

Numpy Crash Course

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

```
In [4]: np.__version__
```

```
Out[4]: '1.26.4'
```

creating Arrays

```
In [43]: my_list = [0,1,2,3,4,5]  
my_list
```

```
Out[43]: [0, 1, 2, 3, 4, 5]
```

```
In [45]: type(my_list)
```

```
Out[45]: list
```

```
In [47]: arr = np.array(my_list)  
arr
```

```
Out[47]: array([0, 1, 2, 3, 4, 5])
```

```
In [49]: type(arr)
```

```
Out[49]: numpy.ndarray
```

```
In [51]: type(my_list)
```

```
Out[51]: list
```

```
In [53]: np.arange(6)
```

```
Out[53]: array([0, 1, 2, 3, 4, 5])
```

```
In [55]: np.arange(4.0)
```

```
Out[55]: array([0., 1., 2., 3.])
```

```
In [57]: np.arange((4.0),dtype = int)
```

```
Out[57]: array([0, 1, 2, 3])
```

```
In [59]: np.arange(0,8)
```

```
Out[59]: array([0, 1, 2, 3, 4, 5, 6, 7])
```

```
In [61]: np.arange(35,38)
```

Out[61]: array([35, 36, 37])

In [63]: `np.arange(45,30)` *# first array should be < then second array*

Out[63]: array([], dtype=int32)

In [65]: `np.arange(-25,0)`

Out[65]: array([-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])

In [67]: `np.arange(5,5)`

Out[67]: array([], dtype=int32)

In [69]: `np.arange(5,25,5.5)` *# 5 is starting 25 is end point & 5.5 is an interval*

Out[69]: array([5. , 10.5, 16. , 21.5])

In [71]: `np.arange(5,25,5.5,3)`

```
-----  
TypeError                                Traceback (most recent call last)  
Cell In[71], line 1  
----> 1 np.arange(5,25,5.5,3)  
TypeError: Cannot interpret '3' as a data type
```

In [73]: `b1 = np.zeros(5)` *# parameter tuning ---> means that it gives it's own datatype*
`b1`

Out[73]: array([0., 0., 0., 0., 0.])

In [75]: `np.zeros(5,dtype=int)` *# hyperparameter tuning---->means that we are giving data*

Out[75]: array([0, 0, 0, 0, 0])

In [77]: `zero = np.zeros((2,2))`
`zero`

Out[77]: array([[0., 0.],
[0., 0.]])

In [79]: `np.zeros((15,20))` *# 1st argument give row--2nd argument give column*

```
Out[79]: 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.],
               [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
                0., 0., 0., 0.],
               [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
                0., 0., 0., 0.],
               [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
                0., 0., 0., 0.],
               [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
                0., 0., 0., 0.],
               [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
                0., 0., 0., 0.],
               [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
                0., 0., 0., 0.],
               [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
                0., 0., 0., 0.],
               [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
                0., 0., 0., 0.],
               [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
                0., 0., 0., 0.],
               [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
                0., 0., 0., 0.],
               [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
                0., 0., 0., 0.],
               [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
                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 [81]: np.zeros((2,7))
```

```
Out[81]: array([[0., 0., 0., 0., 0., 0., 0.],
               [0., 0., 0., 0., 0., 0., 0.]])
```

```
In [83]: n = (2,7)
         n1 = (3,9)
         print(np.zeros(n))
```

```
[[0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0.]
```

```
In [85]: 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.]
```

```
In [87]: np.ones(5,dtype=int)
```

```
Out[87]: array([1, 1, 1, 1, 1])
```

```
In [89]: np.ones(5,dtype=float)
```

```
Out[89]: array([1., 1., 1., 1., 1.])
```

```
In [91]: np.ones(n)
```

```
Out[91]: array([[1., 1., 1., 1., 1., 1., 1.],
               [1., 1., 1., 1., 1., 1., 1.]])
```

```
In [93]: np.ones(n1)
```

```
Out[93]: 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.]])
```

```
In [95]: np.two(5,7)
```

```
-----
AttributeError                                Traceback (most recent call last)
Cell In[95], line 1
----> 1 np.two(5,7)

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 'two'
```

```
In [96]: np.three(4,9)
```

```
-----
AttributeError                                Traceback (most recent call last)
Cell In[96], line 1
----> 1 np.three(4,9)

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'
```

