```
#vector
v = [1, 2, 3, 4, 5]
v
```

```
[1, 2, 3, 4, 5]
```

```
#matrix
mat = [v, v]
mat
```

```
[[1, 2, 3, 4, 5], [1, 2, 3, 4, 5]]
```

Numpy is an N-dimensional array It is a module in python that has an extensive application in the following areas

1. Linear algebra
2. Statistics
3. Applied Math

4. Geometry

```
1 #Focus
2 #Basic Operations on arrays
3 #"Data Containers"
4 #Resize arrays
5 #Stack arrays
6 #Slicing
7 #other stuff
```

```
import numpy as np
import matplotlib.pyplot as plt
```

```
#1D array
arr = np.array([1,2,3,4])
arr
```

```
array([1, 2, 3, 4])
```

```
#Basic operations on arrays
arr1 = np.array([2,4, 5, 9])
#add two arrays
add_arr = arr + arr1
add_arr
```

```
array([ 3,  6,  8, 13])
```

```
#subtract two arrays
sub_arr = arr1 - arr
sub_arr
```

```
array([1, 2, 2, 5])
```

```
#scalar multiplication
scal = 2*arr1
scal
```

```
array([ 4,  8, 10, 18])
```

```
#"Data Containers"
#Zeros
#Ones
#Identity matrix (eye)
#Arrange vs linspace
```

```
arr_zero = np.zeros((10,6), dtype=float)
```

```
arr_zero
```

```
array([[0., 0., 0., 0., 0., 0.],
       [0., 0., 0., 0., 0., 0.],
       [0., 0., 0., 0., 0., 0.],
       [0., 0., 0., 0., 0., 0.],
       [0., 0., 0., 0., 0., 0.],
       [0., 0., 0., 0., 0., 0.],
       [0., 0., 0., 0., 0., 0.],
       [0., 0., 0., 0., 0., 0.],
       [0., 0., 0., 0., 0., 0.],
       [0., 0., 0., 0., 0., 0.]])
```

```
arr_one = np.ones((10,6), dtype=float)
```

```
arr_one
```

```
array([[1., 1., 1., 1., 1., 1.],
       [1., 1., 1., 1., 1., 1.],
       [1., 1., 1., 1., 1., 1.],
       [1., 1., 1., 1., 1., 1.],
       [1., 1., 1., 1., 1., 1.],
       [1., 1., 1., 1., 1., 1.],
       [1., 1., 1., 1., 1., 1.],
       [1., 1., 1., 1., 1., 1.],
       [1., 1., 1., 1., 1., 1.],
       [1., 1., 1., 1., 1., 1.]])
```

```
arr_one = 0.5*arr_one
arr_one
```

```
array([[0.5, 0.5, 0.5, 0.5, 0.5, 0.5],
       [0.5, 0.5, 0.5, 0.5, 0.5, 0.5],
       [0.5, 0.5, 0.5, 0.5, 0.5, 0.5],
       [0.5, 0.5, 0.5, 0.5, 0.5, 0.5],
       [0.5, 0.5, 0.5, 0.5, 0.5, 0.5],
       [0.5, 0.5, 0.5, 0.5, 0.5, 0.5],
       [0.5, 0.5, 0.5, 0.5, 0.5, 0.5],
       [0.5, 0.5, 0.5, 0.5, 0.5, 0.5],
       [0.5, 0.5, 0.5, 0.5, 0.5, 0.5],
       [0.5, 0.5, 0.5, 0.5, 0.5, 0.5]])
```

```
arr_eye = np.eye(3)
arr_eye
```

```
array([[1., 0., 0.],
       [0., 1., 0.],
       [0., 0., 1.]])
```

```
#arange vs linspace
arr_arange = np.arange(0, 50+1, 1)
arr_arange
```

```
array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14, 15, 16,
       17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33,
       34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50])
```

```
arr_lin =np.linspace(0, 50, 50)
arr_lin
```

```
array([ 0.        ,  1.02040816,  2.04081633,  3.06122449,  4.08163265,
        5.10204082,  6.12244898,  7.14285714,  8.16326531,  9.18367347,
       10.20408163, 11.2244898 , 12.24489796, 13.26530612, 14.28571429,
       15.30612245, 16.32653061, 17.34693878, 18.36734694, 19.3877551 ,
       20.40816327, 21.42857143, 22.44897959, 23.46938776, 24.48979592,
       25.51020408, 26.53061224, 27.55102041, 28.57142857, 29.59183673,
```

```
       30.6122449 , 31.63265306, 32.65306122, 33.67346939, 34.69387755,
       35.71428571, 36.73469388, 37.75510204, 38.7755102 , 39.79591837,
       40.81632653, 41.83673469, 42.85714286, 43.87755102, 44.89795918,
       45.91836735, 46.93877551, 47.95918367, 48.97959184, 50.        ])
```

```
#Resizing arrays
#Shape
arr_arange.shape
```

```
(51,)
```

```
#Reshape method
