

op_colon — Colon operators

Description Diagnostics	Syntax Also see	Remarks and examples	Conformability
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Description

Colon operators perform element-by-element operations.

Syntax

a	:+	b	addition
a	:-	b	subtraction
a	:*	b	multiplication
a	:/	b	division
a	:^	b	power
a	:==	b	equality
a	!=	b	inequality
a	>	b	greater than
a	>=	b	greater than or equal to
a	<	b	less than
a	<=	b	less than or equal to
a	&	b	and
a		b	or

Remarks and examples

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Remarks are presented under the following headings:

C-conformability: element by element
Usefulness of colon logical operators
Use parentheses

C-conformability: element by element

The colon operators perform the indicated operation on each pair of elements of a and b . For instance,

$$\begin{bmatrix} c & d \\ f & g \\ h & i \end{bmatrix} :* \begin{bmatrix} j & k \\ l & m \\ n & o \end{bmatrix} = \begin{bmatrix} c * j & d * k \\ f * l & g * m \\ h * n & i * o \end{bmatrix}$$

Also colon operators have a relaxed definition of conformability:

$$\begin{aligned} \begin{bmatrix} c \\ f \\ g \end{bmatrix} :* \begin{bmatrix} j & k \\ l & m \\ n & o \end{bmatrix} &= \begin{bmatrix} c*j & c*k \\ f*l & f*m \\ g*n & g*o \end{bmatrix} \\ \begin{bmatrix} c & d \\ f & g \\ h & i \end{bmatrix} :* \begin{bmatrix} j \\ l \\ n \end{bmatrix} &= \begin{bmatrix} c*j & d*j \\ f*l & g*l \\ h*n & i*n \end{bmatrix} \\ [c \ d] :* \begin{bmatrix} j & k \\ l & m \\ n & o \end{bmatrix} &= \begin{bmatrix} c*j & d*k \\ c*l & d*m \\ c*n & d*o \end{bmatrix} \\ \begin{bmatrix} c & d \\ f & g \\ h & i \end{bmatrix} :* [l \ m] &= \begin{bmatrix} c*l & d*m \\ f*l & g*m \\ h*l & i*m \end{bmatrix} \\ c :* \begin{bmatrix} j & k \\ l & m \\ n & o \end{bmatrix} &= \begin{bmatrix} c*j & c*k \\ c*l & c*m \\ c*n & c*o \end{bmatrix} \\ \begin{bmatrix} c & d \\ f & g \\ h & i \end{bmatrix} :* j &= \begin{bmatrix} c*j & d*j \\ f*j & g*j \\ h*j & i*j \end{bmatrix} \end{aligned}$$

The matrices above are said to be c-conformable; the *c* stands for colon. The matrices have the same number of rows and columns, or one or the other is a vector with the same number of rows or columns as the matrix, or one or the other is a scalar.

C-conformability is relaxed, but not everything is allowed. The following is an error:

$$(c \ d \ e) :* \begin{bmatrix} f \\ g \\ h \end{bmatrix}$$

Usefulness of colon logical operators

It is worth paying particular attention to the colon logical operators because they can produce pattern vectors and matrices. Consider the matrix

: x = (5, 0 \ 0, 2 \ 3, 8)

: x

	1	2
1	5	0
2	0	2
3	3	8

Which elements of x contain 0?

```
x:==0
      1  2
1     0  1
2     1  0
3     0  0
```

How many zeros are there in x ?

```
sum(x:==0)
      2
```

Use parentheses

Because of their relaxed conformability requirements, colon operators are not associative even when the underlying operator is. For instance, you expect $(a+b)+c == a+(b+c)$, at least ignoring numerical roundoff error. Nevertheless, $(a:+b):+c == a:(b:+c)$ does not necessarily hold. Consider what happens when

```
a:    1 × 4
b:    5 × 1
c:    5 × 4
```

Then $(a:+b):+c$ is an error because $a:+b$ is not c -conformable.

Nevertheless, $a:(b:+c)$ is not an error and in fact produces a 5×4 matrix because $b:+c$ is 5×4 , which is c -conformable with a .

Conformability

```
a :op b:
a:    r1 × c1
b:    r2 × c2,  a and b c-conformable
result: max(r1, r2) × max(c1, c2)
```

Diagnostics

The colon operators return missing and abort with error under the same conditions that the underlying operator returns missing and aborts with error.

Also see

[M-2] [exp](#) — Expressions

[M-2] [intro](#) — Language definition