

Numpy (NUMERICAL PYTHON)

16th nov

```
In [ ]: NUMPY  
npTorch
```

1D 1 DIMENSIONAL ARRAY 2D 2 DIMENSIONAL ARRAYS ND N DIMENSIONAL ARRAY

CREATING ARRAY

18TH NOV (random)

```
In [1]: import numpy as np
```

```
In [2]: np.__version__
```

```
Out[2]: '1.26.4'
```

creating arrays

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

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

```
In [11]: type(mylist)
```

```
Out[11]: list
```

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

```
In [7]: arr
```

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

```
In [8]: type(arr)
```

```
Out[8]: numpy.ndarray
```

```
In [12]: type(mylist)
```

```
Out[12]: list
```

```
In [16]: np.arange(5)
```

```
Out[16]: array([0, 1, 2, 3, 4])
```

```
In [17]: np.arange(3.0)
```

```
Out[17]: array([0., 1., 2.])
```

```
In [18]: np.arange(3.0)
```

```
Out[18]: array([0., 1., 2.])
```

```
In [19]: np.arange(10)
```

```
Out[19]: array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])
```

```
In [20]: np.arange(0.5)
```

```
Out[20]: array([0.])
```

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

```
Out[21]: array([], dtype=int32)
```

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

```
Out[22]: array([-2, -1, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19])
```

```
In [23]: np.arange(10,10)
```

```
Out[23]: array([], dtype=int32)
```

```
In [24]: np.arange(-20,20)
```

```
Out[24]: 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 [26]: b=np.arange(-30,20)
```

```
b
```

```
Out[26]: 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 [27]: np.arange(10,30,5)
```

```
Out[27]: array([10, 15, 20, 25])
```

```
In [28]: np.arange(0,10,3)
```

```
Out[28]: array([0, 3, 6, 9])
```

```
In [29]: np.arange(10,30,5,1)
```

```
-----  
TypeError                                         Traceback (most recent call last)  
Cell In[29], line 1  
----> 1 np.arange(10,30,5,1)  
  
TypeError: Cannot interpret '1' as a data type
```

```
In [30]: b1 = np.zeros(2) #parameter tunning  
b1
```

```
Out[30]: array([0., 0.])
```

```
In [31]: np.zeros(5,dtype=int) #hyperparameter tunning
```

```
Out[31]: array([0, 0, 0, 0, 0])
```

```
In [32]: zero = np.zeros((2,2))  
zero
```

```
Out[32]: array([[0., 0.],  
                 [0., 0.]])
```

```
In [33]: np.zeros((10,10))
```

```
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., 0., 0.],  
                [0., 0., 0., 0., 0., 0., 0., 0., 0., 0.],  
                [0., 0., 0., 0., 0., 0., 0., 0., 0., 0.],  
                [0., 0., 0., 0., 0., 0., 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]: np.zeros((2,10))
```

```
Out[34]: array([[0., 0., 0., 0., 0., 0., 0., 0., 0., 0.],  
                 [0., 0., 0., 0., 0., 0., 0., 0., 0., 0.]])
```

```
In [35]: np.zeros((2,2))
```

```
Out[35]: array([[0., 0.],  
                 [0., 0.]])
```

```
In [37]: np.zeros((3,3))
```

```
Out[37]: array([[0., 0., 0.],  
                 [0., 0., 0.],  
                 [0., 0., 0.]])
```

```
In [38]: np.zeros((5,10)) # bydefaul 1arge -- will give row & 2nd arg - columns
```

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

```
In [39]: n = (5,7)
n1 = (6,8)
print(np.zeros(n)) # parameter tunning
#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 [40]: 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 [41]: np.ones(4,dtype=int)
```

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

```
In [42]: np.ones(4)
```

```
Out[42]: array([1., 1., 1., 1.])
```

```
In [43]: n
```

```
Out[43]: (5, 7)
```

```
In [44]: np.ones(n)
```

```
Out[44]: 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 [45]: np.ones((5,4),dtype=int) # by default 5- rows & 4 - columns
```

```
Out[45]: array([[1, 1, 1, 1],
   [1, 1, 1, 1],
   [1, 1, 1, 1],
   [1, 1, 1, 1],
   [1, 1, 1, 1]])
```

```
In [46]: np.twos((2,3))
```

```
-----  
AttributeError  
Cell In[46], line 1  
----> 1 np.twos((2,3))  
  
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             "{}!".format(__name__, attr))  
  
AttributeError: module 'numpy' has no attribute 'twos'
```

