

DDMF: A Generated, Online Dictionary of Special Functions

Frédéric Chyzak^a

^aINRIA (France)

Special functions are used in many areas of applied mathematics and the continuous need of scientists for lists of their mathematical properties has led to a great deal of reference books on special functions. Formulas in such books are typically collected from the literature by mathematical experts. Furthermore, more and more powerful algorithms have been developed over the last decades by the computer-algebra community to compute properties of special functions.

Thus, it has become just natural to automate the writing of a mathematical handbook on special functions, insofar as a sufficiently large and well identified class of functions share common algorithmic properties. Our encyclopedia DDMF (for “Dynamic Dictionary of Mathematical Functions”) focuses on so-called “differentiably finite functions,” that is, functions that are described as solutions of a linear different equation with polynomial coefficients and finitely many initial conditions. These functions enjoy a great deal of common algorithmic properties that have been studied intensively.

For each mathematical function, the current version (v1.6) *algorithmically* computes, then displays: its potential symmetries; Taylor and Chebyshev series expansions; more generally, asymptotic expansions given in closed form or through definitions by recurrence; calculations of guaranteed, arbitrary-precision numerical approximations; real plots; its Laplace transform; expressions in terms of hypergeometric functions. Upon request by the user, more terms in series expansions or more digits in numerical approximations can be computed incrementally. For some of the properties, human-readable proofs are also automatically *generated* and displayed. In addition, our encyclopedia can in principle be augmented with any new function of the class.

In this talk, I will demonstrate the mathematical web site (<http://ddmf.msr-inria.inria.fr/>), present the algorithms used, and briefly touch on the underlying system that generates the web site.

(Joint work in continuous progress with Alexandre Benoit, Alexis Darrasse, Stefan Gerhold, Marc Mezzarobba, and Bruno Salvy.)