

Module 02

Numpy Operations

Data Science Developer

Outline

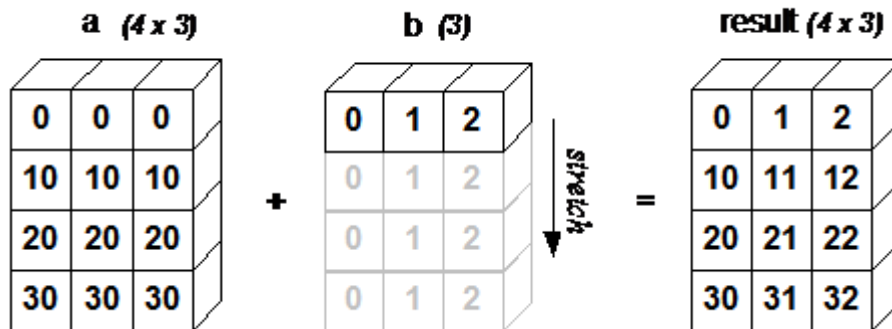
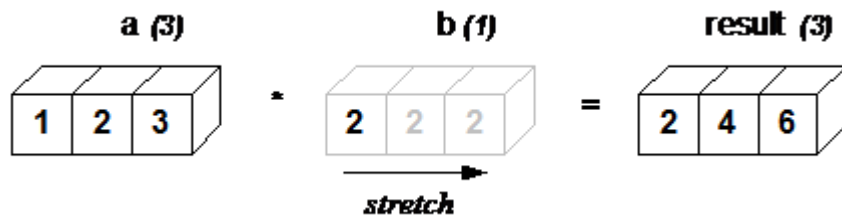
- Broadcasting and Arithmetic Operation in Numpy Array
- Numpy Mathematical Function
- Other Functions

Broadcasting

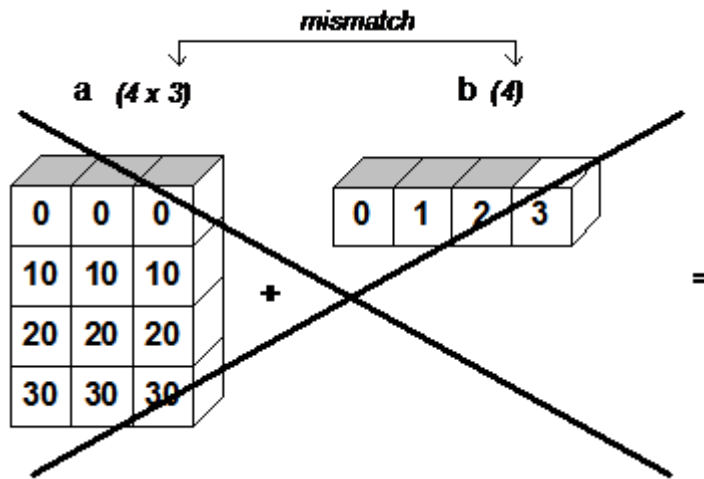
Broadcasting

- During arithmetic operation between arrays in numpy, the smaller array is stretched across the larger array so that they have compatible size
- The rules of broadcasting, the size of the of the axes for both array must be:
 - The same, or
 - One of them is one

Broadcasting



Broadcasting



Arithmetics Operation

Arithmetic 1D Array

```
In [23]: import numpy as np  
arr= np.arange(1,10)  
arr
```

```
Out[23]: array([1, 2, 3, 4, 5, 6, 7, 8, 9])
```

```
In [24]: arr+1
```

```
Out[24]: array([ 2, 3, 4, 5, 6, 7, 8, 9, 10])
```

```
In [25]: 1/arr
```

```
Out[25]: array([1.          , 0.5          , 0.33333333, 0.25          , 0.2          ,  
               0.16666667, 0.14285714, 0.125          , 0.11111111])
```

```
In [26]: arr*arr
```

```
Out[26]: array([ 1,  4,  9, 16, 25, 36, 49, 64, 81])
```


