Enumerating Objects with Mildly Context-Sensitive Encodings

Frank Weinberg Markus E. Nebel
Department of Computer Science, University of Kaiserslautern
[f_weinbe,nebel]@cs.uni-kl.de

Enumerative combinatorics is a major tool in theoretical computer science with applications e.g. for the analysis of algorithms and data structures. Well-known methods are available to enumerate combinatorial classes with a context-free description like certain families of trees that can be represented by Dyck-languages. For objects with dependencies not expressible by context-free grammars, enumeration results are much harder to derive and techniques like bijective combinatorics may be applied. In this talk we show how to use multiple context-free grammars together with generating functions in order to enumerate classes without context-free encoding thereby proving a general theorem that allows the translation of the grammar into an algebraic equation for the corresponding enumerator generating function. For its proof, we implicitly establish a bijection between the grammar's language and an – for enumeration purposes – equivalent context-free description. We prove the new method useful by presenting original results from the analysis of algorithms and theoretical bioinformatics, e.g. enumerating the class of pseudoknot structures by Rivas&Eddy.