

```
In [1]: import numpy as np
In [2]: np.__version__
Out[2]: '1.26.4'
In [3]: import sys
        sys.version
Out[3]: '3.12.4 | packaged by Anaconda, Inc. | (main, Jun 18 2024, 15:03:56) [MSC v.192
9 64 bit (AMD64)]'
```

Creating array

```
In [5]: my_list=[0,1,2,3,4,5]
        my_list
Out[5]: [0, 1, 2, 3, 4, 5]
In [6]: type(my_list)
Out[6]: list
In [7]: arr=np.array(my_list)
In [8]: arr
Out[8]: array([0, 1, 2, 3, 4, 5])
In [9]: type(arr)
Out[9]: numpy.ndarray
In [10]: type(my_list)
Out[10]: list
In [11]: np.arange(5)
Out[11]: array([0, 1, 2, 3, 4])
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)
```

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

```
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 [20]: np.arange(30,20)
```

```
Out[20]: array([], dtype=int32)
```

```
In [21]: np.arange(-30,20)
```

```
Out[21]: 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 [22]: np.arange(10,10)
```

```
Out[22]: array([], dtype=int32)
```

```
In [23]: np.arange(-20,20)
```

```
Out[23]: array([-20, -19, -18, -17, -16, -15, -14, -13, -12, -11, -10, -9, -8, -7, -6, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19])
```

```
In [24]: np.arange(10,30,5)
```

```
Out[24]: array([10, 15, 20, 25])
```

```
In [25]: np.arange(0,10,3)
```

```
Out[25]: array([0, 3, 6, 9])
```

```
In [26]: np.zeros(3)
```

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

```
In [27]: np.zeros(5,dtype=int)
```

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

```
In [28]: np.zeros((2,2),dtype=int)
```

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

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

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

```
In [30]: np.zeros((2,10))
```

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

```
In [31]: n=(6,7)  
n1=(6,8)  
print(np.zeros(n))
```

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

```
In [32]: np.ones(3,dtype=int)
```

```
Out[32]: array([1, 1, 1])
```

```
In [33]: np.ones(4)
```

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

```
In [34]: n
```

```
Out[34]: (6, 7)
```

```
In [35]: np.ones(n)
```

```
Out[35]: 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 [36]: np.ones((5,4),dtype=int)
```

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

```
In [37]: np.ones((2,4))
```

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

```
In [38]: np.ones((6,10),dtype=int)
```

```
Out[38]: array([[1, 1, 1, 1, 1, 1, 1, 1, 1, 1],  
 [1, 1, 1, 1, 1, 1, 1, 1, 1, 1],  
 [1, 1, 1, 1, 1, 1, 1, 1, 1, 1],  
 [1, 1, 1, 1, 1, 1, 1, 1, 1, 1],  
 [1, 1, 1, 1, 1, 1, 1, 1, 1, 1],  
 [1, 1, 1, 1, 1, 1, 1, 1, 1, 1]])
```

```
In [39]: from numpy import *
```

```
In [40]: arange(3)
```

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

```
range(12) list(range(12))
```

```
In [41]: y=list(range(12))  
y
```

```
Out[41]: [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11]
```

```
In [ ]:
```

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

```
Out[42]: array([[0.01251033, 0.67694207, 0.34845568, 0.73914493],  
 [0.70903981, 0.07918441, 0.91304056, 0.38401326]])
```

```
In [43]: np.random.randint(2,4)
```

```
Out[43]: 2
```

```
In [44]: np.random.randint(2,20)
```

```
Out[44]: 15
```

```
In [45]: np.random.randint(0,1)
```

```
Out[45]: 0
```

```
In [46]: np.random.randint(10,20,3)
```

```
Out[46]: array([15, 10, 10])
```

```
In [47]: np.random.randint(1,6,4)
```