Arithmetic 2D Array

```
In [27]: arr_2d=arr.reshape(3,3)
arr_2d
```

```
Out[27]: array([[1, 2, 3],
               [4, 5, 6],
               [7, 8, 9]])
```

```
In [28]: arr_2d**2
```

```
Out[28]: array([[ 1,  4,  9],
               [16, 25, 36],
               [49, 64, 81]], dtype=int32)
```

Arithmetic 2D Array

```
In [29]: arr_1d=np.array([1,2,3])  
arr_2d*arr_1d
```

```
Out[29]: array([[ 1,  4,  9],  
               [ 4, 10, 18],  
               [ 7, 16, 27]])
```

```
In [30]: arr_2d/arr_2d
```

```
Out[30]: array([[1., 1., 1.],  
               [1., 1., 1.],  
               [1., 1., 1.]])
```

Mathematical Array Function

Mathematical Array Functions

```
In [37]: #squareroot  
np.sqrt(arr)
```

```
Out[37]: array([1.          , 1.41421356, 1.73205081, 2.          , 2.23606798,  
                2.44948974, 2.64575131, 2.82842712, 3.          ])
```

```
In [38]: #Exponential (e^)  
np.exp(arr)
```

```
Out[38]: array([2.71828183e+00, 7.38905610e+00, 2.00855369e+01, 5.45981500e+01,  
                1.48413159e+02, 4.03428793e+02, 1.09663316e+03, 2.98095799e+03,  
                8.10308393e+03])
```

Mathematical Array Functions

```
In [39]: #trigonometric sine  
np.sin(arr_2d)
```

```
Out[39]: array([[ 0.84147098,  0.90929743,  0.14112001],  
               [-0.7568025 , -0.95892427, -0.2794155 ],  
               [ 0.6569866 ,  0.98935825,  0.41211849]])
```

```
In [40]: # natural logarithm, the inverse of exponential  
np.log(arr_2d)
```

```
Out[40]: array([[0.          , 0.69314718, 1.09861229],  
               [1.38629436, 1.60943791, 1.79175947],  
               [1.94591015, 2.07944154, 2.19722458]])
```

Other Functions

Other Functions

insert, delete, append

```
In [55]: np.insert(arr,5,10)
```

```
Out[55]: array([ 1,  2,  3,  4,  5, 10,  6,  7,  8,  9])
```

```
In [56]: np.delete(arr,7)
```

```
Out[56]: array([1, 2, 3, 4, 5, 6, 7, 9])
```

```
In [57]: np.append(arr,11)
```

```
Out[57]: array([ 1,  2,  3,  4,  5,  6,  7,  8,  9, 11])
```

Other Functions

Concatenate

```
In [52]: a = np.array([[1, 2], [3, 4]])  
         b = np.array([[5, 6]])  
         np.concatenate((a, b), axis=0)
```

```
Out[52]: array([[1, 2],  
                [3, 4],  
                [5, 6]])
```

```
In [53]: np.concatenate((a, b.T), axis=1)
```

```
Out[53]: array([[1, 2, 5],  
                [3, 4, 6]])
```

```
In [54]: np.concatenate((a, b), axis=None)
```

```
Out[54]: array([1, 2, 3, 4, 5, 6])
```


Other Functions

Where

```
In [58]: np.where(arr>5,1,arr)
```

```
Out[58]: array([1, 2, 3, 4, 5, 1, 1, 1, 1])
```

```
In [59]: np.where(arr>5,1,0)
```

```
Out[59]: array([0, 0, 0, 0, 0, 1, 1, 1, 1])
```

```
In [60]: np.where(arr_2d <=5,0, arr_2d)
```

```
Out[60]: array([[0, 0, 0],  
                [0, 0, 6],  
                [7, 8, 9]])
```

Reference

- Array Broadcasting in Numpy.
<https://numpy.org/doc/stable/user/theory.broadcasting.html#array-broadcasting-in-numpy>
- Application of Exponential Function.
http://www.algebralab.org/lessons/lesson.aspx?file=Algebra_ExponentsApps.xml
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