

numpy crash course

```
In [2]: import numpy as np
```

```
In [14]: np.version
```

```
Out[14]: <module 'numpy.version' from 'C:\\Users\\Asus\\anaconda3\\Lib\\site-packages\\numpy\\version.py'>
```

creating array

```
In [17]: my_list = [0,1,2,3,4,5]  
my_list
```

```
Out[17]: [0, 1, 2, 3, 4, 5]
```

```
In [19]: type(my_list)
```

```
Out[19]: list
```

```
In [23]: arr = np.array(my_list)  
arr
```

```
Out[23]: array([0, 1, 2, 3, 4, 5])
```

```
In [25]: type(arr)
```

```
Out[25]: numpy.ndarray
```

```
In [27]: type(my_list)
```

```
Out[27]: list
```

```
In [29]: np.arange(5)
```

```
Out[29]: array([0, 1, 2, 3, 4])
```

```
In [31]: np.arange(3.0)
```

```
Out[31]: array([0., 1., 2.])
```

```
In [33]: np.arange(10)
```

```
Out[33]: array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])
```

```
In [37]: np.arange(10,15)
```

```
Out[37]: array([10, 11, 12, 13, 14])
```

```
In [39]: np.arange(10,20)
```

```
Out[39]: array([10, 11, 12, 13, 14, 15, 16, 17, 18, 19])
```

```
In [41]: np.arange(20,10)# the second argument must be less than first argument otherwise it
```

```
Out[41]: array([], dtype=int32)
```

```
In [43]: np.arange(-20,10)
```

```
Out[43]: array([-20, -19, -18, -17, -16, -15, -14, -13, -12, -11, -10, -9, -8,
                 -7, -6, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5,
                 6, 7, 8, 9])
```

```
In [45]: np.arange(-15,-10)
```

```
Out[45]: array([-15, -14, -13, -12, -11])
```

```
In [47]: np.arange(10,30)
```

```
Out[47]: array([10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26,
                 27, 28, 29])
```

```
In [49]: b = np.arange(-30,20)
b
```

```
Out[49]: array([-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, 1, 2, 3, 4, 5, 6, 7, 8,
                 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19])
```

```
In [51]: np.arange(10,10)
```

```
Out[51]: array([], dtype=int32)
```

```
In [55]: np.arange(10,20,4) # 10- starting from 20 - end point, 4 - step count.
```

```
Out[55]: array([10, 14, 18])
```

```
In [57]: np.arange(10,20,3,1)
```

```
-----  
TypeError  
Cell In[57], line 1  
----> 1 np.arange(10,20,3,1)
```

```
Traceback (most recent call last)
```

```
TypeError: Cannot interpret '1' as a data type
```

parameter tuning

```
In [60]: b1 = np.zeros(2)
b1
```

```
Out[60]: array([0., 0.])
```

```
In [64]: np.zeros(5,dtype=int)
```

```
Out[64]: array([0, 0, 0, 0, 0])
```

```
In [68]: zero = np.zeros((2,2))
zero
```

```
Out[68]: array([[0., 0.],
 [0., 0.]])
```

```
In [70]: np.zeros((10,10))
```

```
Out[70]: 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.],
 [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.]])
```

```
In [74]: np.zeros((2,10))
```

```
Out[74]: array([[0., 0., 0., 0., 0., 0., 0., 0., 0., 0.],
 [0., 0., 0., 0., 0., 0., 0., 0., 0., 0.]])
```

```
In [76]: np.zeros((10,2))
```

```
Out[76]: array([[0., 0.],
 [0., 0.],
 [0., 0.],
 [0., 0.],
 [0., 0.],
 [0., 0.],
 [0., 0.],
 [0., 0.],
 [0., 0.],
 [0., 0.]])
```

```
In [80]: np.zeros((10,40))
```

```
In [82]: np.zeros((5,10))
```

```
Out[82]: 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.]])
```

```
In [84]: n = (5,7)
         n1 = (6,8)
         print(np.zeros(n))
```

```
[[[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.]]]
```

```
In [86]: print(np.zeros(n1))
```

```
[[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.]]
```

```
In [88]: np.ones(4,dtype=int)
```

```
Out[88]: array([1, 1, 1, 1])
```

```
In [90]: n
```

```
Out[90]: (5, 7)
```

```
In [94]: np.ones(n)
```

```
Out[94]: 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.]])
```

