NAME

BISECT − Find a zero of a scalar function of one variable.

SYNOPSIS

CALL BISECT(FCN,TOL, XL,XR,NFE, X,F,RC)

FCN	is the EXTERNAL name of a REAL*8 function subprogram; see below
TOL(2)	is a REAL*8 vector of convergence tolerances on X and F
XL	is the REAL*8 left end of an interval containing a zero
XR	is the REAL*8 right end of an interval containing a zero
NFE	is the INTEGER*4 number of function evaluations allowed, then used
X	is the REAL*8 root returned
F	is the REAL*8 function value at X
RC	is the INTEGER*4 return code; 0 => convergence, else see below

DESCRIPTION

XL and XR, the endpoints of an interval containing the zero that is sought, must be given on input. The routine assumes that the function has a unique zero in the interval, and uses interval-halving to find a value of X near where it occurs. XL and XR are updated during the bisection process, and on return contain the endpoints of an interval that brackets the zero. The routine calls the user-supplied function subprogram FCN(X) to obtain values of the function at points in the interval [XL,XR]. Convergence is judged to have occurred if, simultaneously, the interval width is less than TOL(1) and the function value is less in absolute value than TOL(2).

DIAGNOSTICS

Return code summary:

0	convergence in both X and F
1	convergence in X or F is the best we can do
2	no root in the interval
3	failure to converge in NFE function evaluations
4	failure to converge in 100 bisections

If a function value is exactly zero before the tolerance on interval width is achieved, the routine returns with RC=1. If the function has the same algebraic sign on both ends of the current interval at any point in the bisection process, BISECT writes the message "No root on interval in BISECT" and returns with RC=2. If NFE=30 (for example) function evaluations are used before convergence, BISECT writes the message "Used 30 function evaluations in BISECT" and returns with RC=3. If 100 bisections are performed without the convergence criteria being satisfied, BISECT writes the message "No convergence in 100 iterations in BISECT" and returns with RC=4 (in this case NFE=102 function evaluations are used). In all cases the best answer found so far is returned in X, its function value is returned in F, and the current bounds are returned in XL and XR. The messages can be suppressed by calling BISECT with RC set to a negative value.

BUGS

The bisection algorithm can fail if the function has more than one zero in the interval that is given on input. If the starting interval is very large the limit of 100 bisections might not be sufficient to permit convergence, even though the function does have exactly one zero in the interval. It is often impossible to obtain a function value of precisely zero, so TOL(2)=0.D0 should be avoided.

LINKAGE

gfortran source.f −L${HOME}/lib −lmisc

AUTHOR

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EXAMPLE

```
      REAL*8 XL/0.7D0/,XR/0.9D0/,TOL(2)/2*1.D-10/,X,F
      INTEGER*4 RC
      EXTERNAL FCN
      NFE=102
      CALL BISECT(FCN,TOL, XL,XR,NFE, X,F,RC)
      WRITE(6,901) RC,NFE,X,F
  901 FORMAT('RC=',I1,' NFE=',I3/'F(',1PD22.15,')=',1PD22.15)
      STOP
      END
C
      FUNCTION FCN(X)
      REAL*8 FCN,X
      FCN=DEXP(4.D0*X)+(X-4.D0)**3
      RETURN
      END
```

This example produced the following output:

```
unix[1] a.out
RC=0 NFE= 39
F( 8.585204196526320D-01)=-5.187843904463918D-11
unix[2]
```