Mapping Contexts to Vocabularies to Represent Intentions
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Abstract.

In the framework of multi-target use of a given ontology, this paper proposes a representation of vocabularies based on the identification of elementary vocabularies, which can be equivalently defined using specializations of the “kind of” relation. It defines a way of combining contexts and vocabularies that allows context-specific querying.

1 INTRODUCTION

A given assertion holds in a given “context”. This single affirmation can be interpreted in various ways, leading to a disparate literature about contexts. We can note two main considerations: (i) a given assertion can lead to several interpretations due to different meanings of terms, depending on the context [1, 4, 8]; (ii) the same interpretation can have different truth values in different contexts [9, 6, 12].

In this paper, our concern is to represent that, for the same piece of information, different descriptions will be given, different aspects will be highlighted, depending on the context, which can be seen as the target the piece of information will be used for (for which public and/or in which purpose). That is to say, different assertions will be used to describe the same piece of information, not because of the ambiguity of terms, nor due to the relativity of truth, but because different aspects will be important to retain, depending on the intention of the message vehiculated in each context. As a consequence, the vocabulary used in each context should be appropriate. Not all terms of the domain ontology are in accordance with the purposes of a given context: the presence of unappropriate terms, that do not conform to the intended use of information, can reveal a possible diversion out of the scope of the context, and thus not be pertinent, not understandable or not useful. For example, information intended for general public should not be too technical, terms that translate a notion not understandable or not useful.

The aim of this paper is to propose a way of representing vocabularies and associating them with contexts. The examples, although simplified, come from a real-world application in food science. The component nutritional quality of a food product may be interpreted in various ways, leading to a disparate literature about contexts. We can note two main considerations: (i) a given assertion holds in a given “context”. This single affirmation can have different truth values in different contexts [9, 6, 12].

A way of representing contexts in this model by structuring knowledge into levels has been descriptively introduced by [11] and furtherly studied e.g. in [3, 10]. The formalization of [2] defines a logically founded knowledge representation formalism based on nested graphs, thus providing operations for reasoning with nested graphs. At first level, a conceptual graph gives an overall description of a fact. Zooming in on certain concept vertices provides more details, also described by conceptual graphs. A conceptual graph that is nested in a concept vertex is thus described in the context defined by this concept. Typed nestings [2] allow specifying the relationship (description, explanation, ...) between the surrounding vertex and one of its descriptions. A new type set is thus added to the support, the set of nesting types. In the following, a context is considered to be represented as a nesting type and expresses the target (public and/or purpose) the nested piece of information is intended for.

An example of nested conceptual graphs, built using the concept type set of Figure 1, is given in Figure 2. It represents the following piece of information: “an article, whose subject is a wheat food product that is cooked in water, has a result, whose nutritional observation is that the vitamin content of this wheat food product decreases, whose biochemical explanation is that this wheat food product contains hydrosoluble vitamin that is dissolved, and whose nutritional evaluation is that the nutritional quality of this wheat food product is deteriorated”.

The set of conceptual graphs is partially pre-ordered by the specialization relation (noted ≤), which can be computed by the pro-computational graph model based on labelled graphs. The conceptual graph model is composed of two parts: the support, which contains the terminological knowledge –, and the conceptual graphs, which contain the assertional knowledge. Figure 1 shows a part of the set of concept types, noted \( T_C \), which is part of the support.

Figure 1. Part of the “food science” concept type set

2 RELATED WORK

2.1 Context representation

The context model we use is based on the definition of contexts as nesting types [2] in the conceptual graph model, which is a knowledge representation model based on labelled graphs. The conceptual graph model is composed of two parts: the support, which contains the terminological knowledge –, and the conceptual graphs, which contain the assertional knowledge. Figure 1 shows a part of the set of concept types, noted \( T_C \), which is part of the support.

