trace() — Trace of square matrix

**Description**

\(\text{trace}(A)\) returns the sum of the diagonal elements of \(A\). Returned result is real if \(A\) is real, complex if \(A\) is complex.

\(\text{trace}(A, B)\) returns \(\text{trace}(AB)\), 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.

\(\text{trace}(A, B, t)\) returns \(\text{trace}(AB)\) if \(t = 0\) and returns \(\text{trace}(A'B)\) 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**

- \text{numeric scalar trace(numeric matrix A)}
- \text{numeric scalar trace(numeric matrix A, numeric matrix B)}
- \text{numeric scalar trace(numeric matrix A, numeric matrix B, real scalar t)}

**Remarks and examples**

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

\(\text{trace}(A, B, 1)\) returns the same result as \(\text{trace}(A'B)\) 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>
</tr>
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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