NAG Toolbox for MATLAB

f08ff

1 Purpose

f08ff generates the real orthogonal matrix Q, which was determined by f08fe when reducing a symmetric matrix to tridiagonal form.

2 Syntax

```
[a, info] = f08ff(uplo, a, tau, 'n', n)
```

3 Description

f08ff is intended to be used after a call to f08fe, which reduces a real symmetric matrix A to symmetric tridiagonal form T by an orthogonal similarity transformation: $A = QTQ^{\mathrm{T}}$. f08fe represents the orthogonal matrix Q as a product of $n-1$ elementary reflectors.

This function may be used to generate Q explicitly as a square matrix.

4 References

Golub G H and Van Loan C F 1996 *Matrix Computations* (3rd Edition) Johns Hopkins University Press, Baltimore

5 Parameters

5.1 Compulsory Input Parameters

1: **uplo – string**

This **must** be the same parameter **uplo** as supplied to f08fe.

Constraint: **uplo** = 'U' or 'L'.

2: **a**(**lda**,$*$) **– double array**

The first dimension of the array **a** must be at least $\max(1, \mathbf{n})$

The second dimension of the array must be at least $\max(1, \mathbf{n})$

Details of the vectors which define the elementary reflectors, as returned by f08fe.

3: **tau**($*$) **– double array**

Note: the dimension of the array **tau** must be at least $\max(1, \mathbf{n} - 1)$.

Further details of the elementary reflectors, as returned by f08fe.

5.2 Optional Input Parameters

1: **n – int32 scalar**

Default: The second dimension of the array **a**.

n, the order of the matrix Q.

Constraint: $\mathbf{n} \geq 0$.

5.3 Input Parameters Omitted from the MATLAB Interface

lda, work, lwork

5.4 Output Parameters

1: **a**(**lda**,∗) – **double array**

The first dimension of the array **a** must be at least $\max(1, \mathbf{n})$

The second dimension of the array must be at least $\max(1, \mathbf{n})$

The n by n orthogonal matrix Q.

2: **info** – **int32 scalar**

info $= 0$ unless the function detects an error (see Section 6).

6 Error Indicators and Warnings

Errors or warnings detected by the function:

info $= -i$

If **info** $= -i$, parameter i had an illegal value on entry. The parameters are numbered as follows:

1: **uplo**, 2: **n**, 3: **a**, 4: **lda**, 5: **tau**, 6: **work**, 7: **lwork**, 8: **info**.

It is possible that **info** refers to a parameter that is omitted from the MATLAB interface. This usually indicates that an error in one of the other input parameters has caused an incorrect value to be inferred.

7 Accuracy

The computed matrix Q differs from an exactly orthogonal matrix by a matrix E such that

$$\|E\|_2 = O(\epsilon),$$

where ϵ is the ***machine precision***.

8 Further Comments

The total number of floating-point operations is approximately $\frac{4}{3}n^3$.

The complex analogue of this function is f08ft.

9 Example

```
uplo = 'L';
a = [2.07, 0, 0, 0;
     3.87, -0.21, 0, 0;
     4.2, 1.87, 1.15, 0;
     -1.15, 0.63, 2.06, -1.81];
[a, d, e, tau, info] = f08fe(uplo, a);
[aOut, info] = f08ff(uplo, a, tau)
```

```
aOut =
    1.0000         0         0         0
         0   -0.6643   -0.0400    0.7464
         0   -0.7209   -0.2294   -0.6539
         0    0.1974   -0.9725    0.1235
info =
           0
```