

# Broadcasting NumPy Arrays: Takeaways

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## Syntax

### ARITHMETIC WITH NDARRAYS

- Create an ndarray with shape  $(a, b)$  in which every value is 1:

```
ones = np.ones((a, b))
```

- Add a value to each entry in an ndarray (other arithmetic operations also work):

```
x = x + 5
```

- Add a row ndarray to each row of a 2-dimensional array:

```
x = np.array([
    [6, 8, 3],
    [2, 5, 4]
])
y = np.array([4, 2, 7])
z = x + y
```

- Add a column ndarray to each column of a 2-dimensional array:

```
x = np.array([
    [6, 8, 3],
    [2, 5, 4]
])
y = np.array([
    [1],
    [2]
])
z = x + y
```

- Reshape an ndarray:

```
x = np.array([1, 2, 3, 4, 5, 6])
x_3_by_2 = x.reshape((3, 2))
x_2_by_3 = x.reshape((2, 3))
```

## Concepts

- Broadcasting is a mechanism implemented by NumPy to operate ndarray of different shapes. Its most common use cases are:
  - Making an operation between an ndarray and a numeric value.
  - Making an operation between every column of an ndarray and another column ndarray having the same number of rows.
  - Making an operation between every row of an ndarray and another row ndarray having the same number of columns.

- NumPy follows three steps to try to identify the shape for broadcastings:
  - If the two ndarrays have a different number of dimensions, add ones to the *left* of the one with a lower dimension until they have the same number of dimension.
  - For each dimension, if they don't have the same length and one of them has length `1`, replace that `1` by the value length of the other one.
  - If after steps 1. and 2. the two ndarrays don't have the same shape throw an error. Otherwise, operate them.
- Reshaping allows changing the shape of an ndarray. The only condition for it to work is that the number of values in the ndarray is the same as the number of values the new shape holds.

## Resources

- [NumPy broadcasting](#)
- [NumPy reshaping](#)