

Enumeration of snakes and cycle-alternating permutations

Matthieu Josuat-Vergès

(Submitted on 3 Nov 2010)

Springer numbers are an analog of Euler numbers for the group of signed permutations. Arnol'd showed that they count some objects called snakes, that generalize alternating permutations. Hoffman established a link between Springer numbers, snakes, and some polynomials related with the successive derivatives of trigonometric functions.

The goal of this article is to give further combinatorial properties of derivative polynomials, in terms of snakes and other objects: cycle-alternating permutations, weighted Dyck or Motzkin paths, increasing trees and forests. We obtain the generating functions, in terms of trigonometric functions for exponential ones and in terms of J-fractions for ordinary ones. We also define natural q-analogs, make a link with normal ordering problems and combinatorial theory of differential equations.

Comments: 22 pages

Subjects: **Combinatorics (math.CO)**

Cite as: **arXiv:1011.0929v1 [math.CO]**

Submission history

From: Matthieu Josuat-Vergès [[view email](#)]

[v1] Wed, 3 Nov 2010 16:31:01 GMT (30kb)

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