

numpy, array, matrix

```
In [1]: import sys  
sys.version
```

```
Out[1]: '3.12.4 | packaged by Anaconda, Inc. | (main, Jun 18 2024, 15:03:56) [MSC v.1929 64 bit (AMD64)]'
```

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

```
In [3]: np.__version__
```

```
Out[3]: '1.26.4'
```

creating arrays

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

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

```
In [5]: type(my_list)
```

```
Out[5]: list
```

```
In [6]: arr = np.array(my_list)  
arr
```

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

```
In [7]: type(arr)
```

```
Out[7]: numpy.ndarray
```

```
In [8]: np.arange(5)
```

```
Out[8]: array([0, 1, 2, 3, 4])
```

```
In [9]: np.arange(4.0)
```

```
Out[9]: array([0., 1., 2., 3.])
```

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

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

```
In [11]: np.arange(0,10)
```

```
Out[11]: array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])
```

```
In [12]: np.arange(5,10)
```

```
Out[12]: array([5, 6, 7, 8, 9])
```

```
In [13]: np.arange(20,10)
```

```
Out[13]: array([], dtype=int32)
```

```
In [14]: np.arange(-20,10)
```

```
Out[14]: 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 [15]: np.arange(-20,-10)
```

```
Out[15]: array([-20, -19, -18, -17, -16, -15, -14, -13, -12, -11])
```

```
In [16]: np.arange(30,20) # frist argument always < second argument
```

```
Out[16]: array([], dtype=int32)
```

```
In [17]: np.arange(-30,30)
```

```
Out[17]: 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, 20, 21,
        22, 23, 24, 25, 26, 27, 28, 29])
```

```
In [18]: np.arange(-20,20)
```

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

```
In [19]: np.arange(10,30,5) # 10- starting from || 30 -end point || 5- step count
```

```
Out[19]: array([10, 15, 20, 25])
```

```
In [20]: np.arange(100,500,3)
```

```
Out[20]: array([100, 103, 106, 109, 112, 115, 118, 121, 124, 127, 130, 133, 136,
        139, 142, 145, 148, 151, 154, 157, 160, 163, 166, 169, 172, 175,
        178, 181, 184, 187, 190, 193, 196, 199, 202, 205, 208, 211, 214,
        217, 220, 223, 226, 229, 232, 235, 238, 241, 244, 247, 250, 253,
        256, 259, 262, 265, 268, 271, 274, 277, 280, 283, 286, 289, 292,
        295, 298, 301, 304, 307, 310, 313, 316, 319, 322, 325, 328, 331,
        334, 337, 340, 343, 346, 349, 352, 355, 358, 361, 364, 367, 370,
        373, 376, 379, 382, 385, 388, 391, 394, 397, 400, 403, 406, 409,
        412, 415, 418, 421, 424, 427, 430, 433, 436, 439, 442, 445, 448,
        451, 454, 457, 460, 463, 466, 469, 472, 475, 478, 481, 484, 487,
        490, 493, 496, 499])
```

```
In [21]: np.arange(10,100,5.5)
```

```
Out[21]: array([10. , 15.5, 21. , 26.5, 32. , 37.5, 43. , 48.5, 54. , 59.5, 65. ,
        70.5, 76. , 81.5, 87. , 92.5, 98. ])
```

```
In [22]: np.arange(0,20,2)
```

```
Out[22]: array([ 0,  2,  4,  6,  8, 10, 12, 14, 16, 18])
```

```
In [23]: np.arange(0,20,2,1)
```

```
-----
TypeError                                Traceback (most recent call last)
Cell In[23], line 1
----> 1 np.arange(0,20,2,1)

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

```
In [24]: b1 = np.zeros(2) # parameter tuning
        b1
```

```
Out[24]: array([0., 0.])
```

```
In [25]: np.zeros(5 ,dtype=int)
```

```
Out[25]: array([0, 0, 0, 0, 0])
```

```
In [26]: zero = np.zeros((2,2))
        zero
```

```
Out[26]: array([[0., 0.],
        [0., 0.]])
```

```
In [27]: np.zeros((10,10))
```

```
Out[27]: 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 [28]: np.zeros((2,10))
```

```
Out[28]: array([[0., 0., 0., 0., 0., 0., 0., 0., 0., 0.],
        [0., 0., 0., 0., 0., 0., 0., 0., 0., 0.]])
```