compare with np & *

```
In [106... np.arange(9)
```

```
Out[106... array([0, 1, 2, 3, 4, 5, 6, 7, 8])
```

```
In [108... from numpy import * # internally it called from 217 functionalitys
arange(9)
```

```
Out[108... array([0, 1, 2, 3, 4, 5, 6, 7, 8])
```

```
In [110... zeros(9)
```

```
Out[110... array([0., 0., 0., 0., 0., 0., 0., 0., 0.])
```

```
In [117... >>> from numpy import *
>>> arange(3)
```

Out[117... array([0, 1, 2])

```
In [121... range(18)
list(range(18))
```

Out[121... [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17]

```
In [125... y = list(range(18))
y
```

Out[125... [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17]

```
In [ ]: np.
```

```
In [129... >>> from numpy import *
>>> zeros(3)
```

Out[129... array([0., 0., 0.])

```
In [135... rand(3,2)
random.rand(3,2)
```

```
-----
NameError                                Traceback (most recent call last)
Cell In[135], line 1
----> 1 rand(3,2)
      2 random.rand(3,2)

NameError: name 'rand' is not defined
```

```
In [141... np.random.rand(4)
```

Out[141... array([0.9725621 , 0.04369838, 0.26486367, 0.31221159])

```
In [143... np.rand(4)
```

```
-----
AttributeError                            Traceback (most recent call last)
Cell In[143], line 1
----> 1 np.rand(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 'rand'
```

```
In [147... np.random.rand(2,4)
```