add new notebook and compare with np & *

```
In [99]: from numpy import*  
arange(3)
```

```
Out[99]: array([0, 1, 2])
```

```
In [101... zeros(5)
```

```
Out[101... array([0., 0., 0., 0., 0.])
```

```
In [103... range(12)  
list(range(12))
```

```
Out[103... [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11]
```

```
In [105... y = list(range(12))  
y
```

```
Out[105... [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11]
```

```
In [107... from numpy import*  
zeros(5)
```

```
Out[107... array([0., 0., 0., 0., 0.])
```

```
In [109... np.random.rand(4)# the array display in float .
```

```
Out[109]: array([0.23308322, 0.67305897, 0.6936567 , 0.97977048])
```

```
In [111]: np.random.randint(4)# by adding 'int' it will display the values.
```

```
Out[111]: 0
```

```
In [121]: np.random.randint(2,20)
```

```
Out[121]: 3
```

```
In [123]: np.random.randint(1,10,4)
```

```
Out[123]: array([8, 3, 4, 1])
```

```
In [127]: np.random.randint(10,21,3)
```

```
Out[127]: array([13, 20, 20])
```

```
In [129]: np.random.randint(10,40,(10,10))# it will generate elements 10-30 with 4*4 matrix.
```

```
Out[129]: array([[23, 20, 37, 17, 22, 32, 12, 34, 33, 32],  
                 [25, 27, 22, 28, 36, 32, 23, 11, 23, 13],  
                 [14, 17, 29, 18, 25, 11, 15, 35, 14, 26],  
                 [11, 13, 28, 34, 28, 33, 20, 35, 17, 16],  
                 [26, 27, 33, 24, 34, 35, 20, 23, 34, 35],  
                 [16, 24, 13, 14, 24, 16, 34, 36, 32, 29],  
                 [36, 25, 39, 21, 35, 17, 37, 38, 39, 35],  
                 [18, 32, 11, 30, 22, 39, 13, 32, 31, 27],  
                 [35, 10, 32, 25, 19, 31, 22, 14, 15, 27],  
                 [25, 30, 29, 13, 28, 17, 16, 25, 38, 14]])
```

```
In [135]: b = np.random.randint(10,20,(6,4))
```

```
b
```

```
Out[135]: array([[17, 13, 15, 14],  
                  [12, 12, 15, 10],  
                  [10, 19, 13, 15],  
                  [17, 11, 19, 16],  
                  [14, 11, 17, 14],  
                  [18, 15, 16, 17]])
```

```
In [137]: b[:]
```

```
Out[137]: array([[17, 13, 15, 14],  
                  [12, 12, 15, 10],  
                  [10, 19, 13, 15],  
                  [17, 11, 19, 16],  
                  [14, 11, 17, 14],  
                  [18, 15, 16, 17]])
```

```
In [139]: b[0:2]
```

```
Out[139]: array([[17, 13, 15, 14],  
                  [12, 12, 15, 10]])
```

```
In [141... b[0:-1]
```

```
Out[141... array([[17, 13, 15, 14],  
                   [12, 12, 15, 10],  
                   [10, 19, 13, 15],  
                   [17, 11, 19, 16],  
                   [14, 11, 17, 14]])
```

```
In [143... b
```

```
Out[143... array([[17, 13, 15, 14],  
                   [12, 12, 15, 10],  
                   [10, 19, 13, 15],  
                   [17, 11, 19, 16],  
                   [14, 11, 17, 14],  
                   [18, 15, 16, 17]])
```

```
In [145... b[0:2]
```

```
Out[145... array([[17, 13, 15, 14],  
                   [12, 12, 15, 10]])
```

```
In [147... np.random.randint(10,20,(5,5))
```

```
Out[147... array([[16, 17, 11, 14, 17],  
                   [18, 14, 10, 12, 16],  
                   [17, 13, 12, 14, 17],  
                   [19, 13, 16, 14, 14],  
                   [16, 12, 13, 14, 10]])
```

