Broadcasting in NumPy

This lesson explains broadcasting in NumPy in detail.

We'll cover the following

What is Broadcasting in NumPy?

The term *broadcasting* describes how numpy treats arrays with different shapes during arithmetic operations. Subject to certain constraints, the smaller array is “broadcast” across the larger array so that they have compatible shapes. Broadcasting provides a means of vectorizing array operations.

General rules for Broadcasting

When operating on two arrays, NumPy compares their shapes element-wise. It starts with the trailing dimensions and works its way forward. Two dimensions of size `N` are compatible when

1. they are equal, or
2. one of them is the singular value
3. one is N * N and other is N * 1
4. one is N * N and other is 1 * N
5. one is N * S and other is S * N where **S** can be any **scalar value**

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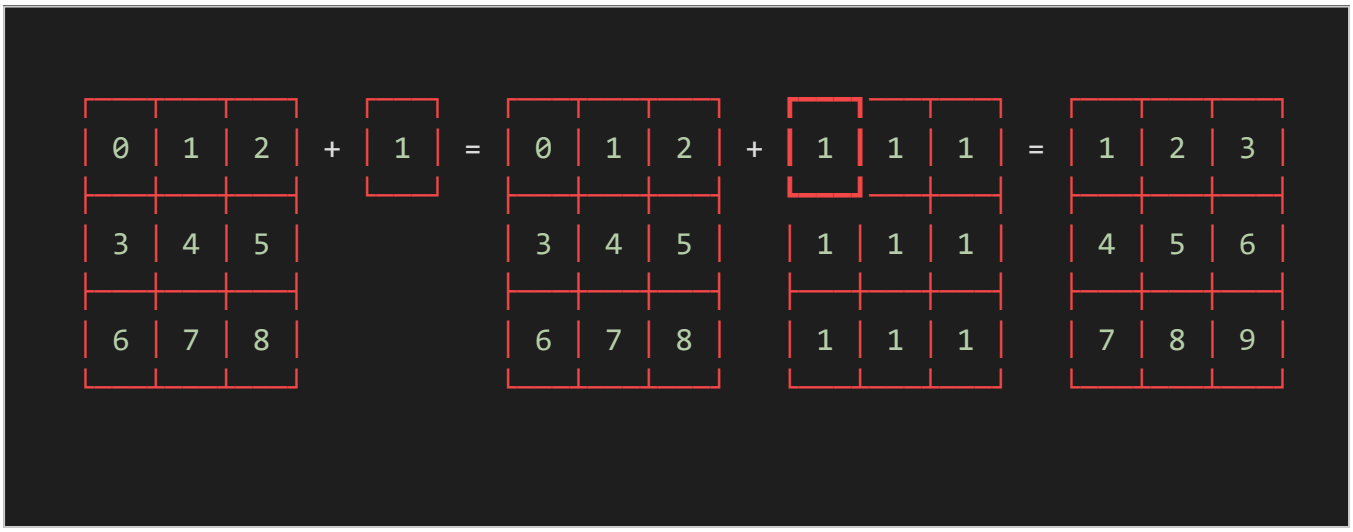
Examples

The concept of broadcasting is explained through code and figure in the following examples:-

When one operand is N*N and other is 1 * 1

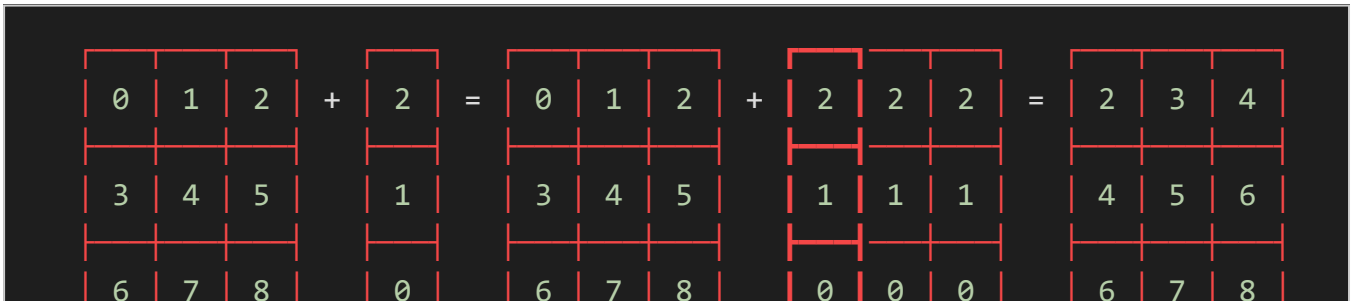
```
Z1 = np.arange(9).reshape(3,3)
Z2 = 1
Z1 + Z2
```




```
import numpy as np
Z1 = np.arange(9).reshape(3,3)
Z2 = 1
print(Z1 + Z2)
```

When one operand is N * N and other is N * 1

```
Z1 = np.arange(9).reshape(3,3)
Z2 = np.arange(3)[::-1].reshape(3,1)
Z1 + Z2
```



