Ontologies and Context

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A representation of "context" is relevant for numerous applications in different fields, such as natural language processing, information retrieval and knowledge representation and reasoning. In artificial intelligence, attention was brought to the investigation of context by McCarthy's criticism of an expert system that provided in some cases useless results because it did not take context into account (compare Akman & Surav (1996)). According to McCarthy, lack of contextual information creates a "problem of generality", which means that minor changes in the constraints of a system may require a complete redesign of the system. Logicians call this a problem of "non-monotonicity" because the truth value of expressions can change by adding true constraints, which is in contrast to traditional logic. An explicit representation of context, which is taken into consideration for logical inference (or "contextual reasoning"), can solve the problem.

While context is thus an important component of knowledge representation and reasoning, so far there has neither been an agreement as to what context is nor what its necessary features are nor how it can ultimately be formalized. An overview of recent applications, methods and theories related to context can be found in the proceedings of the two international conferences on context (CONTEXT'97, CONTEXT'99). An overview of specifically AI related approaches and recent developments can be found in Akman & Surav (1996) and Benerecetti, Bouquet & Ghidini (2000).

In human communication context is used implicitly. It facilitates disambiguation of polysemous terms. There is a duality between the constraints that are contained in a context and the amount of information required to be explicitly mentioned in a representation. A specialized, precise context facilitates terse representations of information that is communicated within that context, whereas a vague context requires detailed representations of communicated information. The question that arises in knowledge representation is how to explicitly represent the constraints that are usually implicit in human communication because the better the representation of otherwise implicit knowledge, the easier it is to process human language. A solution was proposed by Lenat & Guha (1990) who started in the early 1980's to build a large knowledge base, CYC, that was intended to eventually contain all human common sense knowledge. Apart from an inference engine and development tools, CYC contains an (AI) ontology that specifies concepts and their relations.

More recently the notion of "ontology" for representing conceptual systems has spread to other domains and is especially booming in the area of internet-related business, which is documented by the emergence of websites, such as ontology.org, and also by the formation of a special interest group for "standard upper ontologies" (SUO) in the IEEE community. Important applications in this e-business are facilitating interoperability across heterogeneous applications, XML applications and information agents. These enterprise ontologies are usually considerably less systematical and less well defined compared to AI ontologies although some use Stanford's Ontolingua or the knowledge interchange format (KIF) as a means of formal representation.

Although the need for a representation of context was the starting point of enterprise and AI ontologies, and although CYC has mechanisms for dealing with context, such as "micro-theories", the conceptual hierarchies of ontologies themselves do not usually contain a representation of context. This is in contrast to theories from other disciplines, such as library classification where a notion of "facets", which is more narrow than context but related to it, has been applied to conceptual hierarchies (Ranganathan, 1962). But due to the differences between library classifications and AI ontologies, this notion cannot directly be transferred.

Several theories exist that formalize conceptual hierarchies (such as formal concept analysis (Ganter & Wille, 1999)) and the flow of information among conceptual hierarchies (Barwise & Seligman, 1997). This presentation argues that these two theories together with situation theory (Devlin, 1991) are directly applicable to the three dimensions of contextual dependency and reasoning (namely partiality, approximation and perspective) described by Benerecetti et al. (2000). A combination of these theories would thus facilitate a more explicit representation of context within conceptual hierarchies of ontologies. This approach might in the future help to overcome some of the current shortcomings in the design of conceptual hierarchies of ontologies and might help improve representing and using context in general.

Web Resources

- CONTEXT'97. Available at http://context.umcs.maine.edu/

- CONTEXT'99. Available at http://www.cs.unitn.it/CONTEXT-99/
- CYC. Available at http://www.cyc.com/
- Ontolingua, Stanford University. Available at http://www-ksl-svc.stanford.edu:5915/
- Standard Upper Ontology. Available at http://suo.ieee.org/

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