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Binary Search for Element in Ordered Array

Integer function subprograms LOCATI and LOCATR perform a binary search in an array of non-decreasing integer or real numbers $a_1 \leq a_2 \leq \ldots \leq a_n$ to locate a specified value t.

Structure:

FUNCTION subprograms
User Entry Names: LOCATI, LOCATR
Obsolete User Entry Names: LOCATF $\equiv$ LOCATR
On CDC or Cray computers, the double-precision version LOCATD is not available.

Usage:

In any arithmetic expression, for $\mathtt{t} = \mathtt{I}$ (type INTEGER), $\mathtt{t} = \mathtt{R}$ (type REAL), $\mathtt{t} = \mathtt{D}$ (type DOUBLE PRECISION),

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LOCATt(tA,N,tT)
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has the INTEGER value according to the description below.

tA	(type according to t) One-dimensional array. The numbers tA(j) must form a non-decreasing sequence for $j = 1, 2, \ldots,$ N.
N	(INTEGER) Number n of elements in array tA.
tT	(type according to t) Search value t.

Depending on four possible outcomes of the search, each subprogram returns the following value L ($a =$ tA, $t =$ tT):

$a_j = t$ for some j with $1 \leq j \leq \mathtt{N}$	$\mathtt{L} = j$
$t < a_1$	$\mathtt{L} = 0$
$a_k < t < a_{k+1}$ for some k with $1 \leq k \leq \mathtt{N} - 1$	$\mathtt{L} = -k$
$a_n < t$	$\mathtt{L} = -\mathtt{N}$

If the value t occurs more than once in the array a, the result L may correspond to any of the occurrences.

Method:

Repeated bisection of the subscript range.

Notes:

1. The number of comparisons performed is approximately proportional to $\ln \mathtt{N}$. Therefore, for large N the binary search is considerably faster than a sequential search using a DO loop. However, for N less than about 40 a DO loop is faster.
2. The obsolete older entry LOCATF is kept for a transitional period. It will eventually disappear.

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