

31-10-2025 & 30-10-2025

Numpy Crash Course

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

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

```
Out[2]: '2.1.3'
```

```
In [3]: import sys
sys.version
```

```
Out[3]: '3.13.5 | packaged by Anaconda, Inc. | (main, Jun 12 2025, 16:37:03) [MSC v.1929 6
4 bit (AMD64)]'
```

Creating Arrays

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

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

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

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

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

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

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

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

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

```
In [9]: type(my_list)
```

```
Out[9]: list
```

```
In [10]: np.
```

```
Cell In[10], line 1
    np.
    ^
SyntaxError: invalid syntax
```

```
In [11]: np.arange(15)
```

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

```
In [12]: np.arange(3.0)
```

```
Out[12]: array([0.,  1.,  2.])
```

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

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

```
In [14]: np.arange(0, 5)
```

```
Out[14]: array([0,  1,  2,  3,  4])
```

```
In [15]: np.arange(10,20)
```

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

```
In [16]: np.arange(20,10) # 1st arg < 2nd arg
```

```
Out[16]: array([], dtype=int64)
```

```
In [17]: np.arange(-20,10)
```

```
Out[17]: 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 [18]: np.arange(-16,10)
```

```
Out[18]: 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 [19]: np.arange(-20,-10)
```

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

```
In [21]: np.arange(30,20) # 1st arg always be < than 2nd argument
```

```
Out[21]: array([], dtype=int64)
```

```
In [22]: ar = np.arange(-30,20)
         ar
```

```
Out[22]: 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 [23]: np.arange(10,10)
```

```
Out[23]: array([], dtype=int64)
```

```
In [24]: np.arange()
```

TypeError

Traceback (most recent call last)

Cell In[24], line 1
----> 1 np.arange()**TypeError:** arange() requires stop to be specified.

In [25]: np.arange(10,30,5) # 10-starting from 30-end point 5-step count

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

In [26]: np.arange(0,10,3)

Out[26]: array([0, 3, 6, 9])

In [27]: np.arange(10,30,5,8)

TypeError

Traceback (most recent call last)

Cell In[27], line 1
----> 1 np.arange(10,30,5,8)**TypeError:** Cannot interpret '8' as a data type

In [28]: np.zeros(3) # parameter tuning

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

In [29]: np.zeros(5, dtype=int) # hyperparameter tuning

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

In [31]: np.zeros((2,2), dtype=int)

Out[31]: array([[0, 0],
[0, 0]])In [32]: zero = np.zeros([2,2])
print(zero)
print(type(zero))[[0. 0.]
[0. 0.]
<class 'numpy.ndarray'>In [33]: zero = np.zeros([2,2])
print(zero)

print('####')

print(type(zero))[[0. 0.]
[0. 0.]

<class 'numpy.ndarray'>

```
In [40]: n = (6,7)
          n1 = (6,8)
          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]: print(np.zeros(n,dtype=int))
```

```
[[0 0 0 0 0 0 0]
 [0 0 0 0 0 0 0]
 [0 0 0 0 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 [42]: n
```

```
Out[42]: (6, 7)
```

```
In [43]: n1
```

```
Out[43]: (6, 8)
```

```
In [44]: 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 [45]: np.ones(3)
```

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

```
In [46]: np.ones(4, dtype=int)
```

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

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

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

```
In [48]: n
```

```
Out[48]: (6, 7)
```

```
In [49]: np.ones(n)
```

```
Out[49]: 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.]])
```

```
In [50]: np.ones((5,4),dtype=int)
```

```
Out[50]: array([[1, 1, 1, 1],
                [1, 1, 1, 1],
                [1, 1, 1, 1],
                [1, 1, 1, 1],
                [1, 1, 1, 1]])
```

```
In [51]: np.
```

```
Cell In[51], line 1
```

```
np.
```

```
^
```

```
SyntaxError: invalid syntax
```

```
In [53]: np.twos((2,3))
```

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

```
Cell In[53], line 1
```

```
----> 1 np.twos((2,3))
```

```
File D:\Anaconda\Lib\site-packages\numpy\__init__.py:414, in __getattr__(attr)
```

```
411     import numpy.char as char
```

```
412     return char.chararray
```

```
--> 414 raise AttributeError("module {!r} has no attribute "
```

```
415                        "{!r}".format(__name__, attr))
```

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

```
In [54]: np.three(2,3)
```

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

```
Cell In[54], line 1
```

```
----> 1 np.three(2,3)
```

```
File D:\Anaconda\Lib\site-packages\numpy\__init__.py:414, in __getattr__(attr)
```

```
411     import numpy.char as char
```

```
412     return char.chararray
```

```
--> 414 raise AttributeError("module {!r} has no attribute "
```

```
415                        "{!r}".format(__name__, attr))
```

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

```
In [55]: np.ones(2)
```

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

```
In [56]: np.ones((2,4))
```

```
Out[56]: array([[1., 1., 1., 1.],
                [1., 1., 1., 1.]])
```

```
In [57]: np.ones((6,10),dtype = int)
```

```
Out[57]: 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 [58]: np.twos((2,4))
```

```
-----
AttributeError                                Traceback (most recent call last)
Cell In[58], line 1
----> 1 np.twos((2,4))

File D:\Anaconda\Lib\site-packages\numpy\__init__.py:414, in __getattr__(attr)
    411     import numpy.char as char
    412     return char.chararray
--> 414 raise AttributeError("module {!r} has no attribute "
    415                        "{!r}".format(__name__, attr))
```