```
In [29]: np.zeros((2,2))
```

```
Out[29]: array([[0., 0.],
                [0., 0.]])
```

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

[illegible]

```
In [31]: np.zeros((5,10))
```

```
Out[31]: 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.]])
```

```
In [32]: n=(5,7)
n1=(6,8)
print(np.zeros(n))    #parameter tuning
#print np.zeros(n1,dtype =int)  # hyperparameter tuning

[[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 [33]: np.zeros(n1,dtype = int) # hyper parameter tuning
```

```
Out[33]: 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]])
```

```
In [34]: 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 [35]: np.ones(4,dtype=int)
```

```
Out[35]: array([1, 1, 1, 1])
```

```
In [36]: np.ones(4)
```

```
Out[36]: array([1., 1., 1., 1.])
```

```
In [37]: np.ones((2,2))
```

```
Out[37]: array([[1., 1.],
                [1., 1.]])
```

```
In [38]: np.ones((10,10))
```

```
Out[38]: 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.],
               [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.]])
```

```
In [39]: n
```

```
Out[39]: (5, 7)
```

```
In [40]: np.ones(n)
```

```
Out[40]: 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.]])
```

```
In [41]: np.ones((5,4),dtype=int) #by default 5- rows and 4- columns
```

```
Out[41]: array([[1, 1, 1, 1],
               [1, 1, 1, 1],
               [1, 1, 1, 1],
               [1, 1, 1, 1],
               [1, 1, 1, 1]])
```

```
In [42]: np.twos(2,4)
```

```
-----
AttributeError                                Traceback (most recent call last)
Cell In[42], line 1
----> 1 np.twos(2,4)

File ~\anaconda3\Lib\site-packages\numpy\__init__.py:333, in __getattr__(attr)
    330     "Removed in NumPy 1.25.0"
    331     raise RuntimeError("Tester was removed in NumPy 1.25.")
--> 333 raise AttributeError("module {!r} has no attribute "
    334                        "{!r}".format(__name__, attr))

AttributeError: module 'numpy' has no attribute 'twos'
```

```
In [43]: np.ones((6,10),dtype=int)
```

```
Out[43]: 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]])
```

```
In [44]: np.twos((2,4))
```

```
-----
AttributeError                                Traceback (most recent call last)
Cell In[44], line 1
----> 1 np.twos((2,4))

File ~\anaconda3\Lib\site-packages\numpy\__init__.py:333, in __getattr__(attr)
    330     "Removed in NumPy 1.25.0"
    331     raise RuntimeError("Tester was removed in NumPy 1.25.")
--> 333 raise AttributeError("module {!r} has no attribute "
    334                        "{!r}".format(__name__, attr))

AttributeError: module 'numpy' has no attribute 'twos'
```

```
In [45]: np.three((2,4))
```

```

-----
AttributeError                                Traceback (most recent call last)
Cell In[45], line 1
----> 1 np.three((2,4))

File ~\anaconda3\Lib\site-packages\numpy\__init__.py:333, in __getattr__(attr)
    330     "Removed in NumPy 1.25.0"
    331     raise RuntimeError("Tester was removed in NumPy 1.25.")
--> 333 raise AttributeError("module {!r} has no attribute "
    334                        "{!r}".format(__name__, attr))

AttributeError: module 'numpy' has no attribute 'three'

```

In [46]: `np.arange(3)`

Out[46]: `array([0, 1, 2])`

In [47]: `from numpy import * #internally is called all 217 functionality`
`arange(3)`

Out[47]: `array([0, 1, 2])`

In [48]: `range(12)`
`list(range(12))`

Out[48]: `[0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11]`

In [49]: `y = list(range(12))`
`y`

Out[49]: `[0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11]`

In [50]: `from numpy import *`
`zeros(5)`

Out[50]: `array([0., 0., 0., 0., 0.])`

In [51]: `rand(3,2)`
`random.rand(3,2)`

```

-----
NameError                                Traceback (most recent call last)
Cell In[51], line 1
----> 1 rand(3,2)
      2 random.rand(3,2)

