

Numpy Crash Course

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

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

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

Creating Arrays

```
In [3]: my_list = [0,1,2,3,4,5,6,7]
my_list
```

```
Out[3]: [0, 1, 2, 3, 4, 5, 6, 7]
```

```
In [4]: type(my_list)
```

```
Out[4]: list
```

```
In [5]: arr = np.array(my_list)
```

```
In [6]: arr
```

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

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

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

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

```
Out[7]: list
```

```
In [9]: np.arange(5)
```

```
Out[9]: array([0, 1, 2, 3, 4])
```

```
In [10]: np.arange(3.0)
```

```
Out[10]: array([0., 1., 2.])
```

```
In [11]: np.arange(0,5)
```

```
Out[11]: array([0, 1, 2, 3, 4])
```

```
In [12]: np.arange(10,20)
```

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

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

```
Out[13]: 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 [14]: np.arange(-16,10)
```

```
Out[14]: array([-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)
```

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

```
In [18]: b = np.arange(-30,20)
b
```

```
Out[18]: 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 [19]: np.arange(10,20,5) # 10- starting from 30- end point 5 - step count
```

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

```
In [20]: np.arange(0,10,3)
```

```
Out[20]: array([0, 3, 6, 9])
```

```
In [21]: np.arange(10,30,5,1)
```

```
-----  
TypeError                                                 Traceback (most recent call last)  
Cell In[21], line 1  
----> 1 np.arange(10,30,5,1)  
  
TypeError: Cannot interpret '1' as a data type
```

```
In [22]: b1 = np.zeros(2) # parameter tuning  
b1
```

```
Out[22]: array([0., 0.])
```

```
In [23]: np.zeros(5,dtype=int) #hyperparameter tuning
```

```
Out[23]: array([0, 0, 0, 0, 0])
```

```
In [24]: zero = np.zeros((2,2))
```

```
In [25]: zero
```

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

```
In [26]: np.zeros((10,10))
```

```
Out[26]: 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 [27]: np.zeros((2,10))
```

```
Out[27]: array([[0., 0., 0., 0., 0., 0., 0., 0., 0., 0.],
   [0., 0., 0., 0., 0., 0., 0., 0., 0., 0.]])
```

```
In [28]: np.zeros((3,3,))
```

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

```
In [29]: np.zeros((10,40))
```

```
In [30]: np.zeros((5,10)) # by default large -- will give row & 2nd arg - columns
```

```
Out[30]: 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 [31]: 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 [32]: `np.ones(n)`

```
Out[32]: 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 [33]: `np.ones((5,4),dtype=int) # by default 5- rows & 4 - columns`

```
Out[33]: array([[1, 1, 1, 1],  
 [1, 1, 1, 1],  
 [1, 1, 1, 1],  
 [1, 1, 1, 1],  
 [1, 1, 1, 1]])
```

In [34]: `np.twos((2,3))`

```
-----  
AttributeError                                                 Traceback (most recent call last)  
Cell In[34], line 1  
----> 1 np.twos((2,3))  
  
File C:\ProgramData\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 [35]: `np.ones((2,4))`

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

```
In [36]: np.ones((6,10),dtype = int)
```

```
Out[36]: 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 [37]: np.twos((2,4))
```

```
-----
AttributeError                                     Traceback (most recent call last)
Cell In[37], line 1
----> 1 np.twos((2,4))

File C:\ProgramData\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 [38]: np.three((2,4))
```

```
-----
AttributeError                                     Traceback (most recent call last)
Cell In[38], line 1
----> 1 np.three((2,4))

File C:\ProgramData\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'
```

Please add new notebook & compare with np &*

```
In [39]: np.arange(3)
```

```
Out[39]: array([0, 1, 2])
```

```
In [40]: from numpy import * # internally it called all 217 functionality
arange(3)
```

```
Out[40]: array([0, 1, 2])
```

```
In [41]: zeros(5)
```

```
Out[41]: array([0., 0., 0., 0., 0.])
```

```
In [42]: >>> from numpy import *
>>> arange(3)
```

```
Out[42]: array([0, 1, 2])
```

```
In [43]: range(12)
list(range(12))
```

```
Out[43]: [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11]
```

```
In [44]: y = list(range(12))
y
```

```
Out[44]: [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11]
```

```
In [46]: >>> from numpy import *
>>> zeros(5)
```

```
Out[46]: array([0., 0., 0., 0., 0.])
```

```
In [47]: np.threes((3,2))
```

```
-----  
AttributeError Traceback (most recent call last)  
Cell In[47], line 1  
----> 1 np.threes((3,2))  
  