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

```
In [48]: np.random.randint(10,40,(10,10))
```

```
Out[48]: array([[34, 30, 24, 34, 20, 10, 22, 36, 18, 37],  
                 [13, 32, 30, 11, 21, 39, 37, 10, 11, 10],  
                 [19, 38, 10, 12, 22, 17, 18, 29, 30, 15],  
                 [25, 12, 32, 25, 28, 19, 13, 15, 12, 21],  
                 [29, 11, 21, 18, 27, 30, 37, 26, 27, 26],  
                 [16, 28, 32, 24, 30, 37, 23, 11, 23, 31],  
                 [14, 39, 34, 18, 16, 26, 29, 12, 19, 13],  
                 [17, 19, 23, 37, 23, 21, 33, 34, 13, 37],  
                 [26, 33, 21, 17, 26, 14, 38, 30, 36, 26],  
                 [36, 16, 30, 12, 33, 20, 12, 31, 26, 13]])
```

```
In [49]: b=np.random.randint(10,20,(5,4))  
b
```

```
Out[49]: array([[12, 19, 10, 14],  
                 [10, 19, 15, 10],  
                 [12, 11, 18, 14],  
                 [10, 19, 19, 14],  
                 [10, 15, 18, 13]])
```

```
In [50]: b[:]
```

```
Out[50]: array([[12, 19, 10, 14],  
                 [10, 19, 15, 10],  
                 [12, 11, 18, 14],  
                 [10, 19, 19, 14],  
                 [10, 15, 18, 13]])
```

```
In [51]: b[0:2]
```

```
Out[51]: array([[12, 19, 10, 14],  
                 [10, 19, 15, 10]])
```

```
In [52]: b
```

```
Out[52]: array([[12, 19, 10, 14],  
                 [10, 19, 15, 10],  
                 [12, 11, 18, 14],  
                 [10, 19, 19, 14],  
                 [10, 15, 18, 13]])
```

```
In [53]: b[0:1]
```

```
Out[53]: array([[12, 19, 10, 14]])
```

```
In [54]: b[0,2]
```

```
Out[54]: 10
```

```
In [ ]:
```

operations

```
In [56]: a=np.random.randint(10,20,5)  
a
```

```
Out[56]: array([13, 14, 12, 11, 15])
```

```
In [57]: arr2=np.random.randint(0,100,(10,10))
arr2
```

```
Out[57]: array([[53, 92, 32, 78, 96, 31, 93, 74, 91, 95],
 [27, 88, 35, 39, 30, 50, 90, 32, 3, 65],
 [28, 89, 68, 81, 95, 73, 37, 35, 13, 4],
 [81, 55, 35, 32, 36, 66, 8, 88, 48, 29],
 [97, 32, 95, 75, 97, 9, 75, 10, 86, 42],
 [68, 62, 47, 21, 53, 82, 22, 96, 93, 80],
 [48, 69, 4, 64, 12, 66, 47, 67, 2, 7],
 [64, 29, 93, 4, 46, 86, 92, 57, 59, 89],
 [16, 84, 73, 18, 17, 31, 81, 94, 77, 94],
 [29, 29, 86, 68, 34, 4, 14, 25, 14, 49]])
```

```
In [58]: arr
```

```
Out[58]: array([0, 1, 2, 3, 4, 5])
```

```
In [59]: arr[:,]
```