NameError: name 'rand' is not defined

```

In [52]: `np.random.rand(5)`

Out[52]: `array([0.88264494, 0.73485007, 0.03665707, 0.72906118, 0.75054876])`

In [53]: `np.random.rand(2,5)`

Out[53]: `array([[0.32351075, 0.03919587, 0.66900894, 0.9208729 , 0.66322917],
 [0.1203259 , 0.07556259, 0.74695781, 0.22650772, 0.22383365]])`

In [54]: `np.random.randint(3,20) # 2nd argument is exclusive`

Out[54]: `10`

In [55]: `np.random.randint(0,2)`

Out[55]: `0`

In [56]: `np.random.randint(1,10,4)`

Out[56]: `array([5, 3, 3, 3])`

In [57]: `np.random.randint(30,20,10)`

```

-----
ValueError                                Traceback (most recent call last)
Cell In[57], line 1
----> 1 np.random.randint(30,20,10)

File numpy\random\mttrand.pyx:780, in numpy.random.mtrand.RandomState.randint()

File numpy\random\_bounded_integers.pyx:1425, in numpy.random._bounded_integers._rand_int32()

ValueError: low >= high

```

```
In [58]: np.random.randint(5,9) #get the value <=9 & >=5
```

```
Out[58]: 5
```

```
In [59]: np.random.randint(10,21,3)
```

```
Out[59]: array([13, 20, 11])
```

```
In [60]: np.random.randint(10,40,(10,10)) # generate the element 10-40 with 4*4  
# generating array 10x10 in between 10-40
```

```
Out[60]: array([[32, 23, 20, 33, 13, 12, 17, 24, 27, 24],  
               [15, 10, 36, 14, 27, 39, 26, 32, 31, 29],  
               [27, 28, 32, 30, 31, 25, 18, 19, 35, 15],  
               [36, 23, 16, 33, 15, 34, 32, 15, 38, 20],  
               [23, 17, 37, 21, 23, 35, 27, 37, 12, 22],  
               [16, 37, 14, 34, 13, 16, 32, 20, 18, 30],  
               [24, 25, 23, 13, 18, 21, 36, 12, 34, 24],  
               [35, 30, 13, 20, 24, 29, 16, 31, 33, 14],  
               [25, 36, 27, 12, 22, 38, 31, 28, 23, 24],  
               [26, 19, 16, 27, 23, 21, 32, 15, 29, 16]])
```

```
In [61]: b=np.random.randint(10,20,(5,4)) # 5x4 array in between numbers 10-20  
b
```

```
Out[61]: array([[19, 16, 14, 10],  
               [10, 17, 17, 12],  
               [11, 14, 13, 13],  
               [11, 18, 14, 18],  
               [14, 14, 10, 15]])
```

```
In [62]: b[:]
```

```
Out[62]: array([[19, 16, 14, 10],  
               [10, 17, 17, 12],  
               [11, 14, 13, 13],  
               [11, 18, 14, 18],  
               [14, 14, 10, 15]])
```

```
In [63]: b[0:2] # slicing [ start : stop : step]
```

```
Out[63]: array([[19, 16, 14, 10],  
               [10, 17, 17, 12]])
```

```
In [64]: b
```

```
Out[64]: array([[19, 16, 14, 10],  
               [10, 17, 17, 12],  
               [11, 14, 13, 13],  
               [11, 18, 14, 18],  
               [14, 14, 10, 15]])
```

```
In [65]: b[0,2]
```

```
Out[65]: 14
```

```
In [66]: b[0:-1]
```

```
Out[66]: array([[19, 16, 14, 10],  
               [10, 17, 17, 12],  
               [11, 14, 13, 13],  
               [11, 18, 14, 18]])
```

```
In [67]: b
```

```
Out[67]: array([[19, 16, 14, 10],  
               [10, 17, 17, 12],  
               [11, 14, 13, 13],  
               [11, 18, 14, 18],  
               [14, 14, 10, 15]])
```

```
In [68]: np.random.randint(10,20,(4,4))
```

```
Out[68]: array([[11, 17, 14, 19],  
               [16, 15, 11, 19],  
               [17, 13, 11, 18],  
               [11, 13, 14, 17]])
```

operations

