

## The 2013 MoL S.-Y. Kuroda Prize

The first honorees of the newly established S.-Y. Kuroda Prize of the Mathematics of Language Special Interest Group of the Association for Computational Linguists (ACL SIGMOL) are

- [Aravind K. Joshi](#) (University of Pennsylvania),
- [Vijay K. Shanker](#) (University of Delaware), and
- [David J. Weir](#) (University of Sussex).

How they came to share this prize is a long but fascinating story. Exactly one hundred years ago, with the publication of Thue (1914), strings became objects of mathematical inquiry on their own right. Nearly half a century later, conceptualizing languages as stringsets, Chomsky (1956) posed a question that was to remain central to mathematical linguistics to this day: how complex is the class of string manipulation devices or *grammars* that characterize the stringsets corresponding to human languages? Chomsky himself set something of an upper bound in the form of context-sensitive grammars (CSGs), but these enjoyed limited success outside phonology. His own proposal, transformational grammar, turned out to be Turing-equivalent (Salomaa, 1971; Peters and Ritchie, 1973) and thus not specific enough to linguistics.

The resulting pursuit of more language-specific machinery led to a proliferation of syntactic formalisms that made little sense to the more application-minded researchers, as witnessed e.g. by Tsujii (1988). In spite of a well-articulated minority opinion (Simmons and Yu, 1991) the CSG upper bound was not pursued with enthusiasm, for two related reasons: first, because CSG parsing is very resource-intensive (PSPACE-complete), and second, because CSGs are sufficiently flexible to generate all kinds of non-natural languages such as the one composed of all and only strings of prime length.

Given the clarifying effect of Pullum and Gazdar (1982) showing the weaknesses of the then standard arguments against context-free grammars (CFGs), and perhaps more important, given the ease that Generalized Phrase Structure Grammar (Gazdar et al., 1985) handled many of the outstanding long distance cases, research soon focussed on syntactic formalisms that could handle the remaining trans-CF cases, in particular cross-serial dependencies in Dutch (Huybregts, 1976). The first well-articulated alternatives to CSGs were Tree Adjunction Grammars (Joshi et al., 1975) and Head Grammars (Pollard, 1984), and in Weir et al. (1986) and Vijay-Shanker et al. (1987) our three honorees discovered that after some minor modifications these theories were equivalent. This was already remarkable, but there was more to come: Two other formalisms, one originating in categorial grammar (Ajdukiewicz, 1935; Steedman, 1987) and one in computer science (Aho, 1968; Gazdar, 1988) turned out to have minor variants that are also equivalent (Joshi et al., 1990).

While this ‘convergence of grammatical formalisms’, as this family of results became known, is conveniently summarized in the eponymous tech report just referred to, we emphasize that the S.-Y. Kuroda award *is not a “best paper” prize. The recipients are honored for work that was done at least 15 and at most 35 years before the award is made. The work and the author(s) so honored should have made a lasting impact on the mathematics of language, opening up some new area and/or settling some major issue.*

We started out by recalling why finding a better than CS bound for natural language stringsets is a central, if not *the* central question of mathematical linguistics. Nearly thirty years later, the improvement from context-sensitive to mildly context-sensitive (MCS) still exerts an influence, both on the development of ‘minimalist’ transformational grammar and on dependency grammar. There are some arguable counterexamples (Radzinski, 1991), but these come from the domain of arithmetic, which is generally considered to lie outside syntax proper.

Kuroda’s ground-breaking work relating CSGs to linear bounded automata was half a century ago (Kuroda, 1964). When SIGMOL formulated the charter of the prize quoted above, a former colleague of his asked: How did he see so far ahead? It is a pleasure to inaugurate the prize by awarding it to people who have displayed the same far sight.

*András Kornai*

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