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Language : Fortran

Library: MATHLIB
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Zeros of a Complex Polynomial

Subroutine subprograms `CPOLYZ` and `WPOLYZ` compute the zeros of the polynominal

$$P(z) = c_0 z^n + c_1 z^{n-1} + \cdots + c_{n-1} z + c_n$$

of degree n with complex coefficients c_k and $c_0 \neq 0$.
On computers other than CDC or Cray, only the double-precision version `WPOLYZ` is available. On CDC and Cray computers, only the single-precision version `CPOLYZ` is available.

Structure:

`SUBROUTINE` subprograms
User Entry Names: `CPOLYZ`, `WPOLYZ`
Files Referenced: `Unit 6`
External References: `MTLMTR` (N002), `ABEND` (Z035)

Usage:

For `t` = `C` (type `COMPLEX`), `t` = `W` (type `COMPLEX*16`),

```
CALL tPOLYZ(C,N,MAXIT,Z,R)
```

`C` (type according to `t`) One-dimensional array of dimension `(0:d)`, where `d` $\geq$ `N`, containing the coefficients c_k, $(k = 0, 1, \ldots, n)$.

`N` (`INTEGER`) The degree n.

`MAXIT` (`INTEGER`) The maximum number of iterations permitted.

`Z` (type according to `t`) One-dimensional array of length $\geq$ `N`. On entry, `Z(1)`, ..., `Z(N)` must contain starting approximations for the zeros z_i. If no starting approximations are available, the `Z(i)` should be set to zero. On exit, `Z(i)` contains an approximation to the zero z_i.

`R` (`REAL` for `t` = `C`, `DOUBLE PRECISION` for `t` = `W`) One-dimensional array of dimension $\geq$ `N`. On exit, `R(1)`, ..., `R(N)` contain an estimated radius r_i of a circle centered at `Z(i)` within which the true zero z_i is expected to lie.

Notes:

Note that, because of accumulation of rounding errors, unreliable results can be obtained for large n even for well-conditioned polynomials.

Error handling:

Error `C209.1`: $c_0 = 0$.
Error `C209.2`: The number of iterations exceeds `MAXIT`.
Error `C209.3`: An estimated radius r_i cannot be computed for a certain value of i.
In all cases, a message is written on `Unit 6`, unless subroutine `MTLSET` (N002) has been called.

References:

1. T. Pomentale, Homotopy iterative methods for polynomial equations, J. Inst. Maths. Applics. **13** (1974) 201–213.

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