```
In [69]: a = np.random.randint(10,20,5)  
a
```

```
Out[69]: array([15, 12, 15, 10, 14])
```

```
In [70]: arr2 = np.random.randint(0,100,(10,10))  
arr2
```

```
Out[70]: array([[68, 68, 43, 94,  3,  7, 97,  8, 40,  5],  
               [27,  2, 40, 86, 85, 71, 85, 84, 10, 69],  
               [92, 20, 16, 26, 87, 95, 32, 97, 62, 23],  
               [97, 60, 81, 77, 13, 69, 11, 48,  5, 51],  
               [60, 30, 82, 49, 39,  9, 29,  8, 90, 49],  
               [34, 93, 25, 34, 41, 67, 27,  4, 29,  5],  
               [11, 66, 28, 33, 45, 18, 62, 36, 33, 25],  
               [55, 15, 32, 50, 31, 73, 96, 21, 52, 70],  
               [87, 11, 25, 55, 25,  3, 26, 10, 95, 14],  
               [84, 21, 40, 91, 28, 11, 72, 35, 63, 47]])
```

```
In [71]: arr
```

```
Out[71]: array([0, 1, 2, 3, 4, 5])
```

```
In [72]: arr[:]
```

```
Out[72]: array([0, 1, 2, 3, 4, 5])
```

```
In [73]: arr[:4]
```

```
Out[73]: array([0, 1, 2, 3])
```

```
In [74]: arr2[:]
```

```
Out[74]: array([[68, 68, 43, 94,  3,  7, 97,  8, 40,  5],  
               [27,  2, 40, 86, 85, 71, 85, 84, 10, 69],  
               [92, 20, 16, 26, 87, 95, 32, 97, 62, 23],  
               [97, 60, 81, 77, 13, 69, 11, 48,  5, 51],  
               [60, 30, 82, 49, 39,  9, 29,  8, 90, 49],  
               [34, 93, 25, 34, 41, 67, 27,  4, 29,  5],  
               [11, 66, 28, 33, 45, 18, 62, 36, 33, 25],  
               [55, 15, 32, 50, 31, 73, 96, 21, 52, 70],  
               [87, 11, 25, 55, 25,  3, 26, 10, 95, 14],  
               [84, 21, 40, 91, 28, 11, 72, 35, 63, 47]])
```

```
In [75]: arr2[1,5]
```

```
Out[75]: 71
```

```
In [76]: arr2[-5,5]
```

```
Out[76]: 67
```

```
In [77]: arr2[-1,2]
```

```
Out[77]: 40
```

```
In [78]: arr2[::-1]
```

```
Out[78]: array([[84, 21, 40, 91, 28, 11, 72, 35, 63, 47],  
               [87, 11, 25, 55, 25,  3, 26, 10, 95, 14],  
               [55, 15, 32, 50, 31, 73, 96, 21, 52, 70],  
               [11, 66, 28, 33, 45, 18, 62, 36, 33, 25],  
               [34, 93, 25, 34, 41, 67, 27,  4, 29,  5],  
               [60, 30, 82, 49, 39,  9, 29,  8, 90, 49],  
               [97, 60, 81, 77, 13, 69, 11, 48,  5, 51],  
               [92, 20, 16, 26, 87, 95, 32, 97, 62, 23],  
               [27,  2, 40, 86, 85, 71, 85, 84, 10, 69],  
               [68, 68, 43, 94,  3,  7, 97,  8, 40,  5]])
```

```
In [79]: arr2
```

```
Out[79]: array([[68, 68, 43, 94,  3,  7, 97,  8, 40,  5],  
               [27,  2, 40, 86, 85, 71, 85, 84, 10, 69],  
               [92, 20, 16, 26, 87, 95, 32, 97, 62, 23],  
               [97, 60, 81, 77, 13, 69, 11, 48,  5, 51],  
               [60, 30, 82, 49, 39,  9, 29,  8, 90, 49],  
               [34, 93, 25, 34, 41, 67, 27,  4, 29,  5],  
               [11, 66, 28, 33, 45, 18, 62, 36, 33, 25],  
               [55, 15, 32, 50, 31, 73, 96, 21, 52, 70],  
               [87, 11, 25, 55, 25,  3, 26, 10, 95, 14],  
               [84, 21, 40, 91, 28, 11, 72, 35, 63, 47]])
```

```
In [80]: arr2[::-2]
```

```
Out[80]: array([[84, 21, 40, 91, 28, 11, 72, 35, 63, 47],
               [55, 15, 32, 50, 31, 73, 96, 21, 52, 70],
               [34, 93, 25, 34, 41, 67, 27, 4, 29, 5],
               [97, 60, 81, 77, 13, 69, 11, 48, 5, 51],
               [27, 2, 40, 86, 85, 71, 85, 84, 10, 69]])
```