Out[147... array([[0.66979215, 0.98801444, 0.08190846, 0.98455749],
 [0.4512725 , 0.94853266, 0.91784756, 0.1971862]])

```
In [168... np.random.rand(10,3)
```

```
Out[168...] array([[0.98536687, 0.20023131, 0.59780784],
        [0.88740427, 0.0989165 , 0.04695412],
        [0.2102231 , 0.42477815, 0.31966598],
        [0.87866053, 0.08954422, 0.63251312],
        [0.12136883, 0.83634456, 0.30225111],
        [0.51842147, 0.51812483, 0.42647319],
        [0.05796816, 0.99038712, 0.67774495],
        [0.50444667, 0.15200895, 0.71484768],
        [0.81793354, 0.52922393, 0.63494243],
        [0.11044664, 0.00413604, 0.5008574 ]])
```

```
In [190...] np.random.randint(2,20) # it gives random numbers in b/w the numbers
```

```
Out[190...] 14
```

```
In [184...] np.random.randint(0,2)
```

```
Out[184...] 1
```

```
In [196...] np.random.randint(0,25,3)
```

```
Out[196...] array([3, 4, 4])
```

```
In [202...] np.random.randint(1,3,5)
```

```
Out[202...] array([2, 2, 1, 1, 2])
```

```
In [204...] np.random.randint(35,25,8)
```

```
-----
ValueError                                Traceback (most recent call last)
Cell In[204], line 1
----> 1 np.random.randint(35,25,8)

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 [214...] np.random.randint(1)
```

```
Out[214...] 0
```

```
In [27]: import numpy as np
```

```
In [29]: np.random.randint(5,9)
```

```
Out[29]: 5
```

```
In [31]: np.random.randint(10,22,4)
```

```
Out[31]: array([12, 15, 13, 10])
```

```
In [224...] np.random.randint(1,12,10)
```

```
Out[224...] array([ 9,  1, 11,  2,  3,  8,  6,  3,  4,  9])
```

```
In [226...] np.random.randint(25,75,(8,10))
```

```
Out[226...] array([[73, 71, 73, 69, 37, 44, 51, 36, 36, 58],
      [30, 69, 53, 71, 44, 44, 44, 66, 73, 43],
      [59, 50, 46, 52, 29, 41, 27, 34, 28, 36],
      [52, 31, 25, 54, 52, 34, 54, 64, 49, 28],
      [27, 37, 55, 34, 58, 66, 64, 29, 70, 33],
      [62, 38, 45, 64, 33, 33, 54, 51, 67, 46],
      [53, 30, 71, 38, 63, 25, 29, 60, 26, 56],
      [74, 59, 40, 54, 36, 31, 35, 38, 57, 46]])
```

```
In [230...] b = np.random.randint(27,71,(4,6))
b
```

```
Out[230...] array([[62, 39, 63, 40, 31, 37],
      [31, 34, 52, 32, 62, 28],
      [59, 30, 70, 37, 52, 69],
      [56, 36, 35, 42, 54, 52]])
```

```
In [232...] b[:]
```

```
Out[232...] array([[62, 39, 63, 40, 31, 37],
      [31, 34, 52, 32, 62, 28],
      [59, 30, 70, 37, 52, 69],
      [56, 36, 35, 42, 54, 52]])
```

```
In [238...] b[0:3]
```

```
Out[238...] array([[62, 39, 63, 40, 31, 37],
      [31, 34, 52, 32, 62, 28],
      [59, 30, 70, 37, 52, 69]])
```

```
In [240...] b
```

```
Out[240...] array([[62, 39, 63, 40, 31, 37],
      [31, 34, 52, 32, 62, 28],
      [59, 30, 70, 37, 52, 69],
      [56, 36, 35, 42, 54, 52]])
```

```
In [242...] b[0:-2]
```

```
Out[242...] array([[62, 39, 63, 40, 31, 37],
      [31, 34, 52, 32, 62, 28]])
```

```
In [244...] b[0:5]
```

```
Out[244...] array([[62, 39, 63, 40, 31, 37],
      [31, 34, 52, 32, 62, 28],
      [59, 30, 70, 37, 52, 69],
      [56, 36, 35, 42, 54, 52]])
```

```
In [246...] b[0,2]
```

```
Out[246...] 63
```

```
In [248...] np.random.randint(10,20,(4,5))
```

```
Out[248... array([[15, 12, 12, 17, 11],
          [16, 10, 19, 16, 18],
          [12, 16, 13, 13, 10],
          [18, 10, 12, 10, 16]])
```

Operations

```
In [33]: a = np.random.randint(10,20,5)
a
```

```
Out[33]: array([19, 16, 13, 13, 16])
```

```
In [99]: arr = np.array(my_list)
arr
```

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

```
In [107... arr2 = np.random.randint(0,100,(10,10))
arr2
```

```
Out[107... array([[62, 80, 92, 78, 63, 20, 88, 65, 45, 61],
          [36, 56, 72, 97, 63, 41, 83, 48, 24, 18],
          [90, 27, 89,  6,  0, 97, 71, 83, 88, 48],
          [73, 83, 19, 69, 71, 75, 26, 63, 61, 74],
          [96, 46, 34, 79, 71, 22, 32, 89, 45, 65],
          [35, 97, 77, 62, 13, 87, 22, 79, 33, 42],
          [ 0, 39, 74, 46, 87, 13, 68, 76, 77,  0],
          [81, 38, 29, 52, 22, 49, 34, 92, 60, 96],
          [27, 14, 86, 60, 27, 76, 54, 10,  0, 40],
          [43,  5, 81, 71, 55, 67,  0, 70, 70, 26]])
```

```
In [109... arr
```