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Z2 = np.arange(3)[::-1]
Z1 + Z2
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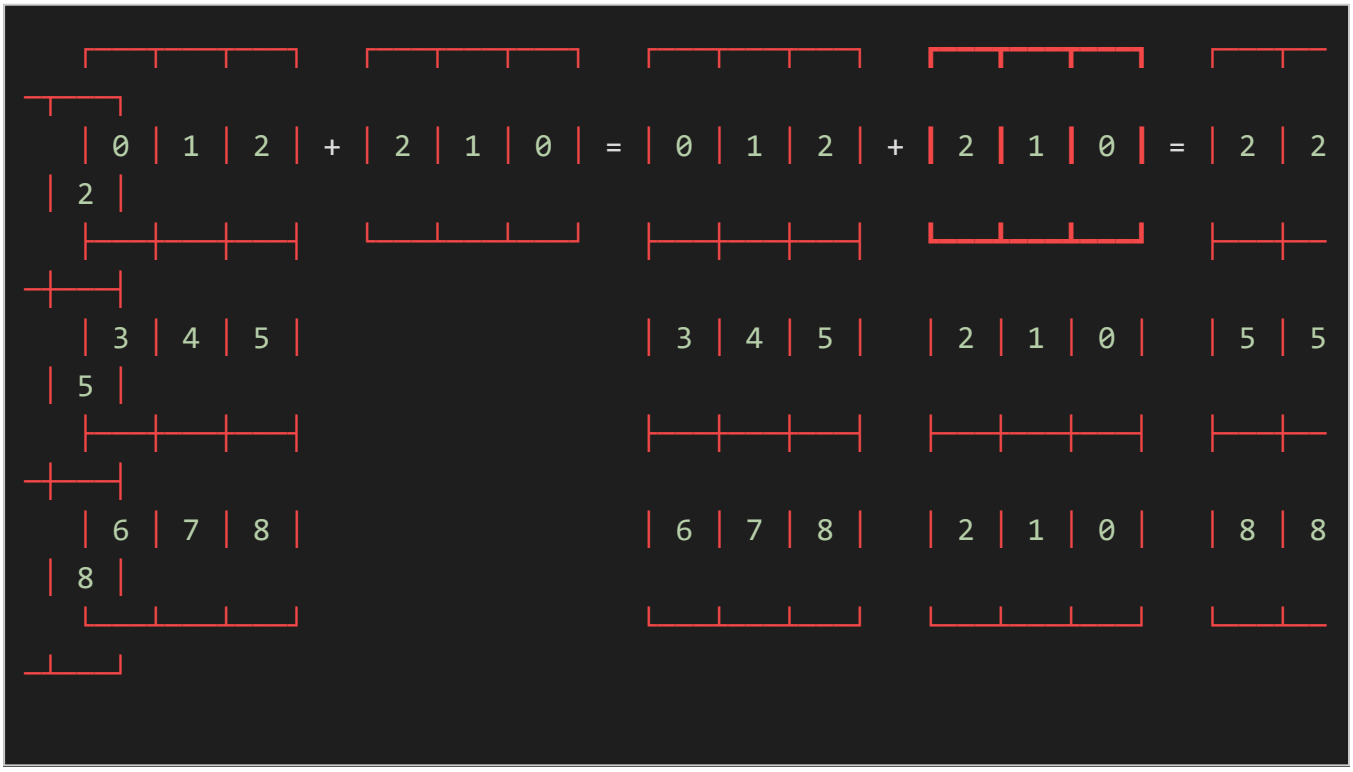


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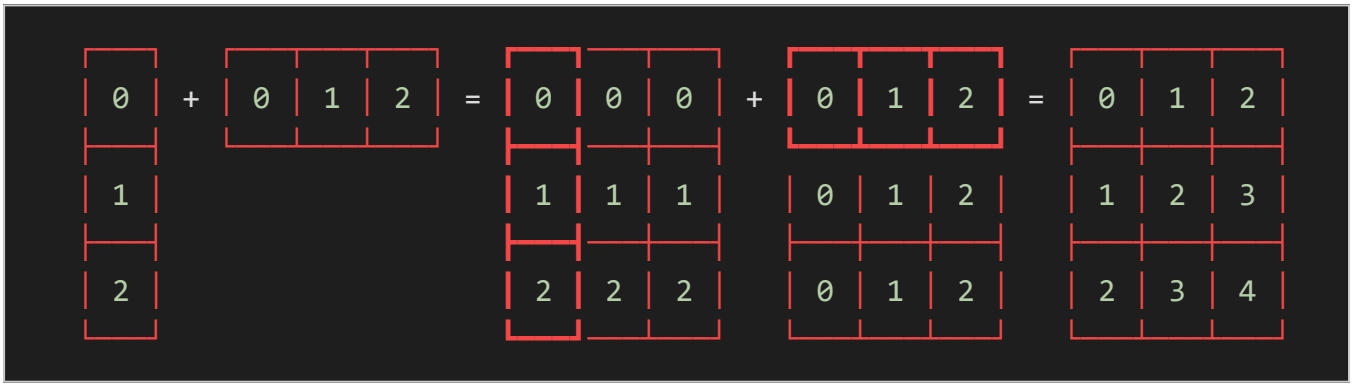
Z2 = np.arange(3)[::-1]
print(Z1 + Z2)
```

When one operand is N * S and other is S * N

Here S can be any scalar value.

In the following example S is 1 and N is 3. So basically dimension 3 * 1 and 1 * 3 is added.

```
Z1 = np.arange(3).reshape(3,1)
Z2 = np.arange(3).reshape(1,3)
Z1 + Z2
```




```
import numpy as np
Z1 = np.arange(3).reshape(3,1)
Z2 = np.arange(3).reshape(1,3)
print(Z1 + Z2)
```

Q Which of the following operation is not possible in broadcasting?

> Assume N is the total size of the NumPy array

- A) If one operand is N * N and other is N * N
- B) If one operand is N * 2 and other is N * 3
- C) If one operand is N * 2 and other is 2 * N

Now that we have an insight into broadcasting in NumPy, let's learn about "NumPy vectorization" in the next lesson.