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

```
In [59]: np.
```

```
Cell In[59], line 1
    np.
      ^
SyntaxError: invalid syntax
```

```
In [60]: np.three((2,4))
```

```
-----
AttributeError                                Traceback (most recent call last)
Cell In[60], line 1
----> 1 np.three((2,4))

File D:\Anaconda\Lib\site-packages\numpy\__init__.py:414, in __getattr__(attr)
    411     import numpy.char as char
    412     return char.chararray
--> 414 raise AttributeError("module {!r} has no attribute "
    415                        "{!r}".format(__name__, attr))
```

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

```
In [61]: range(5)
```

```
Out[61]: range(0, 5)
```

```
In [62]: r = range(5)
```

```
r
```

```
Out[62]: range(0, 5)
```

```
In [63]: for i in r:
          print(i)
```

```
0
1
2
3
4
```

```
In [64]: list(range(5))
```

```
Out[64]: [0, 1, 2, 3, 4]
```

```
In [65]: range(1,10)
```

```
Out[65]: range(1, 10)
```

```
In [66]: list(range(1,10))
```

```
Out[66]: [1, 2, 3, 4, 5, 6, 7, 8, 9]
```

```
In [67]: list(range(1,10,3))
```

```
Out[67]: [1, 4, 7]
```

```
In [68]: y = list(range(12))
          y
```

```
Out[68]: [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11]
```

```
In [69]: rand(3,2)
```

```
-----
NameError                                Traceback (most recent call last)
Cell In[69], line 1
----> 1 rand(3,2)

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

```
In [70]: rand(3,2)
          random.rand(3,2)
```

```
-----
NameError                                Traceback (most recent call last)
Cell In[70], line 1
----> 1 rand(3,2)
      2 random.rand(3,2)

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

```
In [71]: np.random.rand(5)
```



```
Out[71]: array([0.45955314, 0.23748604, 0.21325193, 0.57896819, 0.2999508 ])
```

```
In [72]: np.rand(4)
```

```
-----
AttributeError                                Traceback (most recent call last)
Cell In[72], line 1
----> 1 np.rand(4)

File D:\Anaconda\Lib\site-packages\numpy\_init_.py:414, in __getattr__(attr)
    411     import numpy.char as char
    412     return char.chararray
--> 414 raise AttributeError("module {!r} has no attribute "
    415                        "{!r}".format(__name__, attr))

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

```
In [73]: np.random.rand(2,4)
```

```
Out[73]: array([[0.88519098, 0.66710347, 0.94892035, 0.6468944 ],
                [0.19369392, 0.97180819, 0.87580785, 0.7256841 ]])
```

```
In [75]: np.random.randint(2,4)
```

```
Out[75]: 3
```

```
In [79]: np.random.randint(2,20)
```

```
Out[79]: 4
```

```
In [80]: np.random.randint(0,1)
```

```
Out[80]: 0
```

```
In [88]: np.random.randint(10,20,5)
```

```
Out[88]: array([11, 13, 13, 11, 11], dtype=int32)
```

```
In [91]: np.random.randint(1,6,4)
```

```
Out[91]: array([2, 1, 4, 3], dtype=int32)
```

```
In [92]: np.random.rand(3)
```

```
Out[92]: array([0.06556811, 0.98588096, 0.98918344])
```

```
In [98]: np.random.randint(1)
```

```
Out[98]: 0
```

```
In [99]: np.random.randint(30,20,10)
```

ValueError

Traceback (most recent call last)

Cell In[99], line 1

----> 1 np.random.randint(30,20,10)

File numpy\\random\\mtrand.pyx:796, in numpy.random.mtrand.RandomState.randint()

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

ValueError: low >= high

In [100...] np.random.randint(-30,20,10)

Out[100...] array([-10, -21, -13, 8, 4, -3, 11, -28, -18, -4], dtype=int32)

In [103...] np.random.randint(20,30,10)

Out[103...] array([29, 23, 27, 20, 23, 25, 20, 21, 24, 20], dtype=int32)

In [105...] np.random.randint(10,21,3)

Out[105...] array([12, 15, 19], dtype=int32)

In [106...] np.random.randint(1,12,10)

Out[106...] array([6, 3, 1, 10, 11, 8, 1, 10, 11, 8], dtype=int32)

In [107...] np.random.randint(10,40,(10,10))

```
Out[107...] array([[25, 36, 26, 20, 23, 12, 27, 19, 37, 34],
 [22, 26, 33, 13, 11, 15, 37, 38, 31, 15],
 [27, 29, 27, 16, 34, 31, 20, 31, 14, 23],
 [17, 10, 30, 34, 32, 11, 21, 36, 30, 37],
 [30, 33, 21, 11, 10, 23, 24, 37, 36, 17],
 [29, 33, 36, 28, 19, 20, 23, 21, 28, 39],
 [12, 32, 18, 37, 39, 39, 15, 33, 13, 25],
 [35, 25, 22, 32, 12, 19, 22, 33, 26, 23],
 [33, 18, 35, 14, 36, 31, 34, 21, 11, 33],
 [35, 35, 29, 11, 23, 20, 30, 27, 34, 25]], dtype=int32)
```

In [108...] np.random.randint(1,100,(12,12))