```
In [81]: arr2[::-3]
```

```
Out[81]: array([[84, 21, 40, 91, 28, 11, 72, 35, 63, 47],
               [11, 66, 28, 33, 45, 18, 62, 36, 33, 25],
               [97, 60, 81, 77, 13, 69, 11, 48, 5, 51],
               [68, 68, 43, 94, 3, 7, 97, 8, 40, 5]])
```

```
In [82]: arr
```

```
Out[82]: array([0, 1, 2, 3, 4, 5])
```

```
In [83]: arr.max()
```

```
Out[83]: 5
```

```
In [84]: arr.min()
```

```
Out[84]: 0
```

```
In [85]: arr.mean()
```

```
Out[85]: 2.5
```

```
In [86]: arr.median()
```

```
-----
AttributeError                                Traceback (most recent call last)
Cell In[86], line 1
----> 1 arr.median()

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

```
In [87]: from numpy import *
a = array([1,2,3,4,9])
median(a)
```

```
Out[87]: 3.0
```

```
In [88]: arr
```

```
Out[88]: array([0, 1, 2, 3, 4, 5])
```

```
In [89]: arr.reshape(2,3)
```

```
Out[89]: array([[0, 1, 2],
               [3, 4, 5]])
```

```
In [90]: arr.reshape(1,6)
```

```
Out[90]: array([[0, 1, 2, 3, 4, 5]])
```

```
In [91]: arr
```

```
Out[91]: array([0, 1, 2, 3, 4, 5])
```

```
In [92]: arr.reshape(1,5)
```

```
-----
ValueError                                Traceback (most recent call last)
Cell In[92], line 1
----> 1 arr.reshape(1,5)

ValueError: cannot reshape array of size 6 into shape (1,5)
```

```
In [93]: arr.reshape(3,2,order='C')
```

```
Out[93]: array([[0, 1],
               [2, 3],
               [4, 5]])
```

```
In [94]: arr.reshape(3,2,order='A')
```

```
Out[94]: array([[0, 1],
               [2, 3],
               [4, 5]])
```



```
In [95]: arr.reshape(3,2,order='k')
```

```
-----  
ValueError                                Traceback (most recent call last)  
Cell In[95], line 1  
----> 1 arr.reshape(3,2,order='k')  
  
ValueError: order 'K' is not permitted for reshaping
```

```
In [96]: arr.reshape(6,1)
```

```
Out[96]: array([[0],  
               [1],  
               [2],  
               [3],  
               [4],  
               [5]])
```

```
In [97]: arr.reshape(3,2)
```

```
Out[97]: array([[0, 1],  
               [2, 3],  
               [4, 5]])
```

```
In [ ]:
```

