



*Editorial*

## Trees in Linguistics, Logic, and Computer Science

Trees are ubiquitous structures, particularly attractive with the combination of extremely perspicuous description and deep and complex theory, rich in elegant techniques, beautiful results, and far reaching applications. The manifestation of their diverse and inter-related appearances in the areas of linguistics, logic, and computer science was the topic of a workshop held at the 12th ESSLI Summer School in Birmingham, in August 2000, from which this special issue stemmed. It contains five contributions on the topic, and each of them touches it from its own perspective, rather distinct from the others. Yet, their combination offers a broad and multi-faceted impression of the theoretical aspects and practical applications of trees and tree-like structures.

To start with, James Rogers' article is a comprehensive survey of a parallel and mutually influencing development between the theories of formal languages and logical definability, with applications to computational linguistics. This development originates from classical results of Buchi and Elgot relating language-theoretic definability with logical definability, viz. providing a characterization of regular languages in terms of definability in WS1S, followed by similar characterizations (due to Doner, Thatcher and Wright) of context-free languages in terms of definability in WSnS. These results are further extended and generalized by Rogers's theory of multi-dimensional trees and in this paper he shows how they can be used for characterization of structures featuring in theories of syntax such as Government and Binding theory, Tree Adjoining Grammars and Generalized Phrase-Structure Grammars.

The other survey paper, Gregory McColm's introduction to the theory of random trees, gives a rather more mathematical perspective on trees as relational structures. In particular, the paper provides an accessible exposition of the basic probabilistic methods used to estimate asymptotic probabilities and establish 0–1 laws on logically formalizable properties of trees. Although not directly concerned with linguistic applications, the paper touches upon the asymptotic behaviour of regular and context-free languages and thus offers an interesting and potentially useful approach to formal languages.

In his contribution Denys Duchier formalizes the configuration problem of labelled trees, and in particular dependency parsing, as constraint satisfaction prob-

lems. He addresses important issues in computational linguistics such as lexical ambiguity, structural ambiguity and valency constraints, grammatical principles etc., and demonstrates how they can be treated systematically in the proposed framework and dealt with efficiently using constraint programming techniques.

In Yannick Le Nir's article trees feature as proof structures in the natural deduction system for Lambek calculus, subjected to transformations into proof trees in an Ajdukiewicz – Bar-Hillel's style calculus, used in a study building towards a constructive proof of the equivalence between Lambek grammars and context-free grammars established by Pentus, which would enable transfer of low (polynomial) complexity results to the former.

The paper of Massimo Franceschet and Angelo Montanari deals with yet another interpretation of trees: the one of branching time structures in philosophical or computational sense, particularly important in temporal logics for non-deterministic and parallel computations. They study the monadic second-order theory, and establish expressive completeness, decidability and complexity results of the associated temporal logic of layered tree-like structures representing successively refining levels of time granularity.

This collection is inevitably (given the vastness and diversity of the topic) non-homogeneous and may even appear somewhat idiosyncratic. Yet, it is well-focused on the unifying theme and we hope the reader will be able to see the 'forest behind the trees' and will enjoy the walk through it.

Finally, we would like to thank the authors for the interesting and insightful contributions and the referees for their competent and professional reviews.

Dov M. Gabbay  
Valentin Goranko  
June, 2001