```
Out[108...] array([[45, 32, 22, 82, 98, 82, 57, 1, 91, 31, 17, 72],
 [89, 41, 64, 62, 14, 12, 99, 43, 36, 9, 86, 1],
 [ 3, 39, 36, 16, 87, 47, 87, 14, 97, 59, 92, 7],
 [74, 37, 81, 12, 89, 68, 13, 71, 63, 1, 48, 20],
 [ 2, 24, 73, 74, 25, 88, 61, 87, 62, 42, 82, 53],
 [45, 56, 79, 14, 43, 67, 20, 69, 20, 71, 29, 69],
 [78, 96, 77, 29, 32, 29, 98, 69, 19, 16, 68, 97],
 [25, 51, 84, 89, 20, 87, 15, 15, 46, 16, 36, 37],
 [74, 11, 82, 96, 85, 56, 49, 45, 43, 94, 88, 86],
 [44, 89, 38, 44, 6, 79, 61, 72, 80, 3, 74, 14],
 [81, 5, 94, 57, 67, 60, 18, 42, 17, 24, 1, 14],
 [ 7, 61, 27, 59, 11, 72, 30, 97, 12, 98, 22, 80]], dtype=int32)
```

```
In [109... np.arange(1,13).reshape(3,4)
```

```
Out[109... array([[ 1,  2,  3,  4],
        [ 5,  6,  7,  8],
        [ 9, 10, 11, 12]])
```

```
In [110... np.arange(1,13).reshape(12, 1)
```

```
Out[110... array([[ 1],
        [ 2],
        [ 3],
        [ 4],
        [ 5],
        [ 6],
        [ 7],
        [ 8],
        [ 9],
        [10],
        [11],
        [12]])
```

```
In [111... b = np.random.randint(10,20,(5,4))
b
```

```
Out[111... array([[11, 10, 15, 18],
        [15, 16, 13, 11],
        [15, 17, 15, 14],
        [19, 14, 10, 12],
        [15, 17, 12, 11]], dtype=int32)
```

```
In [112... type(b)
```

```
Out[112... numpy.ndarray
```

```
In [113... b
```

```
Out[113... array([[11, 10, 15, 18],
        [15, 16, 13, 11],
        [15, 17, 15, 14],
        [19, 14, 10, 12],
        [15, 17, 12, 11]], dtype=int32)
```

```
In [114... b[:]
```

```
Out[114... array([[11, 10, 15, 18],
        [15, 16, 13, 11],
        [15, 17, 15, 14],
        [19, 14, 10, 12],
        [15, 17, 12, 11]], dtype=int32)
```

```
In [115... b[1:3]
```

```
Out[115... array([[15, 16, 13, 11],
        [15, 17, 15, 14]], dtype=int32)
```

```
In [116... b
```

```
Out[116...] array([[11, 10, 15, 18],
                [15, 16, 13, 11],
                [15, 17, 15, 14],
                [19, 14, 10, 12],
                [15, 17, 12, 11]], dtype=int32)
```

```
In [117...] b[1,2]
```

```
Out[117...] np.int32(13)
```

```
In [118...] b
```

```
Out[118...] array([[11, 10, 15, 18],
                [15, 16, 13, 11],
                [15, 17, 15, 14],
                [19, 14, 10, 12],
                [15, 17, 12, 11]], dtype=int32)
```

```
In [119...] b[1,3]
```

```
Out[119...] np.int32(11)
```

```
In [120...] b[1,-1]
```

```
Out[120...] np.int32(11)
```

```
In [121...] b
```

```
Out[121...] array([[11, 10, 15, 18],
                [15, 16, 13, 11],
                [15, 17, 15, 14],
                [19, 14, 10, 12],
                [15, 17, 12, 11]], dtype=int32)
```

```
In [122...] b[2:3]
```

```
Out[122...] array([[15, 17, 15, 14]], dtype=int32)
```

```
In [123...] b
```

```
Out[123...] array([[11, 10, 15, 18],
                [15, 16, 13, 11],
                [15, 17, 15, 14],
                [19, 14, 10, 12],
                [15, 17, 12, 11]], dtype=int32)
```

```
In [124...] b[0:-2]
```

```
Out[124...] array([[11, 10, 15, 18],
                [15, 16, 13, 11],
                [15, 17, 15, 14]], dtype=int32)
```

```
In [125...] b
```

```
Out[125...] array([[11, 10, 15, 18],
                [15, 16, 13, 11],
                [15, 17, 15, 14],
                [19, 14, 10, 12],
                [15, 17, 12, 11]], dtype=int32)
```

```
In [126...] b[0,2]
```

```
Out[126...] np.int32(15)
```

```
In [127...] b
```

```
Out[127...] array([[11, 10, 15, 18],
                [15, 16, 13, 11],
                [15, 17, 15, 14],
                [19, 14, 10, 12],
                [15, 17, 12, 11]], dtype=int32)
```

```
In [128...] b[-5,-3]
```

```
Out[128...] np.int32(10)
```

```
In [129...] b
```

```
Out[129...] array([[11, 10, 15, 18],
                [15, 16, 13, 11],
                [15, 17, 15, 14],
                [19, 14, 10, 12],
                [15, 17, 12, 11]], dtype=int32)
```

