A Prismatic Cognitive Layout For Adapting Ontologies

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Abstract. We propose a novel approach to personal ontologies, grounded on the concept of affordance and on the ontological theory of Von Uexküll, in which each concept can be viewed under different perspectives depending on the subjectivity of the user and thus can yield tailored semantic relationships or properties. We suggest a cognitive middle-layer interface between the user and the ontology, which is able on the run to modify and adapt the ontology to the user needs. The goal is to obtain an adapted version of the ontology that is tailored both to the context and to the user prospective and expertise, without the need of explicitly maintaining a high number of ontologies.

Keywords: Ontology-based Recommender Systems, Personal Ontology View, Ontology Learning, Affordance.

1 Introduction

In recent years ontologies proved to be very important tools for recommender systems, since they allow a formal representation of the concepts in a domain, thus being helpful for generating suggestions. However the use of a single ontology domain for all the users in a system is not always the best solution. In fact different users may have different needs and different prospective on a domain and would like to have items classified according their mental ontology. This is possible by using Personal Ontologies Views [1] (POV), which are ontologies tailored on the prospective and the specific domain view of a user. POVs have proven to be useful [2] for assisting the user in tasks as classification, navigation and search. However there are some issues with handling multiple POVs and their construction requires an abundance of evidence. Moreover the same user may have different prospective of the same ontology according to the social and geographical context and her/his expertise on certain topic. For example her/his view can change with time as she/he becomes more familiar with some parts of the domain. We thus need a tool more flexible then a POV and able to be adapted on the run on the basis of user needs.

2 The Prismatic Cognitive Layout

The ontologies are formal explicit specifications of a shared conceptualization [3]. They yield an objective meaning for each concept that does not change according to whom is using them. In this work we explore an alternative specification of conceptualization, grounded on the concept of *affordance* introduced by Gibson [4]. According to his theory, an item meaning can change depending to the context.

Gibson focused in particular on how different animals interact in different ways with their environment, but his idea can be extended to users and items in recommended systems. Moreover, it is demonstrated that cognitive processes are deeply rooted in the body's interaction with the world [5]. Von Uexküll et al [6] state that an entity acquires a meaning when it is used through an action. Thus the meaning is not objective, but is strongly linked to the interaction between an agent and an item. An entity can have a different meaning according to the user with whom it is interacting and to the action that it is used for. For example a concept like "alcoholic beverage" will have a different meaning for a sommelier and for a teenager. In the same way it will assume a different meaning, with different properties and relationships and thus a different ontological view, even for the same person when out for a romantic dinner or having lunch at work or in a pub with friends. This framework is particularly interesting for the user model community. In fact in this field it is often very helpful to be able to adapt the meaning of entity according to the user, the context and other external factors.

To implement this theoretical framework we need to transform a formal ontology in an adapting entity, which will present different classes, semantic relationship and properties to users with different prospective of the domain. We propose a **prismatic cognitive layout** (**PCL**), which is able to act as an ontology interface to this scope. We call it "prismatic" since this kind of ontology behaves as a prism, which shows different faces according to which one appears to be more tailored to the user.

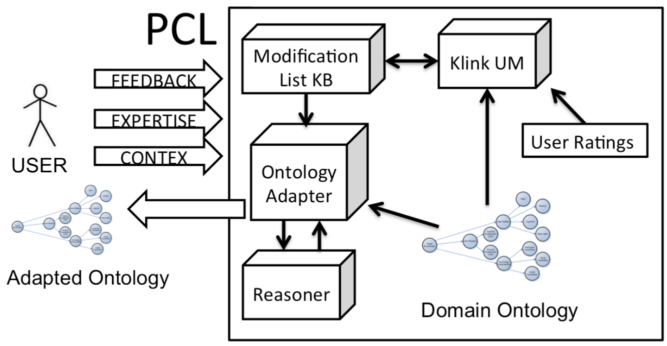

Figure 1. The prismatic cognitive layout architecture.

When a system needs to exploit the domain ontology (e.g. to facilitate user navigation or filter search results) it calls the PCL and feeds as arguments information about 1) the user expertise, 2) the context, 3) the user past feedback on the ontology elements she/he is most interested. Each of these three inputs is evaluated separately by the PCL to yield a list of suggested modifications on the main concepts of the domain ontology as "add property P" or "exclude relationship R between C1 and C2". As now, we solve the possible contradictions among the modification lists by assigning the following priorities: user feedback > expertise > context. We are however working on a more refined way to solve this issue.

The PCL is able to perform the following modifications on the ontology:

-Adding or removing a concept (e.g. "Sparkling Wine" or "Blue Mould Cheese")

-Adding or removing a semantic relationship between two concept (e.g. "skos:broaderGeneric")

-Adding or removing a property (e.g. Vintage or Alcoholic Content)

The user expertise is given a score from 1 to 3 according to the level of knowledge of the user on a concept. Every level is associated with a pre-compiled modification list designed to increase the ontology granularity with each level. Thus at level 1 only the more general concepts and their main properties are showed whereas at level 3 all available concepts and properties are used.

The context is defined as a label describing a situation as “romance_dinner”, “food_fair” or “picnic”. The modification list associated with each of them is computed semi automatically by exploiting Klink UM, a modified version of Klink [7], an algorithm which uses machine learning and statistical techniques to mine semantic relationships among keyword taking as input the co-occurrence graph. Klink UM goes further and exploits the patterns of user ratings on items associated with keywords to mine semantic relationships from those keywords. We run Klink UM on the ratings associated with each context to learn concepts and semantic relationships associated to that situation, which are then refined by ontology engineers and saved as a modification list in a knowledge base. Finally the user can also give direct feedbacks on concepts, semantic relationships and properties as in [2].

After the modifications are implemented, the ontology is checked for consistency with a reasoner as Pellet. If this control fails, the PCL excludes the modifications that give problems and tries all over again.

3 Conclusion

We presented PCL, a layer for ontologies grounded on the concept of affordance and on the ontological theory of Von Uexküll, which allows an ontology to be adapted in real time to a user and a context. As future work we plan to further develop Klink UM and its integration with the PCL. We are also working on a set of more complex heuristics to better integrate the modifications suggested by the tree inputs. A comprehensive evaluation on real users will be run to estimate the pragmatic advantage of using an adapted ontology.

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