

**ghessenberg()** — Generalized Hessenberg decomposition

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## 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 to the [LAPACK](#) routines used to implement the above function. Its direct use is not recommended.

## Syntax

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

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

## 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** — Linear algebra package (LAPACK) routines

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

[M-4] **Matrix** — Matrix functions

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