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Prime Numbers and Prime Factor Decomposition

Subroutine subprogram PRMFCT

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

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

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

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

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), ($j = 1, 2, \dots, N$) contains the j -th prime numbers p_j , where $p_1 = 2, p_2 = 3, p_3 = 5, \dots$

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

NPOWER (INTEGER) One-dimensional array of length $\geq N$. On exit, NPOWER(j), ($j = 1, 2, \dots, M$) 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), ($j = 1, 2, \dots, N$) are set to zero and a message is written on Unit 6, unless subroutine MTLSET (N002) has been called.

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