OPERATIONS

```
In [154... a = np.random.randint(10,20,3)  
a
```

```
Out[154... array([14, 12, 19])
```

```
In [156... arr
```

```
Out[156... array([0, 1, 2, 3, 4, 5])
```

```
In [160... arr2 = np.random.randint(0,100,(10,10))  
arr2
```

```
Out[160... array([[41, 30, 25, 26, 37, 32, 6, 96, 69, 4],  
   [85, 86, 97, 43, 67, 18, 78, 30, 33, 13],  
   [78, 51, 51, 80, 8, 2, 22, 79, 13, 97],  
   [25, 15, 99, 52, 66, 60, 86, 76, 22, 89],  
   [97, 56, 22, 23, 14, 94, 17, 24, 67, 58],  
   [49, 9, 16, 70, 78, 26, 74, 5, 12, 68],  
   [36, 61, 85, 5, 9, 88, 12, 57, 45, 62],  
   [52, 1, 1, 67, 25, 91, 53, 99, 62, 33],  
   [37, 63, 37, 41, 27, 86, 59, 55, 4, 93],  
   [70, 41, 90, 59, 64, 79, 6, 67, 53, 45]])
```

```
In [162... arr
```

```
Out[162... array([0, 1, 2, 3, 4, 5])
```

```
In [164... arr[:]
```

```
Out[164... array([0, 1, 2, 3, 4, 5])
```

```
In [166... arr[:4]
```

```
Out[166... array([0, 1, 2, 3])
```

```
In [168... arr2[:]
```

```
Out[168... array([[41, 30, 25, 26, 37, 32, 6, 96, 69, 4],  
   [85, 86, 97, 43, 67, 18, 78, 30, 33, 13],  
   [78, 51, 51, 80, 8, 2, 22, 79, 13, 97],  
   [25, 15, 99, 52, 66, 60, 86, 76, 22, 89],  
   [97, 56, 22, 23, 14, 94, 17, 24, 67, 58],  
   [49, 9, 16, 70, 78, 26, 74, 5, 12, 68],  
   [36, 61, 85, 5, 9, 88, 12, 57, 45, 62],  
   [52, 1, 1, 67, 25, 91, 53, 99, 62, 33],  
   [37, 63, 37, 41, 27, 86, 59, 55, 4, 93],  
   [70, 41, 90, 59, 64, 79, 6, 67, 53, 45]])
```

```
In [170... arr2[0:5]
```

```
Out[170... array([[41, 30, 25, 26, 37, 32, 6, 96, 69, 4],  
   [85, 86, 97, 43, 67, 18, 78, 30, 33, 13],  
   [78, 51, 51, 80, 8, 2, 22, 79, 13, 97],  
   [25, 15, 99, 52, 66, 60, 86, 76, 22, 89],  
   [97, 56, 22, 23, 14, 94, 17, 24, 67, 58]])
```

```
In [172... arr2
```

```
Out[172... array([[41, 30, 25, 26, 37, 32, 6, 96, 69, 4],  
   [85, 86, 97, 43, 67, 18, 78, 30, 33, 13],  
   [78, 51, 51, 80, 8, 2, 22, 79, 13, 97],  
   [25, 15, 99, 52, 66, 60, 86, 76, 22, 89],  
   [97, 56, 22, 23, 14, 94, 17, 24, 67, 58],  
   [49, 9, 16, 70, 78, 26, 74, 5, 12, 68],  
   [36, 61, 85, 5, 9, 88, 12, 57, 45, 62],  
   [52, 1, 1, 67, 25, 91, 53, 99, 62, 33],  
   [37, 63, 37, 41, 27, 86, 59, 55, 4, 93],  
   [70, 41, 90, 59, 64, 79, 6, 67, 53, 45]])
```

```
In [174... arr2[1,5]
```

```
Out[174... 18
```

```
In [176... arr2
```

```
Out[176... array([[41, 30, 25, 26, 37, 32, 6, 96, 69, 4],  
   [85, 86, 97, 43, 67, 18, 78, 30, 33, 13],  
   [78, 51, 51, 80, 8, 2, 22, 79, 13, 97],  
   [25, 15, 99, 52, 66, 60, 86, 76, 22, 89],  
   [97, 56, 22, 23, 14, 94, 17, 24, 67, 58],  
   [49, 9, 16, 70, 78, 26, 74, 5, 12, 68],  
   [36, 61, 85, 5, 9, 88, 12, 57, 45, 62],  
   [52, 1, 1, 67, 25, 91, 53, 99, 62, 33],  
   [37, 63, 37, 41, 27, 86, 59, 55, 4, 93],  
   [70, 41, 90, 59, 64, 79, 6, 67, 53, 45]])
```

```
In [178... arr2[-5,5]
```

```
Out[178... 26
```

```
In [184... arr2[-4,-4]
```

```
Out[184... 12
```

```
In [186... arr2
```

```
Out[186... array([[41, 30, 25, 26, 37, 32, 6, 96, 69, 4],  
   [85, 86, 97, 43, 67, 18, 78, 30, 33, 13],  
   [78, 51, 51, 80, 8, 2, 22, 79, 13, 97],  
   [25, 15, 99, 52, 66, 60, 86, 76, 22, 89],  