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

```
In [111... arr[:]
```

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

```
In [113... arr[:4]
```

```
Out[113... array([0, 1, 2, 3])
```

```
In [117... arr2[:]
```

```
Out[117... array([[62, 80, 92, 78, 63, 20, 88, 65, 45, 61],
          [36, 56, 72, 97, 63, 41, 83, 48, 24, 18],
          [90, 27, 89,  6,  0, 97, 71, 83, 88, 48],
          [73, 83, 19, 69, 71, 75, 26, 63, 61, 74],
          [96, 46, 34, 79, 71, 22, 32, 89, 45, 65],
          [35, 97, 77, 62, 13, 87, 22, 79, 33, 42],
          [ 0, 39, 74, 46, 87, 13, 68, 76, 77,  0],
          [81, 38, 29, 52, 22, 49, 34, 92, 60, 96],
          [27, 14, 86, 60, 27, 76, 54, 10,  0, 40],
          [43,  5, 81, 71, 55, 67,  0, 70, 70, 26]])
```



```
In [119... arr2[0:5]
```

```
Out[119... array([[62, 80, 92, 78, 63, 20, 88, 65, 45, 61],  
        [36, 56, 72, 97, 63, 41, 83, 48, 24, 18],  
        [90, 27, 89,  6,  0, 97, 71, 83, 88, 48],  
        [73, 83, 19, 69, 71, 75, 26, 63, 61, 74],  
        [96, 46, 34, 79, 71, 22, 32, 89, 45, 65]])
```

```
In [121... arr2[1,6]
```

```
Out[121... 83
```

```
In [123... arr2
```

```
Out[123... array([[62, 80, 92, 78, 63, 20, 88, 65, 45, 61],  
        [36, 56, 72, 97, 63, 41, 83, 48, 24, 18],  
        [90, 27, 89,  6,  0, 97, 71, 83, 88, 48],  
        [73, 83, 19, 69, 71, 75, 26, 63, 61, 74],  
        [96, 46, 34, 79, 71, 22, 32, 89, 45, 65],  
        [35, 97, 77, 62, 13, 87, 22, 79, 33, 42],  
        [ 0, 39, 74, 46, 87, 13, 68, 76, 77,  0],  
        [81, 38, 29, 52, 22, 49, 34, 92, 60, 96],  
        [27, 14, 86, 60, 27, 76, 54, 10,  0, 40],  
        [43,  5, 81, 71, 55, 67,  0, 70, 70, 26]])
```

```
In [128... arr2[-5,5]
```

```
Out[128... 87
```

```
In [130... arr2
```

```
Out[130... array([[62, 80, 92, 78, 63, 20, 88, 65, 45, 61],  
        [36, 56, 72, 97, 63, 41, 83, 48, 24, 18],  
        [90, 27, 89,  6,  0, 97, 71, 83, 88, 48],  
        [73, 83, 19, 69, 71, 75, 26, 63, 61, 74],  
        [96, 46, 34, 79, 71, 22, 32, 89, 45, 65],  
        [35, 97, 77, 62, 13, 87, 22, 79, 33, 42],  
        [ 0, 39, 74, 46, 87, 13, 68, 76, 77,  0],  
        [81, 38, 29, 52, 22, 49, 34, 92, 60, 96],  
        [27, 14, 86, 60, 27, 76, 54, 10,  0, 40],  
        [43,  5, 81, 71, 55, 67,  0, 70, 70, 26]])
```

```
In [136... arr2[-1,-2]
```

```
Out[136... 70
```

```
In [138... arr2
```

```
Out[138...] array([[62, 80, 92, 78, 63, 20, 88, 65, 45, 61],
        [36, 56, 72, 97, 63, 41, 83, 48, 24, 18],
        [90, 27, 89, 6, 0, 97, 71, 83, 88, 48],
        [73, 83, 19, 69, 71, 75, 26, 63, 61, 74],
        [96, 46, 34, 79, 71, 22, 32, 89, 45, 65],