In [47]: `np.ones((2,4))`

Out[47]: `array([[1., 1., 1., 1.],
 [1., 1., 1., 1.]])`

In [48]: `np.ones((6,10),dtype = int)`

Out[48]: `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 []:

In [49]: `rand(3,2)`

```
-----  
NameError  
Cell In[49], line 1  
----> 1 rand(3,2)  
  
NameError: name 'rand' is not defined
```

In []:

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

```
NameError
Cell In[3], line 1
----> 1 rand(3,2)
      2 random.rand(3,2)
```

Traceback (most recent call last)

NameError: name 'rand' is not defined

```
In [8]: import numpy as np # import numpy as np
np.random.rand(3)
```

```
Out[8]: array([0.76138409, 0.49649606, 0.06566276])
```

```
In [9]: np.random.rand(2,4)
```

```
Out[9]: array([[0.09628609, 0.95219587, 0.69269449, 0.25229693],
               [0.48695845, 0.06850299, 0.50473649, 0.72302152]])
```

```
In [12]: np.random.randint(2,4)
```

```
Out[12]: 2
```

```
In [16]: np.random.randint(2,20)
```

```
Out[16]: 16
```

```
In [18]: np.random.randint(0,1)
```

```
Out[18]: 0
```

```
In [19]: np.random.randint(10,20,3)
```

```
Out[19]: array([19, 13, 18])
```

```
In [20]: np.random.randint(1,6,4)
```

```
Out[20]: array([1, 1, 1, 2])
```

```
In [21]: np.random.randint(30,20,10) #high to low
```

```
ValueError
```

Traceback (most recent call last)

```
Cell In[21], line 1
----> 1 np.random.randint(30,20,10)
```

```
File numpy\random\mtrand.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 [62]: np.random.randint(-30,20,10) #cheching of neg value of 1st augment
```

```
Out[62]: array([ 12,  14, -14,    1,   -7, -11,     2, -26,     8,    2])
```

```
In [63]: np.random.randint(10,40,(10,10))
```

```
Out[63]: array([[14, 37, 30, 18, 30, 28, 24, 26, 33, 34],
 [10, 31, 20, 20, 35, 39, 12, 10, 26, 15],
 [28, 24, 37, 31, 29, 23, 27, 10, 16, 17],
 [21, 25, 34, 35, 18, 19, 36, 29, 16, 31],
 [14, 20, 19, 28, 17, 12, 21, 25, 18, 10],
 [26, 25, 23, 31, 30, 30, 14, 33, 33, 12],
 [13, 36, 28, 26, 16, 10, 24, 39, 29, 19],
 [12, 18, 29, 12, 13, 31, 20, 31, 27, 10],
 [25, 20, 19, 27, 39, 33, 37, 20, 32, 24],
 [22, 11, 35, 21, 19, 35, 20, 26, 35, 38]])
```

```
In [64]: np.random.randint(1,100,(12,12))
```

```
Out[64]: array([[29, 59, 83, 76, 56, 63, 10,  9, 99, 51, 34, 36],
 [93, 24, 55, 99, 70, 58, 50, 71, 90, 65, 86, 35],
 [85, 15, 71, 66, 15, 80, 32, 99, 34, 13, 84, 77],
 [21,  5, 83, 97, 36, 10, 74, 74, 25,  7, 30, 21],
 [52,  8, 91, 32, 22, 96, 35, 66, 59, 38, 42, 15],
 [48,  5,  5, 63, 52, 36, 88, 73, 14, 29, 48, 59],
 [28, 87, 52, 13, 15, 94, 93, 11, 98,  4, 90, 30],
 [ 4, 74, 66, 71, 48, 45, 71,  7, 24, 79, 51, 13],
 [82, 52, 94, 57, 40, 82, 33, 52,  3, 47, 88, 16],
 [ 4, 45, 43, 98, 30, 69, 88, 28, 14,  9, 33, 88],
 [14, 41, 67,  1, 52, 11, 83, 28, 16, 68, 10, 64],
 [ 7, 88, 63, 72, 82, 62, 94, 86, 41, 98, 21, 34]])
```

```
In [65]: np.arange(1, 10).reshape(3, 3)
```

```
Out[65]: array([[1, 2, 3],
 [4, 5, 6],
 [7, 8, 9]])
```

```
In [66]: b = np.random.randint(10,20,(5,4))
```

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

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

```
In [68]: type(b)
```

```
Out[68]: numpy.ndarray
```

```
In [69]: b
```

```
Out[69]: array([[18, 19, 17, 12],  
                 [12, 11, 10, 18],  
                 [19, 11, 10, 13],  
                 [12, 19, 18, 14],  
                 [10, 16, 18, 19]])
```