File C:\ProgramData\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 'threes'
```

```
In [48]: rand(3,2)  
random.rand(3,2)
```

```
-----  
NameError Traceback (most recent call last)  
Cell In[48], line 1  
----> 1 rand(3,2)  
      2 random.rand(3,2)  
  
NameError: name 'rand' is not defined
```

```
In [49]: np.random.rand(4)
```

```
Out[49]: array([0.93296542, 0.64292056, 0.43103479, 0.12049579])
```

```
In [50]: np.rand(4)
```

```
-----  
AttributeError                                 Traceback (most recent call last)  
Cell In[50], line 1  
----> 1 np.rand(4)  
  
File C:\ProgramData\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 'rand'
```

```
In [51]: np.random.rand(2,4)
```

```
Out[51]: array([[0.99636371, 0.26092035, 0.37518806, 0.78388532],  
                 [0.02366728, 0.30365643, 0.04147799, 0.21929348]])
```

```
In [52]: np.random.randint(0,2)
```

```
Out[52]: 0
```

```
In [53]: np.random.randint(1,3,5)
```

```
Out[53]: array([1, 1, 2, 2, 2])
```

```
In [54]: np.random.randint(30,20,10)
```

```
-----  
ValueError                                 Traceback (most recent call last)  
Cell In[54], 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 [55]: np.random.randint(1)
```

```
Out[55]: 0
```

```
In [56]: np.random.randint(5,9) #GET THE VALUE <=1 & >=5
```

```
Out[56]: 6
```

```
In [57]: np.random.randint(10,21,3)
```

```
Out[57]: array([17, 20, 14])
```

```
In [58]: np.random.randint(1,12,10)
```

```
Out[58]: array([10, 7, 4, 10, 11, 9, 2, 8, 11, 2])
```

```
In [59]: np.random.randint(10,40,(10,10)) #generre the element 10 -30 with 4*4 mtri
```

```
Out[59]: array([[36, 20, 31, 17, 13, 37, 19, 18, 11, 24],  
                [17, 38, 18, 25, 11, 36, 23, 32, 16, 30],  
                [16, 18, 37, 30, 12, 35, 37, 21, 15, 19],  
                [18, 25, 13, 39, 16, 38, 21, 30, 30, 27],  
                [13, 37, 35, 29, 34, 39, 22, 10, 35, 28],  
                [22, 17, 26, 39, 31, 38, 16, 34, 12, 28],  
                [10, 37, 39, 27, 30, 37, 12, 35, 29, 28],  
                [23, 12, 31, 25, 23, 13, 18, 22, 23, 19],  
                [14, 22, 19, 18, 33, 32, 36, 35, 10, 35],  
                [13, 18, 16, 21, 22, 30, 22, 35, 21, 20]])
```

```
In [60]: b = np.random.randint(10,20,(5,4))  
b
```

```
Out[60]: array([[15, 19, 10, 19],  
                 [17, 14, 19, 13],  
                 [15, 13, 13, 13],  
                 [18, 19, 11, 12],  
                 [19, 18, 10, 14]])
```

```
In [61]: b[:]
```

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

```
In [62]: b[0:2]
```

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

```
In [63]: b[0:-1]
```

```
Out[63]: array([[15, 19, 10, 19],  
                 [17, 14, 19, 13],  
                 [15, 13, 13, 13],  
                 [18, 19, 11, 12]])
```

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

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

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

```
Out[65]: 10
```

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

```
Out[66]: array([[17, 14, 13, 19],  
                 [15, 11, 16, 16],  
                 [19, 18, 16, 16],  
                 [10, 14, 11, 17]])
```

Operations

```
In [67]: a = np.random.randint(10,20,5)
a
```

```
Out[67]: array([11, 12, 18, 15, 12])
```

```
In [68]: arr
```

```
Out[68]: array([0, 1, 2, 3, 4, 5, 6, 7])
```

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

```
In [71]: arr2
```

```
Out[71]: array([[45, 65, 67, 43, 4, 10, 84, 49, 20, 42],
 [74, 80, 60, 97, 34, 49, 83, 31, 75, 46],
 [49, 86, 25, 84, 63, 12, 92, 59, 81, 34],
 [ 9, 59, 66, 1, 84, 21, 28, 70, 81, 52],
 [62, 46, 2, 50, 0, 24, 1, 76, 71, 17],
 [34, 36, 61, 30, 91, 33, 83, 3, 30, 59],
 [17, 8, 15, 68, 1, 4, 94, 9, 5, 71],
 [97, 69, 31, 8, 48, 87, 19, 97, 40, 29],
 [70, 53, 54, 98, 30, 86, 47, 24, 50, 99],
 [77, 14, 40, 19, 49, 83, 31, 16, 53, 57]])
```

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

