

Array vs. Matrix Operations:

Introduction:

MATLAB has two different types of arithmetic operations: array operations and matrix operations. You can use these arithmetic operations to perform numeric computations, for example, adding two numbers, raising the elements of an array to a given power, or multiplying two matrices.

Matrix operations follow the rules of linear algebra. By contrast, array operations execute element by element operations and support multidimensional arrays. The period character (.) distinguishes the array operations from the matrix operations. However, since the matrix and array operations are the same for addition and subtraction, the character pairs .+ and .- are unnecessary.

Array Operations:

Array operations execute element by element operations on corresponding elements of vectors, matrices, and multidimensional arrays. If the operands have the same size, then each element in the first operand gets matched up with the element in the same location in the second operand. If the operands have compatible sizes, then each input is implicitly expanded as needed to match the size of the other.

As a simple example, you can add two vectors with the same size.

$$A = [1 \ 1 \ 1]$$

$$A =$$

$$1 \quad 1 \quad 1$$

$$B = [1 \ 2 \ 3]$$

$$B =$$

$$1 \quad 2 \quad 3$$

$$A+B$$

$$\text{ans} =$$

$$2 \quad 3 \quad 4$$

If one operand is a scalar and the other is not, then MATLAB implicitly expands the scalar to be the same size as the other operand. For example, you can compute the element-wise product of a scalar and a matrix.

$$A = [1 \ 2 \ 3; 1 \ 2 \ 3]$$

$$A =$$

$$1 \quad 2 \quad 3$$

$$1 \quad 2 \quad 3$$

$$3.*A$$

$$\text{ans} =$$

$$3 \quad 6 \quad 9$$

$$3 \quad 6 \quad 9$$

Implicit expansion also works if you subtract a 1-by-3 vector from a 3-by-3 matrix because the two sizes are compatible. When you perform the subtraction, the vector is implicitly expanded to become a 3-by-3 matrix.

```
A = [1 1 1; 2 2 2; 3 3 3]
```

```
A =
```

```
1 1 1
```

```
2 2 2
```

```
3 3 3
```

```
m = [2 4 6]
```

```
m =
```

```
2 4 6
```

```
A - m
```

```
ans =
```

```
-1 -3 -5
```

```
0 -2 -4
```

```
1 -1 -3
```

A row vector and a column vector have compatible sizes. If you add a 1-by-3 vector to a 2-by-1 vector, then each vector implicitly expands into a 2-by-3 matrix before MATLAB executes the element-wise addition.

```
x = [1 2 3]
```

```
x =
```

```
1 2 3
```

```
y = [10; 15]
```

```
y =
```

```
10
```

```
15
```

```
x + y
```

```
ans =
```

```
11 12 13
```

```
16 17 18
```

If the sizes of the two operands are incompatible, then you get an error.

$$A = [8 \ 1 \ 6; 3 \ 5 \ 7; 4 \ 9 \ 2]$$

$$A =$$

$$8 \quad 1 \quad 6$$

$$3 \quad 5 \quad 7$$

$$4 \quad 9 \quad 2$$

$$m = [2 \ 4]$$

$$m =$$

$$2 \quad 4$$

$$A - m$$