developing the so called “browse window (BW)”[3], which was powerful in returning knowledge from KB but was not understandable by end users. As a result we can say that this approach is very valuable for people who understand the structure of knowledge in ontology, they can read it fast and get familiar with it. BW was developed as a part of first Pellucid Prototype[4].

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1.2 Graph

If we talk about ontology languages based on RDF[5] such as DAML, DAML+OIL[6], OWL[7] or RDF itself, the natural way how to present an ontology to the user is drawing of graphs, where arches and points can have assigned certain textual, colored or other values and names. The best example is UML[8] itself, but other representations exist too, like Ontoviz Tab[9] in the Protege editor or Cartoo.com products[10]. See Figure 1. A graph structure can express almost all information encoded in ontology because values could be assigned to arches and points and also other data such as the width of arch or the color can be displayed. If KM system discovers new facts, users usually require explanation of this new explored fact – the Pellucid project confirmed this fact as well. A graph sometimes can explain to a person the reason of creating a new fact, by connections to other facts, or reason for returning of knowledge to the user. KM system is usually not able to create good sentences, which would explain the reasons and ways of thinking but by a graph this can be understood, however reading of graphs needs more flexible users and not everybody can understand graphs. Also as far as we know there is no general tool available for such graph creation, but we see this as an area of future improvement in knowledge presentation.

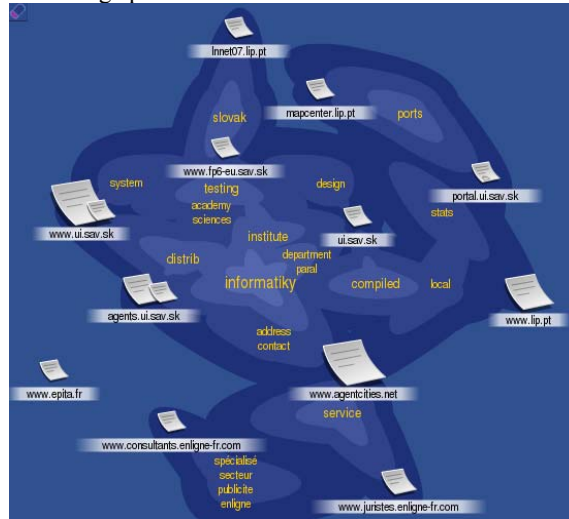


Fig. 1. Relation of www.ui.sav.sk to other sites, Cartoo.com internet search tool.

1.3 XSLT Transformation

RDF based ontology languages are also XML [11] based and thus ontology information can be easy presented by XSLT [12] transformation sheets which transform XML to HTML. This approach was used in the Pellucid project [13] and next chapter describes this solution. XSLT transformation is definitely the best way for presenting ontological knowledge. In XSLT you can define any ways for

graphical representation of knowledge encoded in ontology. The problem is that it involves a lot of customization effort. XSLT style sheets must be created for each ontological element or at least for each type of ontology element. XSLT is a commercial standard which is used in many e-commerce and e-business applications, accepted by a community and thus customization of presentation can be done by regular developers. Such implementation does not require knowledge experts. The core of the KM system just needs to return proper XML of a requested ontology element. In this article we summarize explored alternatives of knowledge presentation and we focus on the XSLT presentation.

2 XSLT Transformation Solution

The key idea of XSLT solution used in the Pellucid Project is to deliver knowledge in HTML format. The core of the system work with the knowledge in OWL, RDF, RDFS format with Jena[14] library.

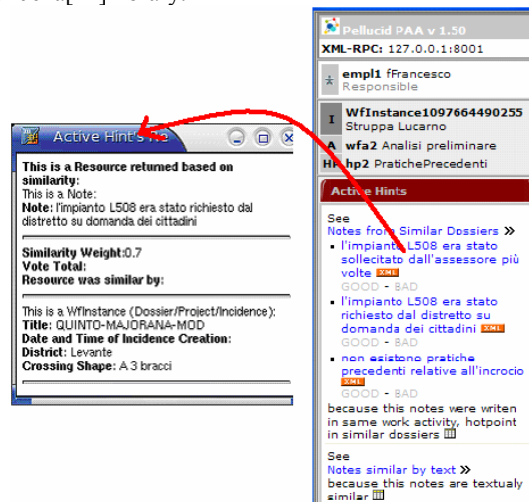


Fig. 2. Pellucid GUI window with Active Hints (right) and opened resource window (left).

Knowledge or experience is returned to a user in an Active Hint format. Active Hints (AH) were created as the central concept of ontology for representation experience in Pellucid. AH is simply a formalization of experience which says what action to do with a resource in a given working context. AH is therefore composed according to the following formula[15]:

$$[\text{ACTIVE_HINT}] = [\text{WORK_CONTEXT}] + [\text{ACTION}] + [\text{RESOURCE}] + [\text{EXPLANATION}]$$

Active Hints are some suggestions stored or computed in the system based on a user context. AHs are present in the system in an RDF/OWL form and thus can be transformed to plain XML. The Pellucid system can adapt any graphical user

interface which can handle XML and supports XML-RPC communication. We developed GUI based on Java JSP technology, which gathers XML from Pellucid through XML-RPC and transform it to HTML using XSL templates. In Figure 2 you can see Pellucid GUI with displayed active hints. AH can contain several resources. By clicking on resource you can see resource properties formatted by the application defined XSLT (Figure 2.)

3 Conclusion

In this article we discuss 3 types of knowledge presentation: Object Trees, Graphs and XSLT. We describe our solutions developed in the scope of the Pellucid project based on the Object Tree and also XSLT solution. Described solutions were evaluated on different types of users. The Object Tree is the best for knowledge experts. Graphs can be valuable for all users and XSLT transformation based on XML is probably the best solution. XML and XSLT is commercial standard and can be implemented by most of developers. In our future work we would like to focus also on Graph representation, find applications where this kind of knowledge presentation is appropriate and evaluate it.

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