trace() — Trace of square matrix

### 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)`

### 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.

### Remarks and examples

`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,

<table>
<thead>
<tr>
<th>To calculate</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>trace(AB)</td>
<td>trace(A, B)</td>
</tr>
<tr>
<td>trace(A'B)</td>
<td>trace(A, B, 1)</td>
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Transpose in the first column means conjugate transpose.

**Conformability**

trace(A):

- \( A: \ n \times n \)
- \( result: \ 1 \times 1 \)

trace(A, B):

- \( A: \ n \times m \)
- \( B: \ m \times n \)
- \( result: \ 1 \times 1 \)

trace(A, B, t)

- \( A: \ n \times m \) if \( t = 0 \), \( m \times n \) otherwise
- \( B: \ m \times n \)
- \( t: \ 1 \times 1 \)
- \( result: \ 1 \times 1 \)

**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 \( 0 \times 0 \) matrix is 0.
Also see

[M-4] matrix — Matrix functions