arr_arange = arr_arange.reshape((-1, 1))
arr_arange
```

```
array([[ 0],
       [ 1],
       [ 2],
       [ 3],
       [ 4],
       [ 5],
       [ 6],
       [ 7],
       [ 8],
       [ 9],
       [10],
       [11],
       [12],
       [13],
       [14],
       [15],
       [16],
       [17],
       [18],
       [19],
       [20],
       [21],
       [22],
       [23],
       [24],
       [25],
       [26],
       [27],
       [28],
       [29],
       [30],
       [31],
       [32],
       [33],
       [34],
       [35],
       [36],
       [37],
       [38],
```

```
       [39],
       [40],
       [41],
       [42],
       [43],
       [44],
       [45],
       [46],
       [47],
       [48],
       [49],
       [50]])
```

```
arr_arange.shape
```

```
(51, 1)
```

```
#stacking arrays
ar1 = np.array([1,2,3,4]).reshape((-1, 1))
ar2 = np.array([5,6,7,8]).reshape((-1, 1))
```

```
ar1
```

```
array([[1],
       [2],
       [3],
       [4]])
```

```
ar2
```

```
array([[5],
       [6],
       [7],
       [8]])
```

```
#vstack
v_arr = np.vstack((ar1, ar2))
v_arr
```

```
array([[1],
       [2],
       [3],
       [4],
       [5],
       [6],
       [7],
       [8]])
```

```
#hstack
h_arr = np.hstack((ar1, ar2))
```

```
h_arr
```

```
array([[1, 5],
       [2, 6],
       [3, 7],
       [4, 8]])
```

```
#np.concatenate -- look up
```

```
#Slicing
```

```
arr_slic = 0.4*np.ones((45, 7), dtype=float)
arr_slic
```

```
array([[0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
```

```
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4]])
```

```
#grab some rows
#5th to 10th row
arr_slic[4:10,:]
```

```
       array([[0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4]])
```

```
#grab some rows
#5th to 10th row
arr_slic[4:10, 0:1]
```

```
       array([[0.4],
              [0.4],
              [0.4],
              [0.4],
              [0.4],
              [0.4]])
```

```
arr_slic[:5,:]=0.5
```

```
arr_slic
```

```
       array([[0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5],
              [0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5],
              [0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5],
              [0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5],
              [0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
```

```
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4]])
```

```
arr_slic[-2:, :]=0.9
```

```
arr_slic
```

```
array([[0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5],
       [0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5],
       [0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5],
       [0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5],
       [0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
       [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
```

```
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.4, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4],
              [0.9, 0.9, 0.9, 0.9, 0.9, 0.9, 0.9],
              [0.9, 0.9, 0.9, 0.9, 0.9, 0.9, 0.9]])
```

```
#grab columns
#first two columns
arr_slic[:, 0:2]
```

```
array([[0.5, 0.5],
       [0.5, 0.5],
       [0.5, 0.5],
       [0.5, 0.5],
       [0.5, 0.5],
       [0.4, 0.4],
       [0.4, 0.4],
       [0.4, 0.4],
       [0.4, 0.4],
       [0.4, 0.4],
       [0.4, 0.4],
       [0.4, 0.4],
       [0.4, 0.4],
       [0.4, 0.4],
       [0.4, 0.4],
       [0.4, 0.4],
       [0.4, 0.4],
       [0.4, 0.4],
       [0.4, 0.4],
       [0.4, 0.4],
