Type-Logical Grammars: Linguistic Applications and Linear Skein Relations

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Abstract

In this second talk of a series, I will show in a self-contained account a number of ways in which certain kinds of logics can be used to model and derive formal descriptions of natural language sentences. These "type logics" are employed in grammars by assigning particular logical formulae (types) to words in the language. The formulae take the place of the traditional "parts of speech" such as noun, verb, etc., and more directly indicate the structures in which different sorts of words can be involved. The logical system is then used to literally prove whether a sentence structure is grammatical in the language. Recent research indicates that such type-logical grammars are as completely descriptive as any other kind of formalized grammar, but have the advantage of more precise learning procedures which model the language acquisition process.

It was mentioned in my previous talk how these grammatical logics are close relatives of Linear Logic. The latter has a developed theory of compressed proof objects known as "proof nets" which were described last time. The proof nets of the grammatical type logics are only partially worked out at present. In the second part of this talk, I will discuss some speculations on how proof nets, which are a species of labeled graph, obey some kind of linear skein relation in the sense similar to the Conway algebra that is at the root of all the knot polynomials from Alexander (1928) to the more recent work of Jones, HOMFLY-PT, etc. In particular, one can have numerous different graphical representations of "the same" proof net; all of these representations will have an identical skein resolution tree (in the fashion

of Cromwell's knot theory research), and a resolution tree of this kind can always be used to produce a polynomial.