```
In [130...] b[-4,2]
```

```
Out[130...] np.int32(13)
```

```
In [131...] np.random.randint(10,20,(4,4))
```

```
Out[131...] array([[10, 18, 10, 15],
                [16, 18, 18, 19],
                [17, 16, 18, 11],
                [19, 17, 19, 10]], dtype=int32)
```

```
In [132...] b
```

```
Out[132...] array([[11, 10, 15, 18],
                [15, 16, 13, 11],
                [15, 17, 15, 14],
                [19, 14, 10, 12],
                [15, 17, 12, 11]], dtype=int32)
```

```
In [133...] b[-4,-2]
```

```
Out[133...] np.int32(13)
```

```
In [134...] b
```

```
Out[134...] array([[11, 10, 15, 18],
                [15, 16, 13, 11],
                [15, 17, 15, 14],
                [19, 14, 10, 12],
                [15, 17, 12, 11]], dtype=int32)
```

```
In [135...] b[-4:2]
```

```
Out[135...] array([[15, 16, 13, 11]], dtype=int32)
```

```
In [136...] b[:]
```

```
Out[136...] array([[11, 10, 15, 18],
                [15, 16, 13, 11],
                [15, 17, 15, 14],
                [19, 14, 10, 12],
                [15, 17, 12, 11]], dtype=int32)
```

Operators

```
In [137...] a = np.random.randint(10,20,10)
a
```

```
Out[137...] array([13, 15, 18, 14, 11, 16, 11, 13, 14, 12], dtype=int32)
```

```
In [138...] id(a)
```

```
Out[138...] 1310468362512
```

```
In [139...] arr
```

```
Out[139...] array([0, 1, 2, 3, 4, 5])
```

```
In [140...] arr2 = np.random.randint(0,100,(10,10))
arr2
```

```
Out[140...] array([[79, 94, 42, 36, 84, 12, 70, 7, 19, 30],
                [9, 22, 61, 19, 79, 77, 7, 21, 96, 54],
                [72, 80, 95, 16, 11, 31, 58, 94, 14, 62],
                [71, 91, 37, 85, 36, 20, 10, 93, 87, 45],
                [70, 39, 81, 40, 93, 44, 23, 28, 14, 85],
                [50, 77, 55, 79, 88, 23, 56, 9, 75, 85],
                [86, 56, 42, 36, 0, 60, 70, 55, 77, 62],
                [98, 15, 42, 0, 7, 95, 54, 23, 7, 60],
                [64, 4, 62, 61, 7, 53, 4, 58, 25, 6],
                [64, 58, 17, 25, 28, 25, 15, 40, 96, 11]], dtype=int32)
```

```
In [141...] arr
```

```
Out[141...] array([0, 1, 2, 3, 4, 5])
```

```
In [142...] arr[:]
```

```
Out[142...] array([0, 1, 2, 3, 4, 5])
```

```
In [143... arr
```

```
Out[143... array([0, 1, 2, 3, 4, 5])
```

```
In [144... arr[:4]
```

```
Out[144... array([0, 1, 2, 3])
```

```
In [145... arr2[:]
```

```
Out[145... array([[79, 94, 42, 36, 84, 12, 70, 7, 19, 30],
        [ 9, 22, 61, 19, 79, 77, 7, 21, 96, 54],
        [72, 80, 95, 16, 11, 31, 58, 94, 14, 62],
        [71, 91, 37, 85, 36, 20, 10, 93, 87, 45],
        [70, 39, 81, 40, 93, 44, 23, 28, 14, 85],
        [50, 77, 55, 79, 88, 23, 56, 9, 75, 85],
        [86, 56, 42, 36, 0, 60, 70, 55, 77, 62],
        [98, 15, 42, 0, 7, 95, 54, 23, 7, 60],
        [64, 4, 62, 61, 7, 53, 4, 58, 25, 6],
        [64, 58, 17, 25, 28, 25, 15, 40, 96, 11]], dtype=int32)
```

```
In [146... arr2[0:5]
```

```
Out[146... array([[79, 94, 42, 36, 84, 12, 70, 7, 19, 30],
        [ 9, 22, 61, 19, 79, 77, 7, 21, 96, 54],
        [72, 80, 95, 16, 11, 31, 58, 94, 14, 62],
        [71, 91, 37, 85, 36, 20, 10, 93, 87, 45],
        [70, 39, 81, 40, 93, 44, 23, 28, 14, 85]], dtype=int32)
```

```
In [147... arr2
```

```
Out[147... array([[79, 94, 42, 36, 84, 12, 70, 7, 19, 30],
        [ 9, 22, 61, 19, 79, 77, 7, 21, 96, 54],
        [72, 80, 95, 16, 11, 31, 58, 94, 14, 62],
        [71, 91, 37, 85, 36, 20, 10, 93, 87, 45],
        [70, 39, 81, 40, 93, 44, 23, 28, 14, 85],
        [50, 77, 55, 79, 88, 23, 56, 9, 75, 85],
        [86, 56, 42, 36, 0, 60, 70, 55, 77, 62],
        [98, 15, 42, 0, 7, 95, 54, 23, 7, 60],
        [64, 4, 62, 61, 7, 53, 4, 58, 25, 6],
        [64, 58, 17, 25, 28, 25, 15, 40, 96, 11]], dtype=int32)
```