```
Out[72]: array([0, 1, 2, 3, 4, 5, 6, 7])
```

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

```
Out[73]: array([0, 1, 2, 3, 4, 5, 6, 7])
```

```
In [74]: arr[:4]
```

```
Out[74]: array([0, 1, 2, 3])
```

```
In [75]: arr2[:]
```

```
Out[75]: array([[45, 65, 67, 43, 4, 10, 84, 49, 20, 42],  
   [74, 80, 60, 97, 34, 49, 83, 31, 75, 46],  
   [49, 86, 25, 84, 63, 12, 92, 59, 81, 34],  
   [ 9, 59, 66, 1, 84, 21, 28, 70, 81, 52],  
   [62, 46, 2, 50, 0, 24, 1, 76, 71, 17],  
   [34, 36, 61, 30, 91, 33, 83, 3, 30, 59],  
   [17, 8, 15, 68, 1, 4, 94, 9, 5, 71],  
   [97, 69, 31, 8, 48, 87, 19, 97, 40, 29],  
   [70, 53, 54, 98, 30, 86, 47, 24, 50, 99],  
   [77, 14, 40, 19, 49, 83, 31, 16, 53, 57]])
```

```
In [76]: arr2[0:5]
```

```
Out[76]: array([[45, 65, 67, 43, 4, 10, 84, 49, 20, 42],  
   [74, 80, 60, 97, 34, 49, 83, 31, 75, 46],  
   [49, 86, 25, 84, 63, 12, 92, 59, 81, 34],  
   [ 9, 59, 66, 1, 84, 21, 28, 70, 81, 52],  
   [62, 46, 2, 50, 0, 24, 1, 76, 71, 17]])
```

```
In [77]: arr2
```

```
Out[77]: array([[45, 65, 67, 43, 4, 10, 84, 49, 20, 42],  
   [74, 80, 60, 97, 34, 49, 83, 31, 75, 46],  
   [49, 86, 25, 84, 63, 12, 92, 59, 81, 34],  
   [ 9, 59, 66, 1, 84, 21, 28, 70, 81, 52],  
   [62, 46, 2, 50, 0, 24, 1, 76, 71, 17],  
   [34, 36, 61, 30, 91, 33, 83, 3, 30, 59],  
   [17, 8, 15, 68, 1, 4, 94, 9, 5, 71],  
   [97, 69, 31, 8, 48, 87, 19, 97, 40, 29],  
   [70, 53, 54, 98, 30, 86, 47, 24, 50, 99],  
   [77, 14, 40, 19, 49, 83, 31, 16, 53, 57]])
```

```
In [78]: arr2[1,5]
```

```
Out[78]: 49
```

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

```
Out[79]: array([[45, 65, 67, 43, 4, 10, 84, 49, 20, 42],  
                 [74, 80, 60, 97, 34, 49, 83, 31, 75, 46],  
                 [49, 86, 25, 84, 63, 12, 92, 59, 81, 34],  
                 [ 9, 59, 66, 1, 84, 21, 28, 70, 81, 52],  
                 [62, 46, 2, 50, 0, 24, 1, 76, 71, 17],  
                 [34, 36, 61, 30, 91, 33, 83, 3, 30, 59],  
                 [17, 8, 15, 68, 1, 4, 94, 9, 5, 71],  
                 [97, 69, 31, 8, 48, 87, 19, 97, 40, 29],  
                 [70, 53, 54, 98, 30, 86, 47, 24, 50, 99],  
                 [77, 14, 40, 19, 49, 83, 31, 16, 53, 57]])
```

```
In [80]: arr2[-5,5]
```

```
Out[80]: 33
```

```
In [81]: arr2[-5,-5]
```

```
Out[81]: 33
```

```
In [82]: arr2
```

```
Out[82]: array([[45, 65, 67, 43, 4, 10, 84, 49, 20, 42],  
                 [74, 80, 60, 97, 34, 49, 83, 31, 75, 46],  
                 [49, 86, 25, 84, 63, 12, 92, 59, 81, 34],  
                 [ 9, 59, 66, 1, 84, 21, 28, 70, 81, 52],  
                 [62, 46, 2, 50, 0, 24, 1, 76, 71, 17],  
                 [34, 36, 61, 30, 91, 33, 83, 3, 30, 59],  
                 [17, 8, 15, 68, 1, 4, 94, 9, 5, 71],  
                 [97, 69, 31, 8, 48, 87, 19, 97, 40, 29],  
                 [70, 53, 54, 98, 30, 86, 47, 24, 50, 99],  
                 [77, 14, 40, 19, 49, 83, 31, 16, 53, 57]])
```

