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# Contextual Semantic Integration for Ontologies

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**Abstract.** Information integration in organisations has been hindered by differences in the software applications used and by the structure and semantic differences of the different data sources (de Bruijn, 2003). This is a common problem in the area of Enterprise Application Integration (EAI) where numerous ad-hoc programs have typically been created to perform the integration process. More recently ontologies have been introduced into this area as a possible solution to these problems, but most of the current approaches to ontology integration only address platform, syntactic and structural differences and do not address the semantic differences between the data sources (de Bruijn, 2003). For ontology semantic integration the underlying meaning of each element is needed. An approach based on introducing the contextualisation of the terms used in an ontology is proposed. This approach is called Contextual Semantic Integration for Ontologies.

## 1. Introduction

The ability to incorporate detailed semantics (Magnini et al, 2003) of data will provide greater consistency in its use, understanding and application. One of the principal benefits of introducing the semantics will be the reduction of human involvement in the process of data integration and data understanding. This can be partially overcome by the introduction of ontologies (Wache *et al*, 2001).

A widely cited definition of an ontology is that it is a specification of a conceptualisation (Gruber, 1993) and can be constructed in a number of stages (Fernandez et al, 1999): specification, conceptualization, formalization, implementation and maintenance. It is generally accepted that an ontology gives a context for the data described by that ontology. Although this may be true, the exact meaning of the terms used to describe the labels of the concepts defined in the ontology is not available. All of the approaches to semantic integration base the semantics on the relationships between the concepts and the existence of the concepts in the ontology. This form of semantic integration still requires the application of a significant amount of human intelligence to determine the exact meaning of each concept.

The Contextual Semantic Integration (CSI) approach involves a contextual semantic plug-in for ontologies that will provide the semantics (meaning) of the individual elements of an ontology. The CSI approach adds the meaning of each concept, which is based on a set of semantically similar words, thus giving contextual semantics. By doing this there can be no ambiguity in the meaning, understanding and how the data should be manipulated.

### 3. Contextual Semantic Integration

Our Contextual Semantic Integration approach allows for two distinct ontologies to be merged/integrated using a set of semantically similar words. For example, if two concepts have the same set of associated words then the concepts can be said to have the same context and can therefore these concepts are equivalent. Concepts with the same label can have a different set of words associated with them and this will indicate that the meaning of the concepts is different and hence the context is different. Another possibility is that two concepts may have a set of associated words that differ by a small number of words. In this case there is a high degree of similarity between the terms. A *Contextual Semantic Distance (CSD)* function is required to indicate if the terms are the same. For example, if the threshold value for the *Contextual Semantic Distance* function was set to 80% then if there was an overlap in the number of common terms equivalent to 80% of the two sets of associated terms then the CSD function would indicate that the terms are the same. Therefore the two concepts could be integrated.

A simple example to illustrate how the contextualisation works, using 'Room' as our concept. The context for the concept is defined by a list of words that have the same meaning or would give meaning the word used for the concept i.e. Room. In our case Room would have the following words to give its context <Space, Walls, Floor, Ceiling, Window, Door, Building>.

In another ontology with a concept labeled 'Room' the following words could be used <Space, Movement, Elbow, Distance, Spatial>. This would give a meaning that the concept Room is to do with how much space something has. This is a very different meaning to the previous context when the meaning was some enclosed area in a building. Such information and semantics is not currently available and cannot be used in ontology merging/integration.

### 4. Conclusion

This paper introduces our approach for adding contextual semantics to ontologies and how this can be used to support greater integration of ontologies. The Contextual Semantic Integration (CSI) approach adds the meaning of each concept that is based on a set of semantically similar words. The existence of this set of words for each concept allows for more automation in the semantic integration of ontologies. By doing this for each concept means that there can be no ambiguity in the meaning, understanding and how the data should be manipulated.

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