

trace() — Trace of square matrix

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Description

`trace(A)` returns the sum of the diagonal elements of A . Returned result is real if A is real, complex if A is complex.

`trace(A, B)` returns `trace(AB)`, the calculation being made without calculating or storing the off-diagonal elements of AB . Returned result is real if A and B are real and is complex otherwise.

`trace(A, B, t)` returns `trace(AB)` if $t = 0$ and returns `trace(A'B)` otherwise, where, if either A or B is complex, transpose is understood to mean [conjugate transpose](#). Returned result is real if A and B are real and is complex otherwise.

Syntax

numeric scalar `trace(numeric matrix A)`

numeric scalar `trace(numeric matrix A, numeric matrix B)`

numeric scalar `trace(numeric matrix A, numeric matrix B, real scalar t)`

Remarks and examples

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`trace(A, B)` returns the same result as `trace(A*B)` but is more efficient if you do not otherwise need to calculate $A*B$.

`trace(A, B, 1)` returns the same result as `trace(A'B)` but is more efficient.

For real matrices A and B ,

$$\text{trace}(A') = \text{trace}(A)$$

$$\text{trace}(AB) = \text{trace}(BA)$$

and for complex matrices,

$$\text{trace}(A') = \text{conj}(\text{trace}(A))$$

$$\text{trace}(AB) = \text{trace}(BA)$$

where, for complex matrices, transpose is understood to mean conjugate transpose.

Thus for real matrices,

To calculate	Code
$\text{trace}(AB)$	<code>trace(A, B)</code>
$\text{trace}(A'B)$	<code>trace(A, B, 1)</code>
$\text{trace}(AB')$	<code>trace(A, B, 1)</code>
$\text{trace}(A'B')$	<code>trace(A, B)</code>

and for complex matrices,

To calculate	Code
$\text{trace}(AB)$	<code>trace(A, B)</code>
$\text{trace}(A'B)$	<code>trace(A, B, 1)</code>
$\text{trace}(AB')$	<code>conj(trace(A, B, 1))</code>
$\text{trace}(A'B')$	<code>conj(trace(A, B))</code>

Transpose in the first column means conjugate transpose.

Conformability

`trace(A)`:

A: $n \times n$
result: 1×1

`trace(A, B)`:

A: $n \times m$
B: $m \times n$
result: 1×1

`trace(A, B, t)`

A: $n \times m$ if $t = 0$, $m \times n$ otherwise
B: $m \times n$
t: 1×1
result: 1×1

Diagnostics

`trace(A)` aborts with error if *A* is not square.

`trace(A, B)` and `trace(A, B, t)` abort with error if the matrices are not conformable or their product is not square.

The trace of a 0×0 matrix is 0.

Also see

[M-4] [matrix](#) — Matrix functions