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Language : Fortran   **Revised:**

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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