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

```
In [60]: arr[:4]
```

```
Out[60]: array([0, 1, 2, 3])
```

```
In [61]: arr2[:,]
```

```
Out[61]: array([[53, 92, 32, 78, 96, 31, 93, 74, 91, 95],
 [27, 88, 35, 39, 30, 50, 90, 32, 3, 65],
 [28, 89, 68, 81, 95, 73, 37, 35, 13, 4],
 [81, 55, 35, 32, 36, 66, 8, 88, 48, 29],
 [97, 32, 95, 75, 97, 9, 75, 10, 86, 42],
 [68, 62, 47, 21, 53, 82, 22, 96, 93, 80],
 [48, 69, 4, 64, 12, 66, 47, 67, 2, 7],
 [64, 29, 93, 4, 46, 86, 92, 57, 59, 89],
 [16, 84, 73, 18, 17, 31, 81, 94, 77, 94],
 [29, 29, 86, 68, 34, 4, 14, 25, 14, 49]])
```

```
In [62]: arr2[0:5]
```

```
Out[62]: array([[53, 92, 32, 78, 96, 31, 93, 74, 91, 95],
 [27, 88, 35, 39, 30, 50, 90, 32, 3, 65],
 [28, 89, 68, 81, 95, 73, 37, 35, 13, 4],
 [81, 55, 35, 32, 36, 66, 8, 88, 48, 29],
 [97, 32, 95, 75, 97, 9, 75, 10, 86, 42]])
```

```
In [63]: arr2
```

```
Out[63]: array([[53, 92, 32, 78, 96, 31, 93, 74, 91, 95],  
[27, 88, 35, 39, 30, 50, 90, 32, 3, 65],  
[28, 89, 68, 81, 95, 73, 37, 35, 13, 4],  
[81, 55, 35, 32, 36, 66, 8, 88, 48, 29],  
[97, 32, 95, 75, 97, 9, 75, 10, 86, 42],  
[68, 62, 47, 21, 53, 82, 22, 96, 93, 80],  
[48, 69, 4, 64, 12, 66, 47, 67, 2, 7],  
[64, 29, 93, 4, 46, 86, 92, 57, 59, 89],  
[16, 84, 73, 18, 17, 31, 81, 94, 77, 94],  
[29, 29, 86, 68, 34, 4, 14, 25, 14, 49]])
```

```
In [64]: arr2[1,5]
```

```
Out[64]: 50
```

```
In [65]: arr2
```

```
Out[65]: array([[53, 92, 32, 78, 96, 31, 93, 74, 91, 95],  
[27, 88, 35, 39, 30, 50, 90, 32, 3, 65],  
[28, 89, 68, 81, 95, 73, 37, 35, 13, 4],  
[81, 55, 35, 32, 36, 66, 8, 88, 48, 29],  
[97, 32, 95, 75, 97, 9, 75, 10, 86, 42],  
[68, 62, 47, 21, 53, 82, 22, 96, 93, 80],  
[48, 69, 4, 64, 12, 66, 47, 67, 2, 7],  
[64, 29, 93, 4, 46, 86, 92, 57, 59, 89],  
[16, 84, 73, 18, 17, 31, 81, 94, 77, 94],  
[29, 29, 86, 68, 34, 4, 14, 25, 14, 49]])
```

```
In [66]: arr2[-5,5]
```

```
Out[66]: 82
```

```
In [67]: arr2[-5,-5]
```

```
Out[67]: 82
```

```
In [68]: arr2
```

```
Out[68]: array([[53, 92, 32, 78, 96, 31, 93, 74, 91, 95],  
[27, 88, 35, 39, 30, 50, 90, 32, 3, 65],  
[28, 89, 68, 81, 95, 73, 37, 35, 13, 4],  
[81, 55, 35, 32, 36, 66, 8, 88, 48, 29],  
[97, 32, 95, 75, 97, 9, 75, 10, 86, 42],  
[68, 62, 47, 21, 53, 82, 22, 96, 93, 80],  
[48, 69, 4, 64, 12, 66, 47, 67, 2, 7],  
[64, 29, 93, 4, 46, 86, 92, 57, 59, 89],  
[16, 84, 73, 18, 17, 31, 81, 94, 77, 94],  
[29, 29, 86, 68, 34, 4, 14, 25, 14, 49]])
```

```
In [69]: arr2[-1,-2]
```

```
Out[69]: 14
```

```
In [70]: arr2
```

```
Out[70]: array([[53, 92, 32, 78, 96, 31, 93, 74, 91, 95],  
[27, 88, 35, 39, 30, 50, 90, 32, 3, 65],  
[28, 89, 68, 81, 95, 73, 37, 35, 13, 4],  
[81, 55, 35, 32, 36, 66, 8, 88, 48, 29],  
[97, 32, 95, 75, 97, 9, 75, 10, 86, 42],  
[68, 62, 47, 21, 53, 82, 22, 96, 93, 80],  
[48, 69, 4, 64, 12, 66, 47, 67, 2, 7],  
[64, 29, 93, 4, 46, 86, 92, 57, 59, 89],  
[16, 84, 73, 18, 17, 31, 81, 94, 77, 94],  
[29, 29, 86, 68, 34, 4, 14, 25, 14, 49]])
```

```
In [71]: arr2[::1]
```

```
Out[71]: array([[53, 92, 32, 78, 96, 31, 93, 74, 91, 95],  
[27, 88, 35, 39, 30, 50, 90, 32, 3, 65],  
[28, 89, 68, 81, 95, 73, 37, 35, 13, 4],  
[81, 55, 35, 32, 36, 66, 8, 88, 48, 29],  
[97, 32, 95, 75, 97, 9, 75, 10, 86, 42],  
[68, 62, 47, 21, 53, 82, 22, 96, 93, 80],  
[48, 69, 4, 64, 12, 66, 47, 67, 2, 7],  
[64, 29, 93, 4, 46, 86, 92, 57, 59, 89],  
[16, 84, 73, 18, 17, 31, 81, 94, 77, 94],  
[29, 29, 86, 68, 34, 4, 14, 25, 14, 49]])
```

```
In [72]: arr2[::2]
```

```
Out[72]: array([[29, 29, 86, 68, 34, 4, 14, 25, 14, 49],  
[64, 29, 93, 4, 46, 86, 92, 57, 59, 89],  
[68, 62, 47, 21, 53, 82, 22, 96, 93, 80],  
[81, 55, 35, 32, 36, 66, 8, 88, 48, 29],  
[27, 88, 35, 39, 30, 50, 90, 32, 3, 65]])
```

```
In [73]: arr2
```

```
Out[73]: array([[53, 92, 32, 78, 96, 31, 93, 74, 91, 95],  
[27, 88, 35, 39, 30, 50, 90, 32, 3, 65],  
[28, 89, 68, 81, 95, 73, 37, 35, 13, 4],  
[81, 55, 35, 32, 36, 66, 8, 88, 48, 29],  
[97, 32, 95, 75, 97, 9, 75, 10, 86, 42],  
[68, 62, 47, 21, 53, 82, 22, 96, 93, 80],  
[48, 69, 4, 64, 12, 66, 47, 67, 2, 7],  
[64, 29, 93, 4, 46, 86, 92, 57, 59, 89],  
[16, 84, 73, 18, 17, 31, 81, 94, 77, 94],  
[29, 29, 86, 68, 34, 4, 14, 25, 14, 49]])
```

```
In [74]: arr2[::3]
```

```
Out[74]: array([[29, 29, 86, 68, 34, 4, 14, 25, 14, 49],  
[48, 69, 4, 64, 12, 66, 47, 67, 2, 7],  
[81, 55, 35, 32, 36, 66, 8, 88, 48, 29],  
[53, 92, 32, 78, 96, 31, 93, 74, 91, 95]])
```

```
In [75]: arr
```

```
Out[75]: array([0, 1, 2, 3, 4, 5])
```

```
In [76]: arr.max()
```

```
Out[76]: 5
```

```
In [77]: arr.min()
```

```
Out[77]: 0
```

```
In [78]: arr.mean()
```

```
Out[78]: 2.5
```

```
In [79]: from numpy import *
a=array([1,2,3,4,9])
median(a)
```

```
Out[79]: 3.0
```

```
In [80]: arr
```

```
Out[80]: array([0, 1, 2, 3, 4, 5])
```

