Author(s) : K.S. Kölbig
Submitter :
Language : Fortran

Library: MATHLIB
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Prime Numbers and Prime Factor Decomposition

Subroutine subprogram `PRMFCT`

- sets the first $n \leq 1229$ prime numbers $p_1 = 2$, $p_2 = 3$, $p_5 = 5$, ..., $p_{1229} = 9973$ into an array;
- performs the decomposition of a positive number $N < 10007$ into its prime factors:

$$N \;=\; 2^{\alpha_1} \cdot 3^{\alpha_2} \cdot 5^{\alpha_3} \;\cdots\; 9973^{\alpha_{1229}};$$

- performs the decomposition of the factorial $N!$ of a positive number $N < 10007$ into its prime factors:

$$N! \;=\; 2^{\alpha_1} \cdot 3^{\alpha_2} \cdot 5^{\alpha_3} \;\cdots\; 9973^{\alpha_{1229}}.$$

Note that this allows in particular to handle quotients of factorials of rather large numbers in an exact way.

Structure:

`SUBROUTINE` subprogram
User Entry Names: `PRMFCT`
Files Referenced: `Unit 6`

Usage:

```
CALL PRMFCT(MODE,N,NPRIME,NPOWER,M)
```

`MODE` $=$ `0` : Sets the first n prime numbers into an array.

`N` (`INTEGER`) The number n of prime numbers requested.

`NPRIME` (`INTEGER`) One-dimensional array of length $\geq$ `N`. On exit, `NPRIME(j)`, (`j` $= 1, 2, \ldots,$ `N`) contains the j-th prime numbers p_j, where $p_1 = 2$, $p_2 = 3$, $p_3 = 5$, ...

`NPOWER` (`INTEGER`) One-dimensional array of length $\geq$ `N`. On exit, `NPOWER(j)`, (`j` $= 1, 2, \ldots,$ `N`) contains the value `1`.

`M` (`INTEGER`) Contains, on exit, the number n.

`MODE` $=$ `1, 2` : Performs the decomposition of N (`MODE` $=$ `1`) or $N!$ (`MODE` $=$ `2`) into its prime factors.

`N` (`INTEGER`) The number N itself (`MODE` $=$ `1`) or its factorial (`MODE` $=$ `2`) to be decomposed into prime factors.

`NPRIME` (`INTEGER`) One-dimensional array of length $\geq$ `N`. On exit, `NPRIME(j)`, (`j` $= 1, 2, \ldots,$ `M`) contains the j-th prime numbers p_j, where $p_1 = 2$, $p_2 = 3$, $p_3 = 5$, ...

`NPOWER` (`INTEGER`) One-dimensional array of length $\geq$ `N`. On exit, `NPOWER(j)`, (`j` $= 1, 2, \ldots,$ `M`) contains the power α_j corresponding to the prime number p_j.

`M` (`INTEGER`) Contains, on exit, the index $M \leq N$ defined by $\alpha_M > 0$ and $\alpha_j = 0$ for $j > M$.

Restrictions:

MODE $=$ 0 : 1 $\leq$ N $\leq$ 1229.
MODE $=$ 1 or MODE $=$ 2 : 2 $\leq$ N $\leq$ 10007.

Error handling:

Error B002.1: MODE $\neq$ 0 and MODE $\neq$ 1 and MODE $\neq$ 2.
Error B002.2: N out of range.
In both cases, NPRIME(j) and NPOWER(j), (j $= 1, 2, \ldots,$ N) are set to zero and a message is written on Unit 6, unless subroutine MTLSET (N002) has been called.
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