```
In [83]: arr2[-5]
```

```
Out[83]: array([34, 36, 61, 30, 91, 33, 83, 3, 30, 59])
```

```
In [84]: arr2[-1,-2]
```

```
Out[84]: 53
```

```
In [85]: arr2
```

```
Out[85]: array([[45, 65, 67, 43, 4, 10, 84, 49, 20, 42],  
 [74, 80, 60, 97, 34, 49, 83, 31, 75, 46],  
 [49, 86, 25, 84, 63, 12, 92, 59, 81, 34],  
 [ 9, 59, 66, 1, 84, 21, 28, 70, 81, 52],  
 [62, 46, 2, 50, 0, 24, 1, 76, 71, 17],  
 [34, 36, 61, 30, 91, 33, 83, 3, 30, 59],  
 [17, 8, 15, 68, 1, 4, 94, 9, 5, 71],  
 [97, 69, 31, 8, 48, 87, 19, 97, 40, 29],  
 [70, 53, 54, 98, 30, 86, 47, 24, 50, 99],  
 [77, 14, 40, 19, 49, 83, 31, 16, 53, 57]])
```

```
In [86]: arr2[::-1]
```

```
Out[86]: array([[77, 14, 40, 19, 49, 83, 31, 16, 53, 57],  
 [70, 53, 54, 98, 30, 86, 47, 24, 50, 99],  
 [97, 69, 31, 8, 48, 87, 19, 97, 40, 29],  
 [17, 8, 15, 68, 1, 4, 94, 9, 5, 71],  
 [34, 36, 61, 30, 91, 33, 83, 3, 30, 59],  
 [62, 46, 2, 50, 0, 24, 1, 76, 71, 17],  
 [ 9, 59, 66, 1, 84, 21, 28, 70, 81, 52],  
 [49, 86, 25, 84, 63, 12, 92, 59, 81, 34],  
 [74, 80, 60, 97, 34, 49, 83, 31, 75, 46],  
 [45, 65, 67, 43, 4, 10, 84, 49, 20, 42]])
```

```
In [87]: arr2
```

```
Out[87]: array([[45, 65, 67, 43, 4, 10, 84, 49, 20, 42],  
 [74, 80, 60, 97, 34, 49, 83, 31, 75, 46],  
 [49, 86, 25, 84, 63, 12, 92, 59, 81, 34],  
 [ 9, 59, 66, 1, 84, 21, 28, 70, 81, 52],  
 [62, 46, 2, 50, 0, 24, 1, 76, 71, 17],  
 [34, 36, 61, 30, 91, 33, 83, 3, 30, 59],  
 [17, 8, 15, 68, 1, 4, 94, 9, 5, 71],  
 [97, 69, 31, 8, 48, 87, 19, 97, 40, 29],  
 [70, 53, 54, 98, 30, 86, 47, 24, 50, 99],  
 [77, 14, 40, 19, 49, 83, 31, 16, 53, 57]])
```

```
In [88]: arr2[::-2]
```

```
Out[88]: array([[77, 14, 40, 19, 49, 83, 31, 16, 53, 57],  
                 [97, 69, 31, 8, 48, 87, 19, 97, 40, 29],  
                 [34, 36, 61, 30, 91, 33, 83, 3, 30, 59],  
                 [ 9, 59, 66, 1, 84, 21, 28, 70, 81, 52],  
                 [74, 80, 60, 97, 34, 49, 83, 31, 75, 46]])
```

```
In [89]: arr2
```

```
Out[89]: array([[45, 65, 67, 43, 4, 10, 84, 49, 20, 42],  
                  [74, 80, 60, 97, 34, 49, 83, 31, 75, 46],  
                  [49, 86, 25, 84, 63, 12, 92, 59, 81, 34],  
                  [ 9, 59, 66, 1, 84, 21, 28, 70, 81, 52],  
                  [62, 46, 2, 50, 0, 24, 1, 76, 71, 17],  
                  [34, 36, 61, 30, 91, 33, 83, 3, 30, 59],  
                  [17, 8, 15, 68, 1, 4, 94, 9, 5, 71],  
                  [97, 69, 31, 8, 48, 87, 19, 97, 40, 29],  
                  [70, 53, 54, 98, 30, 86, 47, 24, 50, 99],  
                  [77, 14, 40, 19, 49, 83, 31, 16, 53, 57]])
```

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