   [97, 56, 22, 23, 14, 94, 17, 24, 67, 58],  
   [49, 9, 16, 70, 78, 26, 74, 5, 12, 68],  
   [36, 61, 85, 5, 9, 88, 12, 57, 45, 62],  
   [52, 1, 1, 67, 25, 91, 53, 99, 62, 33],  
   [37, 63, 37, 41, 27, 86, 59, 55, 4, 93],  
   [70, 41, 90, 59, 64, 79, 6, 67, 53, 45]])
```

```
In [188... arr2[-2,-1]
```

```
Out[188... 93
```

```
In [190... arr2[::-1]
```

```
Out[190... array([[70, 41, 90, 59, 64, 79, 6, 67, 53, 45],  
                  [37, 63, 37, 41, 27, 86, 59, 55, 4, 93],  
                  [52, 1, 1, 67, 25, 91, 53, 99, 62, 33],  
                  [36, 61, 85, 5, 9, 88, 12, 57, 45, 62],  
                  [49, 9, 16, 70, 78, 26, 74, 5, 12, 68],  
                  [97, 56, 22, 23, 14, 94, 17, 24, 67, 58],  
                  [25, 15, 99, 52, 66, 60, 86, 76, 22, 89],  
                  [78, 51, 51, 80, 8, 2, 22, 79, 13, 97],  
                  [85, 86, 97, 43, 67, 18, 78, 30, 33, 13],  
                  [41, 30, 25, 26, 37, 32, 6, 96, 69, 4]])
```

```
In [192... arr2[::-2]
```

```
Out[192... array([[70, 41, 90, 59, 64, 79, 6, 67, 53, 45],  
                  [52, 1, 1, 67, 25, 91, 53, 99, 62, 33],  
                  [49, 9, 16, 70, 78, 26, 74, 5, 12, 68],  
                  [25, 15, 99, 52, 66, 60, 86, 76, 22, 89],  
                  [85, 86, 97, 43, 67, 18, 78, 30, 33, 13]])
```

```
In [198... arr2[::-3]
```

```
Out[198... array([[70, 41, 90, 59, 64, 79, 6, 67, 53, 45],  
                  [36, 61, 85, 5, 9, 88, 12, 57, 45, 62],  
                  [25, 15, 99, 52, 66, 60, 86, 76, 22, 89],  
                  [41, 30, 25, 26, 37, 32, 6, 96, 69, 4]])
```

```
In [200... arr
```

```
Out[200... array([0, 1, 2, 3, 4, 5])
```

```
In [196... arr.max()
```

```
Out[196... 5
```

```
In [202... arr.min()
```

```
Out[202... 0
```

```
In [204... arr.median()
```

```
-----  
AttributeError  
Cell In[204], line 1  
----> 1 arr.median()
```

```
Traceback (most recent call last)
```

```
AttributeError: 'numpy.ndarray' object has no attribute 'median'
```

```
In [206... from numpy import*  
a = array ([1,2,3,4,7,5,6])  
median(a)
```

```
Out[206... 4.0
```

```
In [208... arr
```

```
Out[208... array([0, 1, 2, 3, 4, 5])
```

```
In [210]: arr.reshape(2,3)
```

```
Out[210... array([[0, 1, 2],  
                  [3, 4, 5]])
```

```
In [214]: arr.reshape(6,1)
```

```
Out[214... array([[0],  
                   [1],  
                   [2],  
                   [3],  
                   [4],  
                   [5]])
```

```
In [216]: arr.reshape(1,6)
```

```
Out[216... array([[0, 1, 2, 3, 4, 5]])
```

```
In [224]: arr.reshape(3,2,order='c')
```

```
Out[224... array([[0, 1],  
                   [2, 3],  
                   [4, 5]]))
```

```
In [226]: arr.reshape(3,2,order='c')
```

```
Out[226... array([[0, 1],  
                   [2, 3],  
                   [4, 5]]))
```

```
In [228]: arr.reshape(3,2,order='f')
```

```
Out[228... array([[0, 3],  
                   [1, 4],  
                   [2, 5]]))
```

```
In [232]: arr.reshape(3,2,order='a')
```

```
Out[232... array([[0, 1],  
                   [2, 3],  
                   [4, 5]]))
```

