

Applying type theory and higher order logic on natural language syntax and semantics

Besides providing a foundation for programming languages, type theory has influential applications on the study of natural language syntax and semantics (Lambek, 1958; Montague, 1970; Ranta, 1994). In my presentation, I will briefly analyze the abovementioned, concentrating on their differences, advantages, shortcomings and insights on natural language. This is followed by a more general discussion (and comparison) of the potentials of type theory and higher order logic for modeling natural language syntax and semantics. Because of the need for an alignment between "natural" and logical types, a crucial point for such approaches is type assignment. As the relevant work has been usually done by logicians and mathematicians, the general method has been to either start from a formalism and see what in natural language corresponds to it or (in more radical cases) shoehorn (a fragment of) natural language into a predetermined formalism. Arguably, a more balanced approach, one which could take into account the relevant properties of natural language before deciding on the logical framework or formalism for their analysis or representation, is warranted. In my presentation, I will show how linguistic typological work can guide the researcher's choice of "natural" type assignments, which can then be modeled formally in a suitable logical framework (in this case, type theory or higher order logic). On the more technical side, I will briefly describe how proof assistants like Agda, Coq and Isabelle can facilitate the design of sound formalisms for representing natural language syntax and semantics.

The presentation will conclude with a sample analyses of the semantics of 14 focal Estonian case labels in higher order logic and type theory, respectively, arguing for and against specific choices of formalism with respect to the goal of arriving at a streamlined description of a universal natural language phenomenon (viz., case/adposition semantics). The principle of the primacy of "natural" type assignments over formal ones in aligning the two is followed throughout the demonstration.

References

- Lambek, J. (1958). The mathematics of sentence structure. *The American Mathematical Monthly*, 65(3), 154–170.
- Montague, R. (1970). Universal grammar. *Theoria*, 36, 373–398.
- Ranta, A. (1994). *Type-theoretical grammar*. Oxford; New York: Clarendon Press.