        [35, 97, 77, 62, 13, 87, 22, 79, 33, 42],
        [0, 39, 74, 46, 87, 13, 68, 76, 77, 0],
        [81, 38, 29, 52, 22, 49, 34, 92, 60, 96],
        [27, 14, 86, 60, 27, 76, 54, 10, 0, 40],
        [43, 5, 81, 71, 55, 67, 0, 70, 70, 26]])
```

```
In [140...] arr2[::-1]
```

```
Out[140...] array([[43, 5, 81, 71, 55, 67, 0, 70, 70, 26],
        [27, 14, 86, 60, 27, 76, 54, 10, 0, 40],
        [81, 38, 29, 52, 22, 49, 34, 92, 60, 96],
        [0, 39, 74, 46, 87, 13, 68, 76, 77, 0],
        [35, 97, 77, 62, 13, 87, 22, 79, 33, 42],
        [96, 46, 34, 79, 71, 22, 32, 89, 45, 65],
        [73, 83, 19, 69, 71, 75, 26, 63, 61, 74],
        [90, 27, 89, 6, 0, 97, 71, 83, 88, 48],
        [36, 56, 72, 97, 63, 41, 83, 48, 24, 18],
        [62, 80, 92, 78, 63, 20, 88, 65, 45, 61]])
```

```
In [142...] arr2[::-2]
```

```
Out[142...] array([[43, 5, 81, 71, 55, 67, 0, 70, 70, 26],
        [81, 38, 29, 52, 22, 49, 34, 92, 60, 96],
        [35, 97, 77, 62, 13, 87, 22, 79, 33, 42],
        [73, 83, 19, 69, 71, 75, 26, 63, 61, 74],
        [36, 56, 72, 97, 63, 41, 83, 48, 24, 18]])
```

```
In [146...] arr2
```

```
Out[146...] array([[62, 80, 92, 78, 63, 20, 88, 65, 45, 61],
        [36, 56, 72, 97, 63, 41, 83, 48, 24, 18],
        [90, 27, 89, 6, 0, 97, 71, 83, 88, 48],
        [73, 83, 19, 69, 71, 75, 26, 63, 61, 74],
        [96, 46, 34, 79, 71, 22, 32, 89, 45, 65],
        [35, 97, 77, 62, 13, 87, 22, 79, 33, 42],
        [0, 39, 74, 46, 87, 13, 68, 76, 77, 0],
        [81, 38, 29, 52, 22, 49, 34, 92, 60, 96],
        [27, 14, 86, 60, 27, 76, 54, 10, 0, 40],
        [43, 5, 81, 71, 55, 67, 0, 70, 70, 26]])
```

```
In [144...] arr2[::-3]
```

```
Out[144...] array([[43, 5, 81, 71, 55, 67, 0, 70, 70, 26],
        [0, 39, 74, 46, 87, 13, 68, 76, 77, 0],
        [73, 83, 19, 69, 71, 75, 26, 63, 61, 74],
        [62, 80, 92, 78, 63, 20, 88, 65, 45, 61]])
```

```
In [148...] arr
```

```
Out[148...] array([0, 1, 2, 3, 4, 5])
```

```
In [150...] arr.max()
```

```
Out[150...] 5
```

```
In [152... arr.mean()
```

```
Out[152... 2.5
```

```
In [154... arr.median()
```

```
-----  
AttributeError                                Traceback (most recent call last)  
Cell In[154], line 1  
----> 1 arr.median()  
  
AttributeError: 'numpy.ndarray' object has no attribute 'median'
```

```
In [156... >>> from numpy import *  
>>> a = array([1,2,3,4,9])  
>>> median(a)
```

```
Out[156... 3.0
```

```
In [158... arr
```

```
Out[158... array([0, 1, 2, 3, 4, 5])
```

```
In [160... arr.reshape(2,3)
```

```
Out[160... array([[0, 1, 2],  
                [3, 4, 5]])
```

```
In [162... arr.reshape(6,1)
```