```
In [148... arr2[1,4]
```

```
Out[148... np.int32(79)
```

```
In [150... arr2
```

```
Out[150...] array([[79, 94, 42, 36, 84, 12, 70, 7, 19, 30],
      [ 9, 22, 61, 19, 79, 77, 7, 21, 96, 54],
      [72, 80, 95, 16, 11, 31, 58, 94, 14, 62],
      [71, 91, 37, 85, 36, 20, 10, 93, 87, 45],
      [70, 39, 81, 40, 93, 44, 23, 28, 14, 85],
      [50, 77, 55, 79, 88, 23, 56, 9, 75, 85],
      [86, 56, 42, 36, 0, 60, 70, 55, 77, 62],
      [98, 15, 42, 0, 7, 95, 54, 23, 7, 60],
      [64, 4, 62, 61, 7, 53, 4, 58, 25, 6],
      [64, 58, 17, 25, 28, 25, 15, 40, 96, 11]], dtype=int32)
```

```
In [151...] arr2[-5,-5]
```

```
Out[151...] np.int32(23)
```

```
In [152...] arr2[-5,5]
```

```
Out[152...] np.int32(23)
```

```
In [153...] arr2
```

```
Out[153...] array([[79, 94, 42, 36, 84, 12, 70, 7, 19, 30],
      [ 9, 22, 61, 19, 79, 77, 7, 21, 96, 54],
      [72, 80, 95, 16, 11, 31, 58, 94, 14, 62],
      [71, 91, 37, 85, 36, 20, 10, 93, 87, 45],
      [70, 39, 81, 40, 93, 44, 23, 28, 14, 85],
      [50, 77, 55, 79, 88, 23, 56, 9, 75, 85],
      [86, 56, 42, 36, 0, 60, 70, 55, 77, 62],
      [98, 15, 42, 0, 7, 95, 54, 23, 7, 60],
      [64, 4, 62, 61, 7, 53, 4, 58, 25, 6],
      [64, 58, 17, 25, 28, 25, 15, 40, 96, 11]], dtype=int32)
```

```
In [154...] arr2[-5,-5]
```

```
Out[154...] np.int32(23)
```

```
In [155...] arr2
```

```
Out[155...] array([[79, 94, 42, 36, 84, 12, 70, 7, 19, 30],
      [ 9, 22, 61, 19, 79, 77, 7, 21, 96, 54],
      [72, 80, 95, 16, 11, 31, 58, 94, 14, 62],
      [71, 91, 37, 85, 36, 20, 10, 93, 87, 45],
      [70, 39, 81, 40, 93, 44, 23, 28, 14, 85],
      [50, 77, 55, 79, 88, 23, 56, 9, 75, 85],
      [86, 56, 42, 36, 0, 60, 70, 55, 77, 62],
      [98, 15, 42, 0, 7, 95, 54, 23, 7, 60],
      [64, 4, 62, 61, 7, 53, 4, 58, 25, 6],
      [64, 58, 17, 25, 28, 25, 15, 40, 96, 11]], dtype=int32)
```

```
In [156...] arr2[-1,-2]
```

```
Out[156...] np.int32(96)
```

```
In [157...] arr2
```



```
Out[157...] array([[79, 94, 42, 36, 84, 12, 70, 7, 19, 30],
 [ 9, 22, 61, 19, 79, 77, 7, 21, 96, 54],
 [72, 80, 95, 16, 11, 31, 58, 94, 14, 62],
 [71, 91, 37, 85, 36, 20, 10, 93, 87, 45],
 [70, 39, 81, 40, 93, 44, 23, 28, 14, 85],
 [50, 77, 55, 79, 88, 23, 56, 9, 75, 85],
 [86, 56, 42, 36, 0, 60, 70, 55, 77, 62],
 [98, 15, 42, 0, 7, 95, 54, 23, 7, 60],
 [64, 4, 62, 61, 7, 53, 4, 58, 25, 6],
 [64, 58, 17, 25, 28, 25, 15, 40, 96, 11]], dtype=int32)
```

```
In [158...] arr2[::-1]
```

```
Out[158...] array([[64, 58, 17, 25, 28, 25, 15, 40, 96, 11],
 [64, 4, 62, 61, 7, 53, 4, 58, 25, 6],
 [98, 15, 42, 0, 7, 95, 54, 23, 7, 60],
 [86, 56, 42, 36, 0, 60, 70, 55, 77, 62],
 [50, 77, 55, 79, 88, 23, 56, 9, 75, 85],
 [70, 39, 81, 40, 93, 44, 23, 28, 14, 85],
 [71, 91, 37, 85, 36, 20, 10, 93, 87, 45],
 [72, 80, 95, 16, 11, 31, 58, 94, 14, 62],
 [ 9, 22, 61, 19, 79, 77, 7, 21, 96, 54],
 [79, 94, 42, 36, 84, 12, 70, 7, 19, 30]], dtype=int32)
```

