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Description

1d1(A, L, D, p) returns the Bunch–Kaufman decomposition (with diagonal pivoting) of A in a permuted lower-triangular matrix L and a symmetric block-diagonal matrix D with 1×1 and 2×2 diagonal blocks, along with a permutation vector p.

With the permutation vector, L[p, .] becomes a lower-triangular matrix with unit diagonal.

Up to roundoff error, the returned results are such that

A[p,p] = L[p,.]*D*L[p,.]'

Idl(A, L, D) is similar to Idl(A, L, D, p), but the permutation vector p is omitted from the output.

Up to roundoff error, the returned results are such that

$$A = L * D * L'$$

Syntax

```
void ldl(numeric matrix A, L, D)
void ldl(numeric matrix A, L, D, p)
```

where

- 1. A is symmetric (Hermitian) indefinite.
- 2. the types of *L*, *D*, and *p* are irrelevant; results are returned there.

Remarks and examples

The Bunch-Kaufman decomposition is a generalization of the Cholesky decomposition.

Bunch-Kaufman decomposition of matrix A can be written as

$$PAP' = PLDL' P'$$

where P is a permutation matrix that permutes the rows of A.

L is the permuted lower-triangular matrix. With the permutation matrix *P*, *PL* is a lower-triangular matrix with unit diagonal.

D is the symmetric block-diagonal matrix D with 1×1 and 2×2 diagonal blocks.

Rather than returning P directly, returned is p corresponding to P. Lowercase p is a column vector that contains the subscripts of the rows in the desired order. That is,

$$PL = L[p,.]$$

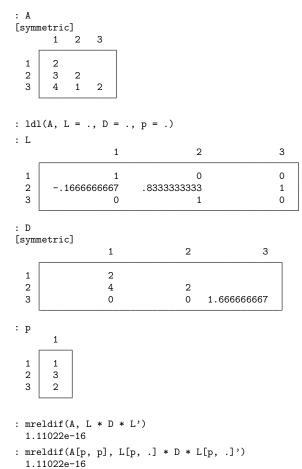
The advantage of this is that p requires less memory than P, and the reorganization, should it be desired, can be performed more quickly; see [M-1] **Permutation**.

Example 1: Bunch–Kaufman decomposition

The Bunch–Kaufman decomposition of A can be written as

$$A = L * D * L'$$

Idl(A, L, D) will make this calculation:



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Conformability

 $\begin{aligned} & \texttt{ldl}(A, L, D, p): \\ & \textit{input:} \\ & A: & n \times n \\ & \textit{output:} \\ & L: & n \times n \\ & D: & n \times n \\ & p: & n \times 1 \quad (\texttt{optional}) \end{aligned}$

Diagnostics

1d1(A, L, D, p) returns missing results if A contains missing values.

Also see

- [M-5] cholesky() Cholesky square-root decomposition
- [M-4] Matrix Matrix functions

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