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

```
In [166... arr.reshape(1,6)
```

```
Out[166... array([[0, 1, 2, 3, 4, 5]])
```

```
In [168... arr.reshape(1,5)
```

```
-----  
ValueError                                Traceback (most recent call last)  
Cell In[168], line 1  
----> 1 arr.reshape(1,5)  
  
ValueError: cannot reshape array of size 6 into shape (1,5)
```

```
In [178... arr.reshape(3,2,order='C')
```

```
Out[178... array([[0, 1],  
                [2, 3],  
                [4, 5]])
```

```
In [176... arr.reshape(3,2,order='F')
```

```
Out[176...] array([[0, 3],
                [1, 4],
                [2, 5]])
```

```
In [174...] arr.reshape(3,2,order='A')
```

```
Out[174...] array([[0, 1],
                [2, 3],
                [4, 5]])
```

```
In [180...] arr.reshape(3,2,order='K')
```

```
-----
ValueError                                Traceback (most recent call last)
Cell In[180], line 1
----> 1 arr.reshape(3,2,order='K')

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

```
In [182...] arr
```

```
Out[182...] array([0, 1, 2, 3, 4, 5])
```

```
In [184...] arr.reshape(1,4)
```

```
-----
ValueError                                Traceback (most recent call last)
Cell In[184], line 1
----> 1 arr.reshape(1,4)

ValueError: cannot reshape array of size 6 into shape (1,4)
```

```
In [186...] arr.reshape(1,6)
```

```
Out[186...] array([[0, 1, 2, 3, 4, 5]])
```

```
In [188...] arr.reshape(6,1)
```

```
Out[188...] array([[0],
                [1],
                [2],
                [3],
                [4],
                [5]])
```

```
In [190...] arr.reshape(2,6)
```

```
-----
ValueError                                Traceback (most recent call last)
Cell In[190], line 1
----> 1 arr.reshape(2,6)

ValueError: cannot reshape array of size 6 into shape (2,6)
```

```
In [192...] arr.reshape(3,3)
```

```
-----  
ValueError                                Traceback (most recent call last)  
Cell In[192], line 1  
----> 1 arr.reshape(3,3)  
  
ValueError: cannot reshape array of size 6 into shape (3,3)
```

```
In [194... arr
```

```
Out[194... array([0, 1, 2, 3, 4, 5])
```

```
In [196... arr.reshape(3,2)
```

```
Out[196... array([[0, 1],  
                [2, 3],  
                [4, 5]])
```

Indexing

```
In [353... mat = np.arange(0,100).reshape(10,10)
```

```
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 [205... row = 4  
col = 5
```

```
In [207... row
```

```
Out[207... 4
```

```
In [209... col
```

```
Out[209... 5
```

```
In [211... mat
```

```
Out[211...] 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[row,col]
```

```
Out[213...] 45
```

```
In [215...] mat[4,5]
```

```
Out[215...] 45
```

```
In [217...] mat
```

```
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],
                [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...] mat[:]
```

```
Out[219...] 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 [221...] col = 6
```

```
In [223...] mat
```

```
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],
                [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 [227... # with slices  
mat[:,col]
```

```
Out[227... array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])
```

```
In [229... mat
```

```
Out[229... 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 [231... mat[row,:]
```

```
Out[231... array([40, 41, 42, 43, 44, 45, 46, 47, 48, 49])
```

```
In [233... mat[:,col]
```

```
Out[233... 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 [235... mat
```

```
Out[235... 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 [237... row
```

```
Out[237... 4
```

```
In [239... mat[:row] # up to the row number
```

```
Out[239... 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 [241... mat[row:] # after the row number
```

```
Out[241...] 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 [243...] mat[:]
```

```
Out[243...] array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
                  [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
                  [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
                  [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
                  [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
                  [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
                  [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
                  [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
                  [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
                  [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [245...] mat[:,8]
```

```
Out[245...] array([ 8, 18, 28, 38, 48, 58, 68, 78, 88, 98])
```

```
In [247...] mat
```

```
Out[247...] 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 [249...] mat[1,4]
```