```
In [159...] arr2
```

```
Out[159...] array([[79, 94, 42, 36, 84, 12, 70, 7, 19, 30],
 [ 9, 22, 61, 19, 79, 77, 7, 21, 96, 54],
 [72, 80, 95, 16, 11, 31, 58, 94, 14, 62],
 [71, 91, 37, 85, 36, 20, 10, 93, 87, 45],
 [70, 39, 81, 40, 93, 44, 23, 28, 14, 85],
 [50, 77, 55, 79, 88, 23, 56, 9, 75, 85],
 [86, 56, 42, 36, 0, 60, 70, 55, 77, 62],
 [98, 15, 42, 0, 7, 95, 54, 23, 7, 60],
 [64, 4, 62, 61, 7, 53, 4, 58, 25, 6],
 [64, 58, 17, 25, 28, 25, 15, 40, 96, 11]], dtype=int32)
```

```
In [160...] arr2[::-2]
```

```
Out[160...] array([[64, 58, 17, 25, 28, 25, 15, 40, 96, 11],
 [98, 15, 42, 0, 7, 95, 54, 23, 7, 60],
 [50, 77, 55, 79, 88, 23, 56, 9, 75, 85],
 [71, 91, 37, 85, 36, 20, 10, 93, 87, 45],
 [ 9, 22, 61, 19, 79, 77, 7, 21, 96, 54]], dtype=int32)
```

```
In [161...] arr2
```

```
Out[161...] array([[79, 94, 42, 36, 84, 12, 70, 7, 19, 30],
      [ 9, 22, 61, 19, 79, 77, 7, 21, 96, 54],
      [72, 80, 95, 16, 11, 31, 58, 94, 14, 62],
      [71, 91, 37, 85, 36, 20, 10, 93, 87, 45],
      [70, 39, 81, 40, 93, 44, 23, 28, 14, 85],
      [50, 77, 55, 79, 88, 23, 56, 9, 75, 85],
      [86, 56, 42, 36, 0, 60, 70, 55, 77, 62],
      [98, 15, 42, 0, 7, 95, 54, 23, 7, 60],
      [64, 4, 62, 61, 7, 53, 4, 58, 25, 6],
      [64, 58, 17, 25, 28, 25, 15, 40, 96, 11]], dtype=int32)
```

```
In [162...] arr2[::-3]
```

```
Out[162...] array([[64, 58, 17, 25, 28, 25, 15, 40, 96, 11],
      [86, 56, 42, 36, 0, 60, 70, 55, 77, 62],
      [71, 91, 37, 85, 36, 20, 10, 93, 87, 45],
      [79, 94, 42, 36, 84, 12, 70, 7, 19, 30]], dtype=int32)
```

```
In [163...] arr2
```

```
Out[163...] array([[79, 94, 42, 36, 84, 12, 70, 7, 19, 30],
      [ 9, 22, 61, 19, 79, 77, 7, 21, 96, 54],
      [72, 80, 95, 16, 11, 31, 58, 94, 14, 62],
      [71, 91, 37, 85, 36, 20, 10, 93, 87, 45],
      [70, 39, 81, 40, 93, 44, 23, 28, 14, 85],
      [50, 77, 55, 79, 88, 23, 56, 9, 75, 85],
      [86, 56, 42, 36, 0, 60, 70, 55, 77, 62],
      [98, 15, 42, 0, 7, 95, 54, 23, 7, 60],
      [64, 4, 62, 61, 7, 53, 4, 58, 25, 6],
      [64, 58, 17, 25, 28, 25, 15, 40, 96, 11]], dtype=int32)
```

```
In [164...] arr2[: -3]
```

```
Out[164...] array([[79, 94, 42, 36, 84, 12, 70, 7, 19, 30],
      [ 9, 22, 61, 19, 79, 77, 7, 21, 96, 54],
      [72, 80, 95, 16, 11, 31, 58, 94, 14, 62],
      [71, 91, 37, 85, 36, 20, 10, 93, 87, 45],
      [70, 39, 81, 40, 93, 44, 23, 28, 14, 85],
      [50, 77, 55, 79, 88, 23, 56, 9, 75, 85],
      [86, 56, 42, 36, 0, 60, 70, 55, 77, 62]], dtype=int32)
```

```
In [165...] arr
```

```
Out[165...] array([0, 1, 2, 3, 4, 5])
```

```
In [166...] arr.max()
```

```
Out[166...] np.int64(5)
```

```
In [167...] arr.min()
```

```
Out[167...] np.int64(0)
```

```
In [168...] arr
```

Out[168... array([0, 1, 2, 3, 4, 5])

In [169... `arr.mean()`

Out[169... np.float64(2.5)

In [170... `arr`

Out[170... array([0, 1, 2, 3, 4, 5])

In [171... `arr.median()`

```
-----  
AttributeError                                Traceback (most recent call last)  
Cell In[171], line 1  
----> 1 arr.median()
```

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

In [172... `from numpy import *`
`a = array([1,2,3,4,9])`
`median(a)`

Out[172... np.float64(3.0)

Without work on import* can you please find the median,mode)

In [173... `arr`

Out[173... array([0, 1, 2, 3, 4, 5])

In [174... `arr.reshape(3,2)`

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

In [175... `arr.reshape(6,1)`

Out[175... array([[0],
[1],
[2],
[3],
[4],
[5]])

In [176... `arr.reshape(1,6)`

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

In [177... `arr`

Out[177... array([0, 1, 2, 3, 4, 5])