Slicing Indexing In Numpy

```
In [70]: b
```

```
Out[70]: array([[18, 19, 17, 12],  
                 [12, 11, 10, 18],  
                 [19, 11, 10, 13],  
                 [12, 19, 18, 14],  
                 [10, 16, 18, 19]])
```

```
In [71]: b[1:3] #slicing(:) gives row
```

```
Out[71]: array([[12, 11, 10, 18],  
                 [19, 11, 10, 13]])
```

```
In [ ]:
```

```
In [72]: b[0:5]
```

```
Out[72]: array([[18, 19, 17, 12],  
                 [12, 11, 10, 18],  
                 [19, 11, 10, 13],  
                 [12, 19, 18, 14],  
                 [10, 16, 18, 19]])
```

```
In [73]: b[0,2] #(,) gives specific int of matrix
```

```
Out[73]: 17
```

```
In [74]: b
```

```
Out[74]: array([[18, 19, 17, 12],  
                 [12, 11, 10, 18],  
                 [19, 11, 10, 13],  
                 [12, 19, 18, 14],  
                 [10, 16, 18, 19]])
```

```
In [75]: b[1,3]
```

```
Out[75]: 18
```

```
In [76]: b[2:3]
```

```
Out[76]: array([[19, 11, 10, 13]])
```

```
In [77]: b[0:-2]
```

```
Out[77]: array([[18, 19, 17, 12],  
                 [12, 11, 10, 18],  
                 [19, 11, 10, 13]])
```

```
In [78]: b[-5,-3]
```

```
Out[78]: 19
```

```
In [79]: b
```

```
Out[79]: array([[18, 19, 17, 12],  
                 [12, 11, 10, 18],  
                 [19, 11, 10, 13],  
                 [12, 19, 18, 14],  
                 [10, 16, 18, 19]])
```

```
In [80]: b[-4,2]
```

```
Out[80]: 10
```

```
In [81]: np.random.randint(10,20,(4,4))
```

```
Out[81]: array([[19, 10, 18, 14],  
                 [13, 17, 13, 15],  
                 [12, 12, 18, 18],  
                 [14, 11, 10, 18]])
```

```
In [82]: b[-4:2]
```

```
Out[82]: array([[12, 11, 10, 18]])
```

Operations

```
In [83]: a = np.random.randint(10,20,10)  
a
```

```
Out[83]: array([10, 19, 19, 12, 18, 18, 15, 15, 14, 15])
```

```
In [84]: id(a)
```

```
Out[84]: 1662638604080
```

```
In [85]: arr2=np.random.randint(0,10,(10,10))
```

```
In [111... arr2
```

```
Out[111]: array([[2, 2, 1, 0, 4, 6, 8, 3, 4, 1],  
                  [0, 5, 1, 4, 4, 3, 7, 3, 2, 1],  
                  [5, 0, 2, 8, 0, 9, 7, 6, 5, 9],  
                  [7, 8, 1, 5, 9, 9, 5, 3, 7, 1],  
                  [4, 4, 7, 7, 2, 0, 9, 5, 3, 4],  
                  [8, 9, 5, 7, 4, 1, 7, 6, 1, 0],  
                  [2, 4, 1, 4, 7, 9, 4, 1, 9, 3],  
                  [2, 1, 7, 7, 1, 4, 6, 5, 5, 1],  
                  [4, 7, 2, 8, 3, 3, 2, 1, 6, 9],  
                  [2, 0, 1, 9, 5, 8, 9, 2, 8, 2]])
```

```
In [112]: arr2[::-1]
```

```
Out[112]: array([[2, 0, 1, 9, 5, 8, 9, 2, 8, 2],  
                  [4, 7, 2, 8, 3, 3, 2, 1, 6, 9],  
                  [2, 1, 7, 7, 1, 4, 6, 5, 5, 1],  
                  [2, 4, 1, 4, 7, 9, 4, 1, 9, 3],  
                  [8, 9, 5, 7, 4, 1, 7, 6, 1, 0],  
                  [4, 4, 7, 7, 2, 0, 9, 5, 3, 4],  
                  [7, 8, 1, 5, 9, 9, 5, 3, 7, 1],  
                  [5, 0, 2, 8, 0, 9, 7, 6, 5, 9],  
                  [0, 5, 1, 4, 3, 7, 3, 2, 1],  
                  [2, 2, 1, 0, 4, 6, 8, 3, 4, 1]])
```

```
In [114]: arr2[::-2]
```

```
Out[114]: array([[2, 0, 1, 9, 5, 8, 9, 2, 8, 2],  
                  [2, 1, 7, 7, 1, 4, 6, 5, 5, 1],  
                  [8, 9, 5, 7, 4, 1, 7, 6, 1, 0],  
                  [7, 8, 1, 5, 9, 9, 5, 3, 7, 1],  
                  [0, 5, 1, 4, 3, 7, 3, 2, 1]])
```

```
In [113]: arr2[-5,5]
```

```
Out[113]: 1
```

```
In [89]: arr2[-5,-5]
```

```
Out[89]: 1
```

```
In [90]: arr2[:-3]
```

```
Out[90]: array([[2, 2, 1, 0, 4, 6, 8, 3, 4, 1],  
                  [0, 5, 1, 4, 4, 3, 7, 3, 2, 1],  
                  [5, 0, 2, 8, 0, 9, 7, 6, 5, 9],  
                  [7, 8, 1, 5, 9, 9, 5, 3, 7, 1],  
                  [4, 4, 7, 7, 2, 0, 9, 5, 3, 4],  
                  [8, 9, 5, 7, 4, 1, 7, 6, 1, 0],  
                  [2, 4, 1, 4, 7, 9, 4, 1, 9, 3]])
```

```
In [91]: arr2.max()
```

```
Out[91]: 9
```

```
In [92]: arr2.mean()
```

```
Out[92]: 4.34
```

```
In [93]: arr2.median()
```

```
-----  
AttributeError  
Cell In[93], line 1  
----> 1 arr2.median()
```