In [234... arr

```
Out[234... array([0, 1, 2, 3, 4, 5])
```

```
In [236]: arr.reshape(3,2)
```

```
Out[236... array([[0, 1],  
                   [2, 3],  
                   [4, 5]]))
```

INDEXING

```
In [243...]: mat = np.arange(0,100).reshape(10,10)
mat
```

```
Out[243...]: 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, 51, 52, 53, 54, 55, 56, 57, 58, 59],
       [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
       [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
       [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
       [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [245...]: row = 4
col = 5
```

```
In [247...]: col
```

```
Out[247...]: 5
```

```
In [249...]: row
```

```
Out[249...]: 4
```

```
In [251...]: mat
```

```
Out[251...]: 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, 51, 52, 53, 54, 55, 56, 57, 58, 59],
       [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
       [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
       [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
       [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [253...]: mat[row,col]
```

```
Out[253...]: 45
```

```
In [255...]: mat[4,5]
```

```
Out[255...]: 45
```

```
In [257...]: mat
```

```
Out[257... 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, 51, 52, 53, 54, 55, 56, 57, 58, 59],
       [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
       [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
       [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
       [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

mat slicing

```
In [260... mat[:]
```

```
Out[260... 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, 51, 52, 53, 54, 55, 56, 57, 58, 59],
       [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
       [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
       [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
       [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [262... col = 6
```

```
In [264... mat
```

```
Out[264... 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, 51, 52, 53, 54, 55, 56, 57, 58, 59],
       [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
       [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
       [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
       [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [266... # with slice
mat[:,col] # this is not slicing this is represent the 6th column, if we input ':,
```

```
Out[266... array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])
```

```
In [268... mat[row,:]
```

```
Out[268... array([40, 41, 42, 43, 44, 45, 46, 47, 48, 49])
```

```
In [270... mat[:col]
```

```
Out[270... 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, 51, 52, 53, 54, 55, 56, 57, 58, 59]])
```

```
In [272... row
```

```
Out[272... 4
```

```
In [274... mat
```

```
Out[274... 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, 51, 52, 53, 54, 55, 56, 57, 58, 59],
   [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
   [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
   [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
   [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [276... mat[:row]
```

```
Out[276... 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]])
```

```
In [278... mat[row:]
```

```
Out[278... array([[40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
   [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
   [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
   [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
   [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
   [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [280... mat[:]
```

```
Out[280... 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, 51, 52, 53, 54, 55, 56, 57, 58, 59],
   [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
   [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
   [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
   [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [282... mat[:,8]
```

```
Out[282... array([ 8, 18, 28, 38, 48, 58, 68, 78, 88, 98])
```

```
In [284... mat[:, -1]
```

```
Out[284... array([ 9, 19, 29, 39, 49, 59, 69, 79, 89, 99])
```

```
In [286... mat[1:4]
```

```
Out[286... array([[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]])
```

```
In [288... mat[3:-3]
```

```
Out[288... array([[30, 31, 32, 33, 34, 35, 36, 37, 38, 39],  
                  [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],  
                  [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],  
                  [60, 61, 62, 63, 64, 65, 66, 67, 68, 69]])
```

```
In [290... mat[0]
```

```
Out[290... array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])
```

```
In [292... mat[6]
```

```
Out[292... array([60, 61, 62, 63, 64, 65, 66, 67, 68, 69])
```

```
In [294... mat[6:]
```

```
Out[294... array([[60, 61, 62, 63, 64, 65, 66, 67, 68, 69],  
                  [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],  
                  [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],  
                  [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [296... mat[:6]
```

```
Out[296... 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, 51, 52, 53, 54, 55, 56, 57, 58, 59]])
```