       [0.4, 0.4],
       [0.4, 0.4],
       [0.4, 0.4],
       [0.4, 0.4],
       [0.4, 0.4],
       [0.4, 0.4],
```

```
              [0.4, 0.4],
              [0.4, 0.4],
              [0.4, 0.4],
              [0.4, 0.4],
              [0.4, 0.4],
              [0.4, 0.4],
              [0.4, 0.4],
              [0.4, 0.4],
              [0.4, 0.4],
              [0.4, 0.4],
              [0.4, 0.4],
              [0.4, 0.4],
              [0.4, 0.4],
              [0.4, 0.4],
              [0.4, 0.4],
              [0.4, 0.4],
              [0.4, 0.4],
              [0.9, 0.9],
              [0.9, 0.9]])
```

```
#other stuff
np.sum(arr_arange)
```

```
1275
```

```
#mean
np.mean(arr_arange)
```

```
25.0
```

```
#standard deviation
np.std(arr_arange)
```

```
14.719601443879744
```

```
#minimum and maximum of array
np.min(arr_arange)
```

```
0
```

```
np.max(arr_arange)
```

```
50
```

```
#Transpose
```

```
np.transpose(arr_arange)
```

```
array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14, 15,
        16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31,
```

```
       32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47,
       48, 49, 50]])
```

```
#Cumulative sum
```

```
np.cumsum(arr_arange)
```

```
array([   0,    1,    3,    6,   10,   15,   21,   28,   36,   45,   55,
         66,   78,   91,  105,  120,  136,  153,  171,  190,  210,  231,
        253,  276,  300,  325,  351,  378,  406,  435,  465,  496,  528,
        561,  595,  630,  666,  703,  741,  780,  820,  861,  903,  946,
        990, 1035, 1081, 1128, 1176, 1225, 1275])
```

```
#sort
```

```
sorted(arr_arange)
```

```
[array([0]),
 array([1]),
 array([2]),
 array([3]),
 array([4]),
 array([5]),
 array([6]),
 array([7]),
 array([8]),
 array([9]),
 array([10]),
 array([11]),
 array([12]),
 array([13]),
 array([14]),
 array([15]),
 array([16]),
 array([17]),
 array([18]),
 array([19]),
 array([20]),
 array([21]),
 array([22]),
 array([23]),
 array([24]),
 array([25]),
 array([26]),
 array([27]),
 array([28]),
 array([29]),
 array([30]),
 array([31]),
 array([32]),
 array([33]),
 array([34]),
 array([35]),
```

```
        array([36]),
        array([37]),
        array([38]),
        array([39]),
        array([40]),
        array([41]),
        array([42]),
        array([43]),
        array([44]),
        array([45]),
        array([46]),
        array([47]),
        array([48]),
        array([49]),
        array([50])]
```

```
#reverse
arr_arange[::-1]
```

```
     array([[50],
            [49],
            [48],
            [47],
            [46],
            [45],
            [44],
            [43],
            [42],
            [41],
            [40],
            [39],
            [38],
            [37],
            [36],
            [35],
            [34],
            [33],
            [32],
            [31],
            [30],
            [29],
            [28],
            [27],
            [26],
            [25],
            [24],
            [23],
            [22],
            [21],
            [20],
            [19],
            [18],
            [17],
            [16],
            [15],
```

```
[14],
[13],
[12],
[11],
[10],
[ 9],
[ 8],
[ 7],
[ 6],
[ 5],
[ 4],
[ 3],
[ 2],
[ 1],
[ 0]])
```

```
aa = np.array([[1, 2],[3, 4], [4, 5]])
```

```
aa
```

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

```
#Transpose
aa.T
```

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

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