Traceback (most recent call last)

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

```
In [100... >>> from numpy import *  
>>> a = array([1,2,3,4,9])  
>>> median(a)
```

```
Out[100... 3.0
```

```
In [97]: arr
```

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

```
In [96]: arr.reshape(2,3)
```

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

```
In [101... arr.reshape(6,1)
```

```
Out[101... array([[0],  
                  [1],  
                  [2],  
                  [3],  
                  [4],  
                  [5]])
```

```
In [105... arr.reshape(1,6)
```

```
Out[105... array([[0, 1, 2, 3, 4, 5]])
```

```
In [106... arr
```

```
Out[106... array([0, 1, 2, 3, 4, 5])
```

```
In [107... arr.reshape(1,5)
```

```
-----  
ValueError  
Cell In[107], line 1  
----> 1 arr.reshape(1,5)
```

Traceback (most recent call last)

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

```
In [108... arr.reshape(3,2,order='C')
```

```
Out[108... array([[0, 1],  
                  [2, 3],  
                  [4, 5]])
```

```
In [109... arr.reshape(3,2,order='F')
```

```
Out[109... array([[0, 3],  
                  [1, 4],  
                  [2, 5]])
```

```
In [117... arr.reshape(3,2,order='a')
```

```
Out[117... array([[0, 1],  
                  [2, 3],  
                  [4, 5]])
```

```
In [118... arr.reshape(3,2,order='k')
```

```
-----  
ValueError
```

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

```
Cell In[118], line 1
```

```
----> 1 arr.reshape(3,2,order='k')
```

```
ValueError: order 'K' is not permitted for reshaping
```

```
In [119... arr
```

```
Out[119... array([0, 1, 2, 3, 4, 5])
```

```
In [ ]:
```

```
In [122... [:,3]
```

```
Cell In[122], line 1
```

```
[ :,3]
```

```
^
```

```
SyntaxError: invalid syntax
```

```
In [123... arr.reshape(1,6)
```

```
Out[123... array([[0, 1, 2, 3, 4, 5]])
```

```
In [124... arr.reshape(6,1)
```

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

```
In [125... arr.reshape(2,6)
```

```
-----  
ValueError  
Cell In[125], line 1  
----> 1 arr.reshape(2,6)  
  
ValueError: cannot reshape array of size 6 into shape (2,6)
```

```
In [127... arr.reshape(3,2)
```

```
Out[127... array([[0, 1],  
                  [2, 3],  
                  [4, 5]])
```

Indexing

```
In [128... mat = np.arange(0,100).reshape(10,10)
```

```
In [130... mat
```

```
Out[130... 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 [131... row = 4  
col = 5
```

```
In [132... col
```

```
Out[132... 5
```

```
In [ ]: row
```

```
In [133... mat
```

```
Out[133... 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 [134... mat[row,col]
```

```
Out[134... 45
```

```
In [135... mat[4,5]
```

```
Out[135... 45
```

```
In [136... mat
```

```
Out[136... 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 [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... col = 6
```

```
In [139... mat
```

```
Out[139... 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 [140... # With Slices
mat[:,col]
```

```
Out[140... array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])
```

```
In [141... mat
```

```
Out[141... 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 [142... mat[row,:]
```

```
Out[142... array([40, 41, 42, 43, 44, 45, 46, 47, 48, 49])
```

```
In [143... mat
```