```
In [298... mat[5:7]
```

```
Out[298... array([[50, 51, 52, 53, 54, 55, 56, 57, 58, 59],  
                  [60, 61, 62, 63, 64, 65, 66, 67, 68, 69]])
```

```
In [302... mat[0:10]
```

```
Out[302... 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, 51, 52, 53, 54, 55, 56, 57, 58, 59],
   [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
   [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
   [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
   [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [304... mat[0:10:3]
```

```
Out[304... array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
   [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
   [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
   [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [306... mat[:::-5]
```

```
Out[306... array([[90, 91, 92, 93, 94, 95, 96, 97, 98, 99],
   [40, 41, 42, 43, 44, 45, 46, 47, 48, 49]])
```

```
In [309... mat[2:4,5:6]# 2:4 --- only row part, 5:6---- it indicates only column part
```

```
Out[309... array([[25],
   [35]])
```

```
In [311... mat[0,1]
```

```
Out[311... 1
```

```
In [313... mat[1,6]
```

```
Out[313... 16
```

```
In [315... mat[1:6]
```

```
Out[315... array([[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, 51, 52, 53, 54, 55, 56, 57, 58, 59]])
```

```
In [317... mat[:6]
```

```
Out[317... 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, 51, 52, 53, 54, 55, 56, 57, 58, 59]])
```

```
In [319... mat[0:11]
```

```
Out[319... 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, 51, 52, 53, 54, 55, 56, 57, 58, 59],
   [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
   [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
   [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
   [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [321... mat[2:3,2:3]
```

```
Out[321... array([[22]])
```

MASKING

MAT -- we also called it has filter

```
In [324... id(mat)
```

```
Out[324... 1935943364368
```

```
In [326... mat
```

```
Out[326... 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, 51, 52, 53, 54, 55, 56, 57, 58, 59],
   [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
   [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
   [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
   [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [328... mat<50
```

```
Out[328... array([[ True,  True,  True,  True,  True,  True,  True,  True,  True,
       True],
       [ True,  True,  True,  True,  True,  True,  True,  True,  True,
       True],
       [ True,  True,  True,  True,  True,  True,  True,  True,  True,
       True],
       [ True,  True,  True,  True,  True,  True,  True,  True,  True,
       True],
       [ True,  True,  True,  True,  True,  True,  True,  True,  True,
       True],
       [False, False, False, False, False, False, False, False, False,
       False],
       [False, False, False, False, False, False, False, False, False,
       False],
       [False, False, False, False, False, False, False, False, False,
       False],
       [False, False, False, False, False, False, False, False, False,
       False],
       [False, False, False, False, False, False, False, False, False,
       False]]))
```

```
In [330... mat>50
```

```
Out[330... array([[False, False, False, False, False, False, False, False,
       False],
       [False, False, False, False, False, False, False, False, False,
       False],
       [False, False, False, False, False, False, False, False, False,
       False],
       [False, False, False, False, False, False, False, False, False,
       False],
       [False, False, False, False, False, False, False, False, False,
       False],
       [False, False, False, False, False, False, False, False, False,
       False],
       [False, True,  True,  True,  True,  True,  True,  True,  True,
       True],
       [ True,  True,  True,  True,  True,  True,  True,  True,  True,
       True],
       [ True,  True,  True,  True,  True,  True,  True,  True,  True,
       True],
       [ True,  True,  True,  True,  True,  True,  True,  True,  True,
       True],
       [ True,  True,  True,  True,  True,  True,  True,  True,  True,
       True]]))
```

```
In [332... mat == 50
```

In [334... mat[mat==50]

Out[334... array([50])

```
In [336]: a1 = mat[mat<50] # it will print all the numbers lessthen 50.  
a1
```

```
Out[336... 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])
```

```
In [338]: a1 = mat[mat<=50]# if we need 50 also we have to use '<='
a1
```

```
Out[338... 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])
```

```
In [340...]: a2 = mat[mat>50]  
          a2
```

```
Out[340...]: array([51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67,
   68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84,
   85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99])
```

```
In [342...]: a3 = mat[mat>=50]  
a3
```

```
Out[342...]: array([50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66,
   67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83,
   84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99])
```

```
In [346]: a4 = mat[mat==50]  
a4
```

```
Out[346... array([50])
```

```
In [348... a1
```

```
Out[348... 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])
```

```
In [ ]:
```