ECtoloG: Construction Grammar Meets the Semantic Web

Recent progress towards formalizing constructions and towards a construction grammar architecture [Kay02,Bergen02,Steels05] raises a number of promising issues and challenging questions. At the same time recent efforts within the so-called *Semantic Web* framework [Berners-Lee01] seek to add machine readable semantics to content found on the web, which includes natural language texts. In this work we present first results of an attempt to formalize construction grammar by means of formal ontologies as employed in the Semantic Web effort. The central aim of this undertaking is to enable semantic processing based on construction grammar for natural language processing applications using the web as their primary source of information.

Up to now there are two formal computational models of construction grammar which are the Embodied Construction Grammar of Chang *et al.* [Chang01] and the Fluid Construction Grammar of Steels [Steels05]. Both are quite similar in terms of their expressive capabilities and basic operators - the main differences being that FCG can be employed for language understanding and generation as well as for modeling language change, while the main focus of ECG has been on language understanding. In this work we seek to develop a formal model of construction grammar – based on the primitives and operators proposed by Chang *et al.* (2001) – employing the state of the art in knowledge representation.

For endowing ontologies with a construction grammar layer, we assume two particular ontological frameworks one called *Descriptions & Situations* (D&S) and one called *Ontology of Information Objects*, which are extensions of the *Descriptive Ontology for Linguistic and Cognitive Engineering* (DOLCE) [Masolo03,Gangemi03]. D&S is an ontology for representing a variety of reified contexts and states of affairs. In contrast to physical objects or events, the extensions of ontologies by non-physical objects pose a challenge to the ontology engineer. The reason for this lies in the fact that non-physical objects are taken to have meaning only in combination with some other *ground* entity. Accordingly, their logical representation is generally set at the level of theories or models and not at the level of concepts or relations. It is, therefore, important to keep in mind that the meaning of a given linguistic expression emerges only through the combination of linguistic & conceptual knowledge with "basic" ontological knowledge, as modeled in such ground ontologies.

Next to the support via dedicated editors and inference engines, one of the central advantages of our ensuing ontological model (called *ECtoloG*) over the currently used ASCII-format of ECG lies in its compatibility with other ground ontologies developed within the Semantic Web framework. We chose to model conceptual schemas as *descriptions* which are in the D&S ontology described as social objects which represent a conceptualization (e.g. a mental object or state), hence they are generically dependent on some agent and communicable. Descriptions define or use concepts or figures and are expressed by an information object. Since descriptions are expressible by information objects, constructions are modeled as those. As future work we will populate our model with appropriate schemas and constructions and employ it in the SmartWeb language-based question answering system [Reithinger05].

References

[Bergen02] Bergen, B. and Chang, N. “Simulation-Based Language Understanding in Embodied Construction Grammar”. Technical Report TR-02-004, International Computer Science Institute, Berkeley, CA, USA, 2002.

[Berners-Lee01] Berners-Lee, T., Hendler, J., and Lassila, O. “The Semantic Web”. In: *Scientific American*, May, 2001.

[Chang01] Chang, N., Feldman, J., Porzel, R. and Sanders, K. “Scaling Cognitive Linguistics: Formalisms for Language Understanding”. In: *Proceedings of the 1st International Workshop on Scalable Natural Language Understanding* (ScaNaLU), Heidelberg, Germany, 2002.

[Gangemi03] Gangemi A., Mika P. “Understanding the Semantic Web through Descriptions and Situations”. In: Meersman R., et al. (eds.), *Proceedings of ODBASE03 Conference*, Springer, 2003.

[Kay02] Kay, P. “An Informal Sketch of a Formal Architecture for Construction Grammar”. In: *Grammars*. 5:1-19, 2002.

[Masolo03] Masolo, C., Borgo, S., Gangemi, A., Guarino, N., and Oltramari, A. “Ontology Library”. WonderWeb Deliverable D18, I STC-CNR, Padova, Italy. See: http://wonderweb.semanticweb.org/deliverables/documents/D18.pdf, 2003.

[Reithinger05]. Reithinger, N., Bergweiler, S., Engel, R., Herzog, G., Pfleger, N., Romanelli, M., Sonntag, D. “A Look Under the Hood – Design and Development of the First SmartWeb System Demonstrator”. In: *Proceedings of the Seventh International Conference on Multimodal Interfaces*, Trento, Italy, October, 2005.

[Steels05] Steels, L. “The Role of Construction Grammar in Fluid Language Grounding”. Submitted. *Elsevier Science*, 2005.