What Is Your Context?

Position Paper
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STATEMENT OF POSITION

Is the statement: "All Birds Fly" always true? Penguins are birds but can't fly. This statement, however, might be entirely true if its context was "In Brazil". Here we have added context to the statement, and the context being "In Brazil".

The geospatial community is busy catching up with the Semantic hype. One thing they agree on is the use of OWL as the lingua franca to develop ontology. They, however, ignored the need for an ontological model that account for Context. In the last twenty years, the notion of context has become more and more central in the theories of knowledge representation in Artificial Intelligence, cognitive psychology and linguistics, but to the best of our knowledge not in the geospatial domain.

Several domains have already elaborated their own working definition of context. In human-machine interaction, a context is a set of information that could be used to define and interpret a situation in which agents interact. In the context-aware applications community, the context is composed of a set of information for characterizing the situation in which humans interact with applications and the immediate environment [Dey, 1998]. In artificial intelligence, the context is what does not intervene directly in a problem solving but constrains it [Brézillon, 1999a]. Our working definition of context is that it is a collection of relevant conditions and surroundings that make a situation unique and comprehensible.

Our position is that Semantic Interoperability can only be achieved with general and unifying theory of context for geospatial applications. By unifying theory we mean a theory that augments ontology of the geospatial domain with context to enable agents to conduct meaningful inference and hence semantic interoperability.

A FOUNDATION FOR A THEORY OF CONTEXT FOR GEOSPATIAL APPLICATIONS

Ontologies are shared models of a domain that encode a view which is common to different communities. Context is a model that cast a local view of shared models, i.e., shared ontologies. Context can be considered as a filter that helps scope this subset of an ontology that is relevant to a given situation. Developing a theory of context for the geospatial domains must satisfy the following requirements:

1) Context should allow a simpler formalization of axioms by defining the set of known conditions that are common to the stated axioms.

2) Context should allow us to restrict the vocabulary and the facts that are used to solve a problem on a given occasion. This requirement will enable us to scope large ontologies to those subsets that are relevant to the problem at hand.

3) The truth values of facts should be dealt with as dependent on a collection of assumptions which implicitly define context.

4) There are no absolute, context independent facts, namely each fact must be stated into an appropriate context.

5) Reasoning across different contexts should be modeled. This will enable mapping between ontologies (in context), and hence semantic interoperability.

6) A theory of geospatial context must consider the role of time, location, and other spatio-temporal aspects in determining the truth value of a given set of axioms.

McCarthy defined a context as a generalization of a collection of assumptions. The basic relation of context is *ist(c,p)*. It asserts that the proposition p is true in the context c, where c is meant to capture all that is not explicit in p that is required to make p a meaningful statement representing what it is intended to state. We go further and state that the truth value of any proposition cannot be established without establishing its context c. Context c is a collection of propositions p`, which in turn can only be true in context c`. Formulas ist(c,p) are always asserted within a context, i.e., something like ist(c', ist(c,p)): c': ist (c, p). This is inline with Russel's introduction of context, where he introduced contextual descriptions that have no meaning of their own. However every sentence in which they occur has a meaning [Arbab, 1992]. The consequences are:

- A context is always relative to another context,
- Contexts have an infinite dimension
- Contexts cannot be described completely,
- When several contexts occur in a discussion, there is a common context above all of them into which all terms and predicates can be lifted.
- There are relations between contexts. For example a context c may subsumes context c`. This enables us to propagate or lift assertions of one context into another using some predefined lifting rules.

CONCLUSIONS

Semantic interoperability can only be achieved if we introduce context into our ontological models. To the best of my knowledge there is a lack of body of research that investigates the role of context in the ongoing activities to build ontological model for geospatial applications. This position paper intends to mobilize the research community to build a coherent general theory of context for the geospatial domain and begin to lay the foundation for such theory.

Selected References:

[Brézillon, 1999a] Brézillon P., "Context in problem solving: A survey", *The Knowledge Engineering Review*, 1999, 14(1), 1-34.

[Dey, 1998] Dey A.K. and Abowd G.D., "A conceptual framework and a toolkit for supporting the rapid prototyping of context-aware applications", 1998.

Arbab B. (1992) "A formal language for representation of knowledge", Proceedings of the AAAI'92 Workshop on Propositional Knowledge Representation, Stanford, CA, pp. 1-8.