indexing

```
In [98]: mat = np.arange(0,100).reshape(10,10)  
mat
```

```
Out[98]: 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 [99]: row = 4  
col = 5
```

```
In [100]: print(row)  
print(col)
```

```
4  
5
```

```
In [101]: mat
```

```
Out[101]: 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 [102]: mat[row,col]
```

```
Out[102]: 45
```

```
In [103]: mat[:]
```

```
Out[103]: 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 [104]: col=6 # this will be use to specify column to extract
```

```
In [105... # with slices
mat[:,col]

Out[105... array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])

In [106... mat[:,6]

Out[106... array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])

In [107... mat[row,: ]

Out[107... array([40, 41, 42, 43, 44, 45, 46, 47, 48, 49])

In [108... row

Out[108... 4

In [109... mat[:,col] # this slice extract frist 6 columns

Out[109... 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 [110... mat[row,: ]

Out[110... array([40, 41, 42, 43, 44, 45, 46, 47, 48, 49])

In [111... mat[:,row]

Out[111... 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 [112... mat[row:]

Out[112... 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 [113... mat

Out[113... 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 [114... mat[:,8]

Out[114... array([ 8, 18, 28, 38, 48, 58, 68, 78, 88, 98])

In [115... mat[:,8]

Out[115... 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]])

In [116... mat[:, -1]

Out[116... array([ 9, 19, 29, 39, 49, 59, 69, 79, 89, 99])

In [117... mat
```

```
Out[117...] 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 [118...] row
```

```
Out[118...] 4
```

```
In [119...] col
```

```
Out[119...] 6
```

```
In [120...] mat[1,4]
```

```
Out[120...] 14
```

```
In [121...] mat[1:4]
```

```
Out[121...] 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 [122...] mat
```

```
Out[122...] 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 [123...] mat[3:-3]
```

```
Out[123...] 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 [124...] mat[0]
```

```
Out[124...] array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])
```

```
In [125...] mat[6]
```

```
Out[125...] array([60, 61, 62, 63, 64, 65, 66, 67, 68, 69])
```

```
In [126...] mat[6:] # print from 60 to end.
```

```
Out[126...] 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 [127...] mat[5:7]
```

```
Out[127...] array([[50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
                  [60, 61, 62, 63, 64, 65, 66, 67, 68, 69]])
```

```
In [128...] mat
```

```
Out[128...] 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 [129.. mat[0:10]

Out[129.. 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 [130.. mat[0:10:3]

Out[130.. 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 [131.. mat[:4]

Out[131.. 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 [132.. mat

Out[132.. 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 [133.. mat[::-1]

Out[133.. array([[90, 91, 92, 93, 94, 95, 96, 97, 98, 99],
                 [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
                 [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
                 [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
                 [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
                 [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
                 [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
                 [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
                 [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
                 [ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9]])

In [134.. mat[::-2]

Out[134.. array([[90, 91, 92, 93, 94, 95, 96, 97, 98, 99],
                 [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
                 [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
                 [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
                 [10, 11, 12, 13, 14, 15, 16, 17, 18, 19]])

In [135.. mat[::-3]

Out[135.. array([[90, 91, 92, 93, 94, 95, 96, 97, 98, 99],
                 [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
                 [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
                 [ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9]])

In [136.. mat[::-5]

Out[136.. array([[90, 91, 92, 93, 94, 95, 96, 97, 98, 99],
                 [40, 41, 42, 43, 44, 45, 46, 47, 48, 49]])

In [137.. mat
```

```
Out[137...] 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 [138...] mat[2:6]
```

```
Out[138...] array([[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 [139...] mat[2:6,2:4] #--->. only row part /// 1:3--- indicates only column parts
```

```
Out[139...] array([[22, 23],
                  [32, 33],
                  [42, 43],
                  [52, 53]])
```

```
In [140...] mat[0,1]
```

```
Out[140...] 1
```

```
In [141...] mat[1,6]
```

```
Out[141...] 16
```

```
In [142...] mat[1:6]
```

```
Out[142...] 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 [143...] mat[1:]
```

```
Out[143...] 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],
                  [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 [144...] mat[:,6]
```

```
Out[144...] 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 [145...] mat[0:1]
```

```
Out[145...] array([[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]])
```

```
In [146...] mat[3:5]
```

```
Out[146...] array([[30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
                  [40, 41, 42, 43, 44, 45, 46, 47, 48, 49]])
```

```
In [147...] mat
```

```
Out[147...] 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 [148...] mat[1:2,2:4] # it should be 12 and 13
```

```
Out[148...] array([[12, 13]])
```

```
In [149...] mat[2:3,2:3]
```

```
Out[149...] array([[22]])
```

```
In [150...] mat[3:5,2:4]
```

```
Out[150...] array([[32, 33],  
                  [42, 43]])
```

```
In [151...] mat[2:3,4:5]
```

```
Out[151...] array([[24]])
```

masking

```
In [152...] mat #we also called as filter
```

```
Out[152...] 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 [153...] id(mat)
```

```
Out[153...] 2970409443344
```

```
In [154...] mat
```

```
Out[154...] 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 [155...] mat < 50
```

```
Out[155...] 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],  
                  [False, False, False, False, False, False, False, False, False,  
                    False]])
```

```
In [156...] mat > 50
```

```
Out[156.. 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, 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 [157.. mat == 50
```

```
Out[157.. 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],
[ 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, False, False, False, False, False, False, False, False,
False]])
```

```
In [158.. mat[mat==50]
```

```
Out[158.. array([50])
```

```
In [159.. array([50])
```

```
Out[159.. array([50])
```

```
In [160.. a1 = mat[mat<50]
a1
```

```
Out[160.. 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 [161.. mat
```

```
Out[161.. 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 [162.. a2=mat[mat>50]
a2
```

```
Out[162.. 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 [163.. a3=mat[mat>=50]
a3
```

```
Out[163... 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 [164... a1
```

```
Out[164... 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 [165... a2
```

```
Out[165... 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 [ ]:
```

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