```
Out[90]: array([[77, 14, 40, 19, 49, 83, 31, 16, 53, 57],  
                  [17, 8, 15, 68, 1, 4, 94, 9, 5, 71],  
                  [ 9, 59, 66, 1, 84, 21, 28, 70, 81, 52],  
                  [45, 65, 67, 43, 4, 10, 84, 49, 20, 42]])
```

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

```
Out[91]: array([0, 1, 2, 3, 4, 5, 6, 7])
```

```
In [93]: arr.max()
```

```
Out[93]: 7
```

```
In [94]: arr.min()
```

```
Out[94]: 0
```

```
In [95]: arr
```

```
Out[95]: array([0, 1, 2, 3, 4, 5, 6, 7])
```

```
In [96]: arr.mean()
```

```
Out[96]: 3.5
```

```
In [97]: arr.median()
```

```
-----  
AttributeError  
Cell In[97], line 1  
----> 1 arr.median()
```

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

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

```
In [98]: >>> from numpy import *  
>>> a = array([1,2,3,4,9])  
>>> median(a)
```

```
Out[98]: 3.0
```

```
In [99]: arr
```

```
Out[99]: array([0, 1, 2, 3, 4, 5, 6, 7])
```

```
In [106...]: arr.reshape(2,4)
```

```
Out[106...]: array([[0, 1, 2, 3],  
                   [4, 5, 6, 7]])
```

```
In [108...]: arr.reshape(8,1)
```

```
Out[108...]: array([[0],  
                   [1],  
                   [2],  
                   [3],  
                   [4],  
                   [5],  
                   [6],  
                   [7]])
```

```
In [110... arr.reshape(1,8)
```

```
Out[110... array([[0, 1, 2, 3, 4, 5, 6, 7]])
```

```
In [111... arr
```

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

```
In [112... arr.reshape(1,7)
```

```
-----  
ValueError  
Cell In[112], line 1  
----> 1 arr.reshape(1,7)
```

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

```
ValueError: cannot reshape array of size 8 into shape (1,7)
```

```
In [114... arr.reshape(4,2,order='C')
```

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

```
In [115... arr.reshape(4,2,order='A')
```

```
Out[115... array([[0, 1],  
                  [2, 3],  
                  [4, 5],  
                  [6, 7]])
```

```
In [116... arr.reshape(4,2,order='K')
```

```
-----  
ValueError  
Cell In[116], line 1  
----> 1 arr.reshape(4,2,order='K')
```

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

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

```
In [117... arr
```

```
Out[117... array([0, 1, 2, 3, 4, 5, 6, 7])
```

```
In [119... arr.reshape(2,4)
```

```
Out[119... array([[0, 1, 2, 3],  
                  [4, 5, 6, 7]])
```

```
In [120... arr.reshape(1,4)
```

ValueError

Traceback (most recent call last)

Cell In[120], line 1
----> 1 arr.reshape(1,4)

ValueError: cannot reshape array of size 8 into shape (1,4)

```
In [121... arr.reshape(1,8)
```

```
Out[121... array([[0, 1, 2, 3, 4, 5, 6, 7]])
```

```
In [123... arr.reshape(8,1)
```

```
Out[123... array([[0],  
                  [1],  
                  [2],  
                  [3],  
                  [4],  
                  [5],  
                  [6],  
                  [7]])
```

```
In [124... arr.reshape(2,4)
```

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

```
In [125... arr
```

```
Out[125... array([0, 1, 2, 3, 4, 5, 6, 7])
```

Indexing

```
In [126...]: mat = np.arange(0,100).reshape(10,10)
```

```
In [127...]: mat
```

```
Out[127...]: 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 [128...]: row = 4
```

```
In [129...]: col=5
```

```
In [130...]: col
```

```
Out[130...]: 5
```

```
In [131...]: row
```

```
Out[131...]: 4
```

```
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[row,col]
```

```
Out[133... 45
```

```
In [134... mat[4,5]
```

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

```
In [135... mat
```

```
Out[135... 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 [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... col = 6
```

```
In [138... mat
```

```
Out[138... 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 [139... # With slices
mat[:,col]
```

