Polynomial having large coefficients 2

`large2.1.n`

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Ring: $\mathbb{C}[x], \mathbb{R}[x]$
Equations:

$ax^n + x^{11} + 10^{300}x + 10^{-300}, \quad (n = 20, a = 1, i)$

Polynomial supplied by D. A. Bini (Oct. 1996).

1 Characteristics

- The polynomial has coefficients that have modulus close to the largest and to the smallest numbers representable as double in the IEEE standard. Overflow conditions/failure are likely for programs that do not use extended arithmetic.
- The polynomial, even if its coefficients are representable as double, has a root which is too small in order to be represented as a nonzero double.

2 Problem

Newton-isolate all the roots.

2.1 Solution

Algorithm based on simultaneous iterations (Aberth's method) with cluster analysis (see [?]).

Program in Fortran 90 based on the multiprecision package MPFUN, by D. Bailey.

Machine used: IBM Risc 6000.

Time for Newton-isolating all the roots: for $n = 20$, $a = 1$, 2.3 seconds; for $n = 200$, $a = 1$, 15 seconds; for $n = 500$, $a = 1$, 18 seconds.

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References

[1] D. Bini. Numerical computation of polynomial zeros by means of aberth's method. *Numerical Algorithms*, 1997. (to appear).

[2] D. Bini and B. Mourrain. Polynomials test suite. 1996.