NAG Toolbox for MATLAB

f08qt

1 Purpose

f08qt reorders the Schur factorization of a complex general matrix.

2 Syntax

```
[t, q, info] = f08qt(compq, t, q, ifst, ilst, 'n', n)
```

3 Description

f08qt reorders the Schur factorization of a complex general matrix $A = QTQ^{\mathrm{H}}$, so that the diagonal element of T with row index **ifst** is moved to row **ilst**.

The reordered Schur form $\tilde{T}$ is computed by a unitary similarity transformation: $\tilde{T} = Z^{\mathrm{H}}TZ$. Optionally the updated matrix $\tilde{Q}$ of Schur vectors is computed as $\tilde{Q} = QZ$, giving $A = \tilde{Q}\tilde{T}\tilde{Q}^{\mathrm{H}}$.

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: **compq – string**

Indicates whether the matrix Q of Schur vectors is to be updated.

compq = 'V'

The matrix Q of Schur vectors is updated.

compq = 'N'

No Schur vectors are updated.

Constraint: **compq** = 'V' or 'N'.

2: **t**(**ldt**,$*$) **– complex array**

The first dimension of the array **t** 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 upper triangular matrix T, as returned by f08ps.

3: **q**(**ldq**,$*$) **– complex array**

The first dimension, **ldq**, of the array **q** must satisfy

if **compq** = 'V', **ldq** $\geq \max(1, \mathbf{n})$;
if **compq** = 'N', **ldq** ≥ 1.

The second dimension of the array must be at least $\max(1, \mathbf{n})$ if **compq** = 'V' and at least 1 if **compq** = 'N'

If **compq** = 'V', **q** must contain the n by n unitary matrix Q of Schur vectors.

4: **ifst – int32 scalar**

5: **ilst – int32 scalar**

ifst and **ilst** must specify the reordering of the diagonal elements of T. The element with row index **ifst** is moved to row **ilst** by a sequence of exchanges between adjacent elements.

Constraint: $1 \leq \mathbf{ifst} \leq \mathbf{n}$ and $1 \leq \mathbf{ilst} \leq \mathbf{n}$.

5.2 Optional Input Parameters

1: **n – int32 scalar**

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

n, the order of the matrix T.

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

5.3 Input Parameters Omitted from the MATLAB Interface

ldt, ldq

5.4 Output Parameters

1: **t(ldt,∗) – complex array**

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

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

t contains the updated matrix $\tilde{T}$.

2: **q(ldq,∗) – complex array**

The first dimension, **ldq**, of the array **q** must satisfy

if **compq** = 'V', **ldq** $\geq \max(1, \mathbf{n})$;
if **compq** = 'N', **ldq** ≥ 1.

The second dimension of the array must be at least $\max(1, \mathbf{n})$ if **compq** = 'V' and at least 1 if **compq** = 'N'

If **compq** = 'V', **q** contains the updated matrix of Schur vectors.

If **compq** = 'N', **q** is not referenced.

3: **info – int32 scalar**

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

6 Error Indicators and Warnings

info $= -i$

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

1: **compq**, 2: **n**, 3: **t**, 4: **ldt**, 5: **q**, 6: **ldq**, 7: **ifst**, 8: **ilst**, 9: **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 $\tilde{T}$ is exactly similar to a matrix $(T + E)$, where

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

and ϵ is the ***machine precision***.

The values of the eigenvalues are never changed by the reordering.

8 Further Comments

The total number of real floating-point operations is approximately $20nr$ if **compq** = 'N', and $40nr$ if **compq** = 'V', where $r = |\mathbf{ifst} - \mathbf{ilst}|$.

The real analogue of this function is f08qf.

9 Example

```
compq = 'No update';
t  =  [complex(-6,  -7),  complex(0.36,  -0.36),  complex(-0.19,  +0.48),
complex(0.88, -0.25);
       complex(0, +0), complex(-5, +2), complex(-0.03, -0.72), complex(-
0.23, +0.13);
                 complex(0,   +0),   complex(0,   +0),   complex(8,   -1),
complex(0.9399999999999999, +0.53);
     complex(0, +0), complex(0, +0), complex(0, +0), complex(3, -4)];
q = [complex(0, 0)];
ifst = int32(1);
ilst = int32(4);
[tOut, qOut, info] = f08qt(compq, t, q, ifst, ilst)
```

```
tOut =
   -5.0000 + 2.0000i   -0.1574 + 0.7143i    0.1781 - 0.1913i    0.3950 +
0.3861i
         0               8.0000 - 1.0000i    1.0742 + 0.1447i    0.2515 -
0.3397i
         0                    0              3.0000 - 4.0000i    0.2264 +
0.8962i
         0                    0                   0             -6.0000 -
7.0000i
qOut =
     0
info =
           0
```