Relating Chomsky Normal Form and Greibach Normal Form by exponential transposition: towards the categorification of the theory of context-free languages

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Abstract.

We show that context-free grammars in Chomsky Normal Form and in Greibach Normal Form are related via exponential transposition, or Currying. This results from combining Bob Walters' approach to context-free grammars via multigraphs [**?**] with an observation concerning the equivalence of certain kinds of trees as inductive data types [**?**, Exercise 1.14]. On the one hand, this leads to a new more conceptual algorithm for constructing Greibach normal forms. But it also suggests a natural extension of Walters' approach that subsumes the familiar dichotomy between finite state automata and regular grammars, a feature missing from Walters' original set-up. Taking into account Walters' construction of the free category with products on a multigraph [**?**], further techniques from the categorical treatment of labeled transition systems then become available, e.g., the notions of simulation and bisimulation arise naturally for context-free grammars as well as for push-down automata. Our methods readily extend to variations of context-free languages, e.g., weighted ones.