![Figure 1](https://via.placeholder.com/150)

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The set of conceptual graphs is partially pre-ordered by the specialization relation (noted ≤), which can be computed by the pro-
vocabulary depend on its depth in the ontology. An example is the following. To
ogy, seems coherent to us. We propose a construction of vocabularies
hence cannot be used. In this example, this
be pertinent for the same uses.
In Figure 3, 4 direct specializations of the “kind of” relation are
V, (appellation)
V, (technological process)
Universal

Figure 2. An example of nested conceptual graphs

As mentioned in previous works (see part 2.2), in practice ontolo-
gies are constructed by successive specializations from top to bottom level. Moreover considering that several direct specializations of a
given concept type can have related meanings seems sensible. To
conserve these notions, we consider that vocabularies are composed of
elementary vocabularies built by successive specializations, in a
top-down way, of the concept type set.

Definition 2 \( T_c \) is partitioned into a set of elementary vocabularies \( V_i \) built as follows:

For \( n > 0 \), \( V_n \) is obtained by defining specializations of concept
types of one elementary vocabulary \( V_k \) (\( k < n \)), or common special-
izations of several given elementary vocabularies, through a given
specialization criterion\(^4\) (noted \( \text{crt} \)).

An example is given in Figure 3 for a small part of the set of con-
cept types. The criterion used for each vocabulary is noted in brack-
ests. In this example, each elementary vocabulary is built by special-
izing one preceding elementary vocabulary.

Vocabularies can then be built as unions of elementary vocabu-
laries, obtained through specialization criteria that make sense for a
given informational purpose (see Section 4). The use of the same
specialization criterion in the definition of different elementary vo-
cabularies (for instance in Figure 3, vocabularies \( V_3 \) and \( V_5 \)) can ex-
plain why categories that are at different depths in the ontology may
be pertinent for the same uses.

3.2 An equivalent definition

The main idea being that the depth in the ontology is not so important
as the specialization criterion, we propose to formalize the notion of
criterion as a specialization of the “kind of” relation.

Definition 3 A specialization of the “kind of” relation (noted \( <_{\text{crt}} \)) is a restriction of the “kind of” relation obtained by specifying the
criterion \( \text{crt} \) used to establish it.

In Figure 3, 4 direct specializations of the “kind of” relation are
used to define the elementary vocabularies: “kind of, with regard to
role for humans” (noted \( \text{koR} \)), “kind of, with regard to composition”
(noted \( \text{koC} \)), “kind of, with regard to appellation” (noted \( \text{koA} \)), “kind
of, with regard to technological process” (noted \( \text{koT} \)). They could
themselves be specialized, as proposed in Figure 4.

Elementary vocabularies can now be re-defined on the basis of the
specializations of the “kind of” relation (more simply called: “kind
of” relations, in the following) used to define them.

4 declaratively defined.
is the basis of querying in that model, remains unchanged using this
4.2 Context-specific querying

For example, in Figure 3, there is one path from Universal to Extruded pasta, with the following “kind of” relations: koR, koC, koC, koC, koA, koT. The alteration of “kind of” relations on this path is thus: koR, koC, koA, koT. From Universal to Dry laminated pasta, there are two paths (one through Laminated pasta and one through Dry pasta) that both have the same “kind of” relations: koR, koC, koC, koC, koA, koT. The alteration of “kind of” relations on these paths is: koR, koC, koA, koT. As Extruded pasta and Dry laminated pasta have the same alteration of “kind of” relations on their paths from Universal, they belong to the same elementary vocabulary according to Definition 4.

Definitions 2 and 4 of an elementary vocabulary can be shown to be equivalent.

5 CONCLUSION AND PERSPECTIVES

This work has proposed two equivalent ways of defining vocabularies, the first one based on the identification of elementary vocabularies, the second one on specializations of the “kind of” relation. A mapping between contexts, represented as nesting types, and vocabularies has been proposed, which is in accordance with the querying mechanism of the conceptual graph model.

This work, emerging from user needs in an application in food science, should evolve in several directions. A first perspective is an extension in order to provide complementary answers during the querying, e.g. answers from other contexts – that is, from nestings with a non-comparable nesting type – that have compatible vocabularies (common concept types) and that effectively only use concepts that are allowed in the context of the query.

An important issue will be to give the user the choice of the “kind of” relations used in the querying, that can be different from one part of a query to another, so as to allow a rich expression of needs.

REFERENCES