

## F01CRF – NAG Fortran Library Routine Document

**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

F01CRF transposes a rectangular matrix in-place.

### 2 Specification

```
SUBROUTINE F01CRF(A, M, N, MN, MOVE, LMOVE, IFAIL)
  INTEGER          M, N, MN, MOVE(LMOVE), LMOVE, IFAIL
  real           A(MN)
```

### 3 Description

F01CRF requires that the elements of an  $m$  by  $n$  matrix  $A$  are stored consecutively by columns in a one-dimensional array. It re-orders the elements so that on exit the array holds the transpose of  $A$  stored in the same way. For example, if  $m = 4$  and  $n = 3$ , on entry the array must hold:

$$a_{11} \ a_{21} \ a_{31} \ a_{41} \ a_{12} \ a_{22} \ a_{32} \ a_{42} \ a_{13} \ a_{23} \ a_{33} \ a_{43}$$

and on exit it holds

$$a_{11} \ a_{12} \ a_{13} \ a_{21} \ a_{22} \ a_{23} \ a_{31} \ a_{32} \ a_{33} \ a_{41} \ a_{42} \ a_{43}.$$

### 4 References

- [1] Cate E G and Twigg D W (1977) Algorithm 513: Analysis of in-situ transposition *ACM Trans. Math. Software* **3** 104–110

### 5 Parameters

- |           |                                                                                                               |                     |
|-----------|---------------------------------------------------------------------------------------------------------------|---------------------|
| <b>1:</b> | A(MN) — <i>real</i> array                                                                                     | <i>Input/Output</i> |
|           | <i>On entry:</i> the elements of the $m$ by $n$ matrix $A$ , stored by columns.                               |                     |
|           | <i>On exit:</i> the elements of the transpose matrix, also stored by columns.                                 |                     |
| <b>2:</b> | M — INTEGER                                                                                                   | <i>Input</i>        |
|           | <i>On entry:</i> $m$ , the number of rows of the matrix $A$ .                                                 |                     |
| <b>3:</b> | N — INTEGER                                                                                                   | <i>Input</i>        |
|           | <i>On entry:</i> $n$ , the number of columns of the matrix $A$ .                                              |                     |
| <b>4:</b> | MN — INTEGER                                                                                                  | <i>Input</i>        |
|           | <i>On entry:</i> the value $m \times n$ .                                                                     |                     |
| <b>5:</b> | MOVE(LMOVE) — INTEGER array                                                                                   | <i>Workspace</i>    |
| <b>6:</b> | LMOVE — INTEGER                                                                                               | <i>Input</i>        |
|           | <i>On entry:</i> the dimension of the array MOVE as declared in the (sub)program from which F01CRF is called. |                     |
|           | <i>Suggested value:</i> LMOVE = $(m + n)/2$ .                                                                 |                     |
|           | <i>Constraint:</i> LMOVE $\geq 1$ .                                                                           |                     |

**7: IFAIL — INTEGER***Input/Output*

*On entry:* IFAIL must be set to 0, -1 or 1. For users not familiar with this parameter (described in Chapter P01) the recommended value is 0.

*On exit:* IFAIL = 0 unless the routine detects an error (see Section 6).

**6 Error Indicators and Warnings**

Errors detected by the routine:

IFAIL = 1

On entry,  $MN \neq M \times N$ .

IFAIL = 2

On entry,  $LMOVE \leq 0$ .

IFAIL < 0

A serious error has occurred. Check all subroutine calls and array sizes. Seek expert help.

**7 Accuracy**

Exact results are produced.

**8 Further Comments**

The time taken by the routine is approximately proportional to  $mn$ .

**9 Example**

The example program transposes a 7 by 3 matrix and prints out, for convenience, its transpose.

**9.1 Program Text**

**Note.** The listing of the example program presented below uses bold italicised terms to denote precision-dependent details. Please read the Users' Note for your implementation to check the interpretation of these terms. As explained in the Essential Introduction to this manual, the results produced may not be identical for all implementations.

```

*      F01CRF Example Program Text
*      Mark 14 Revised.  NAG Copyright 1989.
*      .. Parameters ..
      INTEGER          M, N, MN, LMOVE
      PARAMETER        (M=3,N=7,MN=M*N,LMOVE=(M+N)/2)
      INTEGER          NOUT
      PARAMETER        (NOUT=6)
*      .. Local Scalars ..
      INTEGER          I, IFAIL
*      .. Local Arrays ..
      real            A(MN)
      INTEGER          MOVE(LMOVE)
*      .. External Subroutines ..
      EXTERNAL         F01CRF
*      .. Intrinsic Functions ..
      INTRINSIC        real
*      .. Executable Statements ..
      WRITE (NOUT,*) 'F01CRF Example Program Results'
      DO 20 I = 1, MN

```

```
      A(I) = real(I)
20 CONTINUE
      IFAIL = 0
*
      CALL F01CRF(A,M,N,MN,MOVE,LMOVE,IFAIL)
*
      WRITE (NOUT,*)
      WRITE (NOUT,99999) (A(I),I=1,MN)
      STOP
*
99999 FORMAT (1X,7F7.1)
      END
```

## 9.2 Program Data

None.

## 9.3 Program Results

F01CRF Example Program Results

1.0	4.0	7.0	10.0	13.0	16.0	19.0
2.0	5.0	8.0	11.0	14.0	17.0	20.0
3.0	6.0	9.0	12.0	15.0	18.0	21.0

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