
MR2022851 (2004k:33046)
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Computer algebra algorithms for orthogonal polynomials and special functions. (English summary)
Orthogonal polynomials and special functions (*Leuven*, 2002), 1–24, *Lecture Notes in Math.*, 1817, *Springer*, *Berlin*, 2003.
33F10 (33C45 33D45 68W30)

References: 0 **Reference Citations: 0** **Review Citations: 0**

Summary: "In this minicourse I would like to present computer algebra algorithms for the work with orthogonal polynomials and special functions. This includes the computation of power series representations of hypergeometric type functions, given by 'expressions', like $\arcsin(x)/x$; the computation of holonomic differential equations for functions, given by expressions; the computation of holonomic recurrence equations for sequences, given by expressions, like $\binom{n}{k}\frac{x^k}{k!}$; the identification of hypergeometric functions; the computation of antidifferences of hypergeometric terms (Gosper's algorithm); the computation of holonomic differential and recurrence equations for hypergeometric series, given the series summand, like

$$P_n(x) = \sum_{k=0}^{n} \binom{n}{k} \binom{-n-1}{k} \left(\frac{1-x}{2}\right)^k$$

(Zeilberger's algorithm); the computation of hypergeometric term representations of series (Zeilberger's and Petkovšek's algorithm); the verification of identities for (holonomic) special functions; the detection of identities for orthogonal polynomials and special functions; the computation with Rodrigues formulas; the computation with generating functions; corresponding algorithms for q-hypergeometric (basic hypergeometric) functions; the identification of classical orthogonal polynomials, given by recurrence equations. All topics are properly introduced, the algorithms are discussed in some detail and many examples are demonstrated by Maple implementations. In the lecture, the participants are invited to submit and compute their own examples.

"Let us remark that as a general reference we use the book [W. A. Koepf, *Hypergeometric summation*, Vieweg, Braunschweig, 1998; MR1644447 (2000c:33002)], the computer algebra

system Maple and the Maple packages FPS [W. A. Koepf, J. Symbolic Comput. **13** (1992), no. 6, 581–603; MR1177710 (93j:68087); D. Gruntz and W. A. Koepf, Maple Tech. Newsletter **2** (1995), no. 2, 22–28; per bibl.], gfun [B. Salvy and P. Zimmermann, ACM Trans. Math. Software **20** (1994), no. 2, 163–177], hsum [W. A. Koepf, op. cit.; MR1644447 (2000c:33002)], infhsum [R. Vidunas and T. H. Koornwinder, "Zeilberger method for non-terminating hypergeometric series", to appear], hsols [M. van Hoeij, J. Pure Appl. Algebra **139** (1999), no. 1-3, 109–131; MR1700540 (2001h:39023)], qsum [H. Böing and W. A. Koepf, J. Symbolic Comput. **28** (1999), no. 6, 777–799; MR1750546 (2001j:33019)] and retode [W. A. Koepf and D. Schmersau, Appl. Math. Comput. **128** (2002), no. 2-3, 303–327; MR1891025 (2003i:33010)]."

{For the entire collection see MR2022850 (2004f:33002)}