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

```
Out[144... array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])
```

```
In [145... mat[:col]
```

```
Out[145... 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 [146... row
```

```
Out[146... 4
```

```
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[:row]
```

```
Out[148... 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 [149... mat[row:]
```

```
Out[149... 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 [150... mat[:,8]
```

```
Out[150... array([ 8, 18, 28, 38, 48, 58, 68, 78, 88, 98])
```

```
In [151... mat
```

```
Out[151... 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 [152... mat[:, -1]
```

```
Out[152... array([ 9, 19, 29, 39, 49, 59, 69, 79, 89, 99])
```

```
In [153... mat
```

```
Out[153... 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 [154... row
```

```
Out[154... 4
```

```
In [155... col
```

```
Out[155... 6
```

```
In [156... mat[:,col]
```

```
Out[156... array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])
```

```
In [157... mat[1,4]
```

```
Out[157... 14
```

```
In [158... mat[1:4]
```

```
Out[158... 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 [159... mat[3:-3]
```

```
Out[159... 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 [160... mat
```

```
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],
   [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 [161... mat[0]
```

```
Out[161... array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])
```

```
In [163... mat[6]
```

```
Out[163... array([60, 61, 62, 63, 64, 65, 66, 67, 68, 69])
```

```
In [164... mat[6:]
```

```
Out[164... 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 [165... mat[:6]
```

```
Out[165... 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 [166... mat
```

```
Out[166... 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 [168... mat[5:7]
```

```
Out[168... array([[50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
                  [60, 61, 62, 63, 64, 65, 66, 67, 68, 69]])
```

```
In [169... mat[0:10]
```

```
Out[169... 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 [170... mat[0:10:3]
```

```
Out[170... 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 [171... mat[0:10]
```

```
Out[171... 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 [173... mat[4:]
```

```
Out[173... 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 [174... mat[:4]
```

```
Out[174... 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 [175... mat[::-1]
```

```
Out[175... 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 [176... mat[::-2]
```

```
Out[176... 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 [177... mat[::-3]
```

```
Out[177... 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 [178... mat[:::-5]

```
Out[178... array([[90, 91, 92, 93, 94, 95, 96, 97, 98, 99],
   [40, 41, 42, 43, 44, 45, 46, 47, 48, 49]])
```

In [179... mat[2:6]

```
Out[179... 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 [180... mat[2:6,2:4] # 1:5 --> only row part /// 1:3 -- it indicates only column parts

```
Out[180... array([[22, 23],
   [32, 33],
   [42, 43],
   [52, 53]])
```

In [181... mat

```
Out[181... 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 [182... mat[0,1]

```
Out[182... 1
```

In [183... mat[1,6]

```
Out[183... 16
```

In [184... mat[1:6]

```
Out[184... 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 [185... mat[:1]

```
Out[185... array([[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]])
```

```
In [186... mat[:6]
```

```
Out[186... 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 [187... mat[0:1]
```

```
Out[187... array([[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]])
```

```
In [193... mat[3:5]
```

```
Out[193... array([[30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
                  [40, 41, 42, 43, 44, 45, 46, 47, 48, 49]])
```

```
In [188... mat[3,5]
```

```
Out[188... 35
```

```
In [189... mat[1:2,2:4]
```

```
Out[189... array([[12, 13]])
```

```
In [191... mat[2:3,2:3]
```

```
Out[191... array([[22]])
```

```
In [192... mat[3:5,2:4]
```

```
Out[192... array([[32, 33],
                  [42, 43]])
```

```
In [194... mat[2:3,4:5]
```

```
Out[194... array([[24]])
```

Masking

```
In [195... mat #also called as filter
```

```
Out[195... 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 [196... id(mat)
```

```
Out[196... 1662639208272
```

```
In [197... mat<50
```

```
Out[197... 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],
   [ 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 [198... mat == 50
```

```
In [199]: mat[mat==50]
```

```
Out[199... array([50])
```

```
In [202]: a1 = mat[mat<50]  
a1
```

```
Out[202... 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 [204]: a2 = mat[mat>50]  
a2
```

```
Out[204...]: 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 [205]: a3 = mat[mat>=50]
```

In 「206... a3

```
Out[206...]: 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 [207...]: a4 = mat[mat==50]  
a4
```

```
Out[207... array([50])
```

In 「208... mat>50

```
Out[208... 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, 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 [209... a1

```
Out[209... 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 [210... a2

```
Out[210... 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 []: