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Compacted binary trees and minimal automata admit stretched exponentials

A compacted binary tree is a directed acyclic graph encoding a binary tree in which common subtrees are factored and represented only once. We show that the number of such trees of size n is equal to

$$\Theta(n! 4^n e^{3a_1 n^{1/3}} n^{3/4}),$$

where $a_1 \approx -2.338$ is the largest root of the Airy function. Our approach involves bijections to enriched Dyck paths, two-parameter recurrences, induction, asymptotically tight bounds, and adapted Newton polygons. This method also allows to enumerate minimal DFAs recognizing a finite binary language. This is joint work with Andrew Elvey Price and Wenjie Fang.