```
In [178... arr.reshape(2,4)
```

```
-----  
ValueError                                Traceback (most recent call last)  
Cell In[178], line 1  
----> 1 arr.reshape(2,4)
```

```
ValueError: cannot reshape array of size 6 into shape (2,4)
```

```
In [179... arr
```

```
Out[179... array([0, 1, 2, 3, 4, 5])
```

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

```
Out[180... array([[0, 1, 2],  
                [3, 4, 5]])
```

```
In [181... arr.reshape(2,3,order='F')
```

```
Out[181... array([[0, 2, 4],  
                [1, 3, 5]])
```

```
In [182... arr.reshape(2,3,order='A')
```

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

```
In [183... arr
```

```
Out[183... array([0, 1, 2, 3, 4, 5])
```

```
In [184... arr.reshape(2,3)
```

```
Out[184... array([[0, 1, 2],  
                [3, 4, 5]])
```

```
In [185... arr.reshape(1,4)
```

```
-----  
ValueError                                Traceback (most recent call last)  
Cell In[185], 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 [187... arr.reshape(6,1)
```

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

```
In [188...] arr.reshape(2,6)
```

```
-----
ValueError                                Traceback (most recent call last)
Cell In[188], line 1
----> 1 arr.reshape(2,6)
```

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

```
In [189...] arr.reshape(3,3)
```

```
-----
ValueError                                Traceback (most recent call last)
Cell In[189], line 1
----> 1 arr.reshape(3,3)
```

ValueError: cannot reshape array of size 6 into shape (3,3)

```
In [190...] arr
```

```
Out[190...] array([0, 1, 2, 3, 4, 5])
```

```
In [191...] arr.reshape(3,2)
```

```
Out[191...] array([[0, 1],
                [2, 3],
                [4, 5]])
```

Indexing

```
In [192...] mat = np.arange(0,100).reshape(10,10)
mat
```

```
Out[192...] 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 [193...] row = 4
col = 5
```

```
In [194...] col
```

Out[194...] 5

In [195...] row

Out[195...] 4

In [196...] mat

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],
 [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 [197...] mat[row,col]

Out[197...] np.int64(45)

In [198...] mat[4,5]

Out[198...] np.int64(45)

In [199...] mat

Out[199...] 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 [200...] mat[:]

Out[200...] 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 [201...] col = 6

In [202...

```
mat
```

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],
       [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 [203...

```
mat[6]
```

Out[203...

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

In [204...

```
mat
```

Out[204...

```
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...

```
mat[:,col]
```

Out[205...

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

In [206...

```
mat
```

Out[206...

```
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 [207...

```
mat[row,:]
```

Out[207...

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

In [208...

```
mat
```

```
Out[208... 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 [209... mat[:,8]
```

```
Out[209... array([ 8, 18, 28, 38, 48, 58, 68, 78, 88, 98])
```

```
In [210... mat[:col]
```

```
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]])
```

```
In [211... mat[:6]
```

```
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]])
```

```
In [212... row
```

```
Out[212... 4
```

```
In [213... mat
```

```
Out[213... 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 [214... `mat[:row]`

Out[214... `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 [215... `mat`

Out[215... `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 [216... `mat[row:]`

Out[216... `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 [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 [218... `mat[:,8]`

Out[218... `array([8, 18, 28, 38, 48, 58, 68, 78, 88, 98])`

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 [220...] mat[:, -1]
```

```
Out[220...] array([ 9, 19, 29, 39, 49, 59, 69, 79, 89, 99])
```

```
In [221...] mat
```

```
Out[221...] 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 [222...] row
```

```
Out[222...] 4
```

```
In [223...] col
```

```
Out[223...] 6
```

```
In [224...] mat[:, col]
```

```
Out[224...] array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])
```

```
In [225...] mat
```

```
Out[225...] 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 [226...] mat[1, 4]
```

Out[226...] `np.int64(14)`

In [227...] `mat`

Out[227...] `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 [230...] `mat[1:4]`

Out[230...] `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 [231...] `mat`

Out[231...] `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 [232...] `mat[3:-3]`

Out[232...] `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 [233...] `mat`

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],
 [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 [234...] `mat[0]`

```
Out[234...] array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])
```

```
In [235...] mat[6]
```

```
Out[235...] array([60, 61, 62, 63, 64, 65, 66, 67, 68, 69])
```

```
In [236...] mat
```

```
Out[236...] 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...] mat[6:]
```

```
Out[237...] 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 [238...] mat[:6]
```

```
Out[238...] 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 [239...] mat
```

```
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],
                  [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 [240...] mat[5:7]
```

```
Out[240...] array([[50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
                  [60, 61, 62, 63, 64, 65, 66, 67, 68, 69]])
```

```
In [241...] mat
```

```
Out[241...] 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 [242...] mat[0:10]
```

```
Out[242...] 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 [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 [244...] mat[0:10:3]
```

```
Out[244...] 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 [245...] mat[0:10]
```

```
Out[245...] 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 [246... `mat[0:10:3]`

Out[246... `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 [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 [248... `mat[4:]`

Out[248... `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 [249... `mat`

Out[249... `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 [250... `mat[:4]`