```
Out[249...] 14
```

```
In [251...] mat[3:-3]
```

```
Out[251...] 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 [253...] mat
```



```
Out[253...] 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 [255...] mat[0]
```

```
Out[255...] array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])
```

```
In [257...] mat[8]
```

```
Out[257...] array([80, 81, 82, 83, 84, 85, 86, 87, 88, 89])
```

```
In [259...] mat[6:]
```

```
Out[259...] 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 [261...] mat[:6]
```

```
Out[261...] 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 [265...] mat
```

```
Out[265...] 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 [263...] mat[0:10:3]
```

```
Out[263...] 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 [267...] mat[:, :-1]
```

```
Out[267...] 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 [269...] mat[:, :-2]
```

```
Out[269...] 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 [271...] mat[:, :-3]
```

```
Out[271...] 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 [273...] mat[:, :-5]
```

```
Out[273...] array([[90, 91, 92, 93, 94, 95, 96, 97, 98, 99],
      [40, 41, 42, 43, 44, 45, 46, 47, 48, 49]])
```

```
In [275...] mat
```

```
Out[275...] 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 [277...] mat[2:6, 2:4] # 1:5--->only row part /// 1:3--- it indicates only column parts
```

```
Out[277...] array([[22, 23],
      [32, 33],
      [42, 43],
      [52, 53]])
```

```
In [279...] mat
```

```
Out[279...] 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 [281...] mat[0,1]
```

```
Out[281...] 1
```

```
In [283...] mat[0,1]
```

```
Out[283...] 1
```

```
In [285...] mat[1,6]
```

```
Out[285...] 16
```

```
In [287...] mat[1:6]
```

```
Out[287...] 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 [289...] mat[1:]
```

```
Out[289...] 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 [291...] mat[:,6]
```

```
Out[291...] 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 [293...] mat[0:1]
```

```
Out[293...] array([[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]])
```

```
In [295...] mat[3:5]
```

```
Out[295...] array([[30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
                [40, 41, 42, 43, 44, 45, 46, 47, 48, 49]])
```

```
In [297...] mat[3,5]
```

```
Out[297...] 35
```

```
In [299...] mat
```

```
Out[299...] 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 [303...] mat[1:2,2:4]
```

```
Out[303...] array([[12, 13]])
```

```
In [301...] mat
```

```
Out[301...] 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 [305...] mat[2:3,2:3]
```

```
Out[305...] array([[22]])
```

```
In [307...] mat
```

```
Out[307...] 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 [309...] mat[3:5,2:4]
```

```
Out[309...] array([[32, 33],
                  [42, 43]])
```

```
In [311... mat[3:5,2:4]
```

```
Out[311... array([[32, 33],  
         [42, 43]])
```

Masking

```
In [355... mat # we also called as filter
```

```
Out[355... 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 [338... id(mat)
```

```
Out[338... 140704863043704
```

```
In [340... mat
```

```
Out[340... 55
```

```
In [342... mat < 55
```

```
Out[342... False
```

```
In [344... mat > 55
```

```
Out[344... False
```

```
In [357... mat == 55
```

```
Out[357...] 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, False, False, False,
False],
[False, False, False, False, False, False, False, False, False,
False],
[False, False, False, False, False, False, 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 [359...] mat
```

```
Out[359...] 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 [361...] mat[mat==55]
```

```
Out[361...] array([55])
```

```
In [365...] a1 = mat[mat<55]
a1
```

```
Out[365...] 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])
```

```
In [367...] mat
```

```
Out[367...] 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 [373... a2 = mat[mat>55]
a2
```

```
Out[373... array([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 [375... a3 = mat[mat>=55]
a3
```

```
Out[375... array([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 [377... a4 = mat[mat==55]
a4
```

```
Out[377... array([55])
```

```
In [379... a1
```

```
Out[379... 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])
```

```
In [381... a2
```

```
Out[381... array([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 [ ]:
```