Title

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ghessenbergd( ) — Generalized Hessenberg decomposition

Syntax

void ghessenbergd(*numeric matrix A*, *B*, *H*, *R*, *U*, *V*)

void _ghessenbergd(*numeric matrix A*, *B*, *U*, *V*)

Description

ghessenbergd(*A*, *B*, *H*, *R*, *U*, *V*) computes the generalized Hessenberg decomposition of two general, real or complex, square matrices, *A* and *B*, returning the upper Hessenberg form matrix in *H*, the upper triangular matrix in *R*, and the orthogonal (unitary) matrices in *U* and *V*.

_ghessenbergd(*A*, *B*, *U*, *V*) mirrors ghessenbergd(), the difference being that it returns *H* in *A* and *R* in *B*.

_ghessenbergd_la() is the interface into the LAPACK routines used to implement the above function; see [M-1] **LAPACK**. Its direct use is not recommended.

Remarks and examples

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The generalized Hessenberg decomposition of two square, numeric matrices (**A** and **B**) can be written as

$$\mathbf{U}' \times \mathbf{A} \times \mathbf{V} = \mathbf{H}$$

$$\mathbf{U}' \times \mathbf{B} \times \mathbf{V} = \mathbf{R}$$

where **H** is in upper Hessenberg form, **R** is upper triangular, and **U** and **V** are orthogonal matrices if **A** and **B** are real or are unitary matrices otherwise.

In the example below, we define A and B, obtain the generalized Hessenberg decomposition, and list H and Q.

```
: A = (6, 2, 8, -1\-3, -4, -6, 4\0, 8, 4, 1\-8, -7, -3, 5)
: B = (8, 0, -8, -1\-6, -2, -6, -1\-7, -6, 2, -6\1, -7, 9, 2)
: ghessenbergd(A, B, H=., R=., U=., V=.)
: H
                 1              2              3              4
    +-------------------------------------------------------------+
  1 | -4.735680169    1.363736029    5.097381347    3.889763589 |
  2 |  9.304479208   -8.594240253   -7.993282943    4.803411217 |
  3 |             0    4.553169015    3.236266637   -2.147709419 |
  4 |             0              0    6.997043028   -3.524816722 |
    +-------------------------------------------------------------+
```

```
: R
                 1              2              3              4
    +-------------------------------------------------------------+
  1 |  -12.24744871   -1.089095534   -1.848528639   -5.398470103  |
  2 |             0   -5.872766311    8.891361089    3.86967647   |
  3 |             0              0    9.056748937    1.366322731  |
  4 |             0              0              0    8.357135399  |
    +-------------------------------------------------------------+
```

Conformability

`ghessenbergd(`A`, `B`, `H`, `R`, `U`, `V`)`:

input:

A:	$n \times n$
B:	$n \times n$

output:

H:	$n \times n$
R:	$n \times n$
U:	$n \times n$
V:	$n \times n$

`_ghessenbergd(`A`, `B`, `U`, `V`)`:

input:

A:	$n \times n$
B:	$n \times n$

output:

A:	$n \times n$
B:	$n \times n$
U:	$n \times n$
V:	$n \times n$

Diagnostics

`_ghessenbergd()` aborts with error if A or B is a view.

`ghessenbergd()` and `_ghessenbergd()` return missing results if A or B contains missing values.

Also see

[M-1] **LAPACK** — The LAPACK linear-algebra routines

[M-5] **gschurd( )** — Generalized Schur decomposition

[M-4] **matrix** — Matrix functions