Out[250... `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 [251... `mat`

```
Out[251...] array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
 [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
 [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
 [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
 [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
 [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
 [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
 [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
 [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
 [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [252...] mat[:, -1]
```

```
Out[252...] 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 [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 [254...] mat[:, -3]
```

```
Out[254...] 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 [255...] mat
```

```
Out[255...] 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 [256... `mat[::-5]`

Out[256... `array([[90, 91, 92, 93, 94, 95, 96, 97, 98, 99],
 [40, 41, 42, 43, 44, 45, 46, 47, 48, 49]])`

In [257... `mat`

Out[257... `array([[0, 1, 2, 3, 4, 5, 6, 7, 8, 9],
 [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
 [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
 [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
 [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
 [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
 [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
 [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
 [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
 [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])`

In [258... `mat[2:6]`

Out[258... `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 [259... `mat`

Out[259... `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 [260... `mat[2:6,2:4]`

Out[260... `array([[22, 23],
 [32, 33],
 [42, 43],
 [52, 53]])`

In [261... `mat`


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

```
In [262...] mat[0,1]
```

```
Out[262...] np.int64(1)
```

```
In [263...] mat[1,6]
```

```
Out[263...] np.int64(16)
```

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

```
Out[264...] array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
                [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
                [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
                [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
                [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
                [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
                [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
                [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
                [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
                [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [265...] mat[1:6]
```

```
Out[265...] 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 [266...] mat[1:]
```

```
Out[266...] 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 [267...] mat
```

```
Out[267...] 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 [268...] mat[:6]
```

```
Out[268...] 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 [269...] mat[0:1]
```

```
Out[269...] array([[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]])
```

```
In [270...] mat
```

```
Out[270...] array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
 [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
 [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
 [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
 [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
 [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
 [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 [271...] mat[3:5]
```

```
Out[271...] array([[30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
 [40, 41, 42, 43, 44, 45, 46, 47, 48, 49]])
```

```
In [272...] mat[3,5]
```

```
Out[272...] np.int64(35)
```

```
In [273...] mat
```

```
Out[273...] 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 [274...] mat[1:2,2:4]
```

```
Out[274...] array([[12, 13]])
```

```
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 [276...] mat[2:3,2:3]
```

```
Out[276...] array([[22]])
```

```
In [277...] mat
```

```
Out[277...] 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 [278...] mat[2:4,3:5]
```

```
Out[278...] array([[23, 24],
                [33, 34]])
```

```
In [279...] mat[3:5,2:4]
```

```
Out[279...] array([[32, 33],
                [42, 43]])
```

```
In [280... mat
```

```
Out[280... array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
        [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
        [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
        [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
        [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
        [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
        [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
        [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
        [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
        [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [281... mat[2:3,4:5]
```

```
Out[281... array([[24]])
```

Masking

```
In [282... mat
```

```
Out[282... 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 [283... id(mat)
```

```
Out[283... 1310468715120
```

```
In [284... mat
```

```
Out[284... 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 [285... mat[mat<50]
```

```
Out[285... 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 [286... mat[mat<=50]
```

```
Out[286... array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14, 15, 16,
        17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33,
        34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50])
```

```
In [287... mat > 50
```

```
Out[287... array([[False, False, False, False, False, False, False, False, False,
        False],
        [False, False, False, False, False, False, False, False, False,
        False],
        [False, False, False, False, False, False, False, False, False,
        False],
        [False, False, False, False, False, False, False, False, False,
        False],
        [False, False, False, False, False, False, False, False, False,
        False],
        [False, True,  True,  True,  True,  True,  True,  True,  True,
        True],
        [ True,  True,  True,  True,  True,  True,  True,  True,  True,
        True],
        [ True,  True,  True,  True,  True,  True,  True,  True,  True,
        True],
        [ True,  True,  True,  True,  True,  True,  True,  True,  True,
        True],
        [ True,  True,  True,  True,  True,  True,  True,  True,  True,
        True]])
```

```
In [288... mat[mat==50]
```

```
Out[288... array([50])
```

```
In [289... mat
```

```
Out[289... 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 [290... mat == 50
```

```
Out[290...] array([[False, False, False, False, False, False, False, False, False,
False],
[False, False, False, False, False, False, False, False, False,
False],
[False, False, False, False, False, False, False, False, False,
False],
[False, False, False, False, False, False, False, False, False,
False],
[False, False, False, False, False, False, False, False, False,
False],
[ True, False, False, False, False, False, False, False, False,
False],
[False, False, False, False, False, False, False, False, False,
False],
[False, False, False, False, False, False, False, False, False,
False],
[False, False, False, False, False, False, False, False, False,
False],
[False, False, False, False, False, False, False, False, False,
False],
[False, False, False, False, False, False, False, False, False,
False]])
```

```
In [291...] mat
```

```
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],
[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 [292...] a1 = mat[mat<50]
a1
```

```
Out[292...] 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 [293...] mat
```

```
Out[293...] 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 [294...] a2 = mat[mat>50]
a2
```

```
Out[294...] 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 [295...] a3 = mat[mat<=50]
a3
```

```
Out[295...] array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14, 15, 16,
        17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33,
        34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50])
```

```
In [296...] a4 = mat[mat==50]
a4
```

```
Out[296...] array([50])
```

```
In [ ]:
```