```
Out[139... array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])
```

```
In [140... mat
```

```
Out[140... 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 [141... mat[row,:]
```

```
Out[141... array([40, 41, 42, 43, 44, 45, 46, 47, 48, 49])
```

```
In [142... mat
```

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

```
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]])
```

```
In [144... mat[:,col]
```

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

```
In [145... row
```

```
Out[145... 4
```

```
In [146... mat
```

```
Out[146... 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 [147... mat[:row]
```

```
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]])
```

```
In [148... mat[row:]
```

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

```
Out[149... 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 [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[1,4]
```

```
Out[156... 14
```

```
In [157... mat
```

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

```
Out[159]: 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 [160]: mat[3:-3]
```

```
Out[160]: 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 [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]: mat[0]
```

```
Out[162]: 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
```

```
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],
   [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 [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[6:]
```

```
Out[166... 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 [167... mat
```

```
Out[167... 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
```

```
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]
```

```
Out[170... 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 [172... mat[0:10:3]
```

```
Out[172... 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 [173... mat[0:10]
```

```
Out[173... 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 [174... mat
```

```
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],
   [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 [175... mat[4:]
```

```
Out[175... 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 [176... mat
```

```
Out[176... 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 [177... mat[4:]
```

```
Out[177... 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 [178... mat
```

```
Out[178... 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 [179... mat[:4]
```

```
Out[179... 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 [182... mat[4:]
```

```
Out[182... 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 [183... mat
```

```
Out[183... 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 [184... mat[::-1]
```

```
Out[184... 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 [185... mat[::-3]
```

```
Out[185... 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 [186... mat
```

```
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],
   [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 [187... mat[2:6]
```

```
Out[187... 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 [188... mat
```

```
Out[188... 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 [189... mat[2:6,2:4] # 1:5 --> only row part /// 1:3 -- it indicates only column parts
```

```
Out[189... array([[22, 23],
   [32, 33],
   [42, 43],
   [52, 53]])
```

```
In [190... mat
```

```
Out[190... 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 [191... mat[0,1]
```

```
Out[191... 1
```

```
In [192... mat[1,6]
```

```
Out[192... 16
```

```
In [193... mat
```

```
Out[193... 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 [194... mat[1:6]
```

```
Out[194... 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 [195... mat[1:]
```

```
Out[195... 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 [196... mat[:6]
```

```
Out[196... 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 [197... mat[0:1]
```

```
Out[197... array([[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]])
```

```
In [198... mat
```

```
Out[198... 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 [199... mat[3:5]
```

```
Out[199... array([[30, 31, 32, 33, 34, 35, 36, 37, 38, 39],  
   [40, 41, 42, 43, 44, 45, 46, 47, 48, 49]])
```

```
In [200... mat[3,5]
```

```
Out[200... 35
```

```
In [201... mat
```

```
Out[201... 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 [202... mat[1:2,2:4]
```

```
Out[202... array([[12, 13]])
```

```
In [203... mat
```

```
Out[203... 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 [204... mat[2:3,2:3]
```

```
Out[204... array([[22]])
```

```
In [205... mat
```

```
Out[205... 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 [206... mat[3:5,2:4]
```

```
Out[206... array([[32, 33],
   [42, 43]])
```

```
In [207... mat
```

```
Out[207... 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 [208... mat[2:3,4:5]
```

```
Out[208... array([[24]])
```

Masking

```
In [210... mat # We also called as filter
```

```
Out[210... 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 [211... id(mat)
```

```
Out[211... 2697716247760
```

```
In [212... mat
```

```
Out[212... 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 [213... mat < 50
```

```
Out[213... 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],
       [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 [214... mat > 50
```

```
Out[214... 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]]))
```

```
In [215... mat == 50
```

```
Out[215... 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, 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, False, False,
       False]]))
```

```
In [216... mat[mat==50]
```

```
Out[216... array([50])
```

```
In [217... a1 = mat[mat<50]
a1
```

```
Out[217... 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 [218... mat
```

```
Out[218]: 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 [219]: a2 = mat[mat>50]
a2
```

```
Out[219]: 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 [220]: a3 = mat[mat>=50]
a3
```

```
Out[220]: 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 [221]: a4 = mat[mat==50]
a4
```

```
Out[221]: array([50])
```

```
In [222]: mat>50
```

```
Out[222... 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]]))
```

```
In [223... a1
```

```
Out[223... 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 [224... a2
```

```
Out[224... 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 [ ]:
```

```
In [ ]:
```