

# NAG Fortran Library Routine Document

## A02AAF

**Note:** before using this routine, please read the Users' Note for your implementation to check the interpretation of *bold italicised* terms and other implementation-dependent details.

### 1 Purpose

A02AAF evaluates the square root of the complex number  $x = (x_r, x_i)$ .

### 2 Specification

```
SUBROUTINE A02AAF(XR, XI, YR, YI)
  real XR, XI, YR, YI
```

### 3 Description

The method of evaluating  $y = \sqrt{x}$  depends on the value of  $x_r$ .

For  $x_r \geq 0$ ,

$$y_r = \sqrt{\frac{x_r + \sqrt{x_r^2 + x_i^2}}{2}}, \quad y_i = \frac{x_i}{2y_r}.$$

For  $x_r < 0$ ,

$$y_i = \text{sign}(x_i) \times \sqrt{\frac{|x_r| + \sqrt{x_r^2 + x_i^2}}{2}}, \quad y_r = \frac{x_i}{2y_i}.$$

Overflow is avoided when squaring  $x_i$  and  $x_r$  by calling A02ABF to evaluate  $\sqrt{x_r^2 + x_i^2}$ .

### 4 References

Wilkinson J H and Reinsch C (1971) *Handbook for Automatic Computation II, Linear Algebra* Springer-Verlag

### 5 Parameters

1: XR – *real* *Input*  
 2: XI – *real* *Input*

*On entry:*  $x_r$  and  $x_i$ , the real and imaginary parts of  $x$ , respectively.

3: YR – *real* *Output*  
 4: YI – *real* *Output*

*On exit:*  $y_r$  and  $y_i$ , the real and imaginary parts of  $y$ , respectively.

### 6 Error Indicators and Warnings

None.

### 7 Accuracy

The result should be correct to *machine precision*.

## 8 Further Comments

The time taken by the routine is negligible.

## 9 Example

To find the square root of  $-1.7 + 2.6i$ .

### 9.1 Program Text

```
*      A02AAF Example Program Text
*      Mark 14 Revised.  NAG Copyright 1989.
*      .. Parameters ..
      INTEGER          NIN, NOUT
      PARAMETER       (NIN=5,NOUT=6)
*      .. Local Scalars ..
      real             XI, XR, YI, YR
*      .. External Subroutines ..
      EXTERNAL        A02AAF
*      .. Executable Statements ..
      WRITE (NOUT,*) 'A02AAF Example Program Results'
*      Skip heading in data file
      READ (NIN,*)
      READ (NIN,*) XR, XI
*
      CALL A02AAF(XR,XI,YR,YI)
*
      WRITE (NOUT,*)
      WRITE (NOUT,*) '      XR      XI      YR      YI'
      WRITE (NOUT,99999) XR, XI, YR, YI
      STOP
*
99999  FORMAT (1X,2F6.1,2F9.4)
      END
```

### 9.2 Program Data

```
A02AAF Example Program Data
-1.7 2.6
```

### 9.3 Program Results

```
A02AAF Example Program Results

      XR      XI      YR      YI
-1.7    2.6    0.8386   1.5502
```

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