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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 $p_1 = 2,\ p_2 = 3,\ p_5 = 5,\ \ldots\ ,\ p_{1229} = 9973$ 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 $p_1 = 2,\ p_2 = 3,\ p_3 = 5,\ \ldots$

`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 $p_1 = 2,\ p_2 = 3,\ p_3 = 5,\ \ldots .$

`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:

$\texttt{MODE} = 0 : 1 \le \texttt{N} \le 1229$.
$\texttt{MODE} = 1$ or $\texttt{MODE} = 2 : 2 \le \texttt{N} \le 10007$.

Error handling:

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

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