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

```
In [81]: arr.reshape(3,2)
```

```
Out[81]: array([[0, 1],
 [2, 3],
 [4, 5]])
```

```
In [82]: arr.reshape(6,1)
```

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

```
In [83]: arr
```

```
Out[83]: array([0, 1, 2, 3, 4, 5])
```

```
In [84]: arr.reshape(2,3,order='c')
```

```
Out[84]: array([[0, 1, 2],
 [3, 4, 5]])
```

```
In [85]: arr.reshape(2,3,order='f')
```

```
Out[85]: array([[0, 2, 4],
 [1, 3, 5]])
```

```
In [86]: arr.reshape(2,3,order='a')
```

```
Out[86]: array([[0, 1, 2],
 [3, 4, 5]])
```

```
In [87]: arr.reshape(2,3)
```

```
Out[87]: array([[0, 1, 2],
 [3, 4, 5]])
```

```
In [88]: arr.reshape(1,6)
```

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

```
In [89]: arr.reshape(6,1)
```

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

```
In [90]: arr.reshape(3,2)
```

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

indexing

```
In [92]: mat=np.arange(0,100).reshape(10,10)  
mat
```

```
Out[92]: 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 [93]: row=4  
col=5
```

```
In [94]: col
```

```
Out[94]: 5
```

```
In [95]: row
```

```
Out[95]: 4
```

```
In [96]: mat
```

```
Out[96]: 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 [98]: mat[row,col]
```

```
Out[98]: 45
```

```
In [99]: mat[4,5]
```

```
Out[99]: 45
```

```
In [100...]: mat
```

```
Out[100...]: 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 [101...]: mat[:,]
```

```
Out[101...]: array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
   [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
   [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
   [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
   [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
   [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
   [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
   [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
   [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
   [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [102...]: col=6
```

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

```
Out[103...]: array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
       [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
       [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
       [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
       [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
       [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
       [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
       [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
       [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [104...]: mat[:,col]
```

```
Out[104...]: array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])
```

```
In [105...]: mat
```

```
Out[105...]: 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 [106...]: mat[row,:]
```

```
Out[106...]: array([40, 41, 42, 43, 44, 45, 46, 47, 48, 49])
```

```
In [107...]: mat[:,col]
```

```
Out[107...]: array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])
```

```
In [108...]: mat[:,col]
```

```
Out[108...]: array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])
```

```
In [109...]: mat[:col]
```

```
Out[109...]: array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
       [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
       [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
       [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
       [50, 51, 52, 53, 54, 55, 56, 57, 58, 59]])
```

```
In [110...]: mat[:row]
```

```
Out[110...]: array([[ 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 [111...]: mat[:]
```

```
Out[111... array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
       [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
       [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
       [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [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 [112... mat[:,8]
```

```
Out[112... array([ 8, 18, 28, 38, 48, 58, 68, 78, 88, 98])
```

```
In [113... mat[:, -1]
```

```
Out[113... array([ 9, 19, 29, 39, 49, 59, 69, 79, 89, 99])
```

```
In [114... mat[:, col]
```

```
Out[114... array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])
```

```
In [115... mat[1,4]
```

```
Out[115... 14
```

```
In [116... mat[1:4]
```

```
Out[116... 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 [117... mat[3:-3]
```

```
Out[117... 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 [118... mat[0]
```

```
Out[118... array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])
```

```
In [119... mat[6]
```

```
Out[119... array([60, 61, 62, 63, 64, 65, 66, 67, 68, 69])
```

```
In [120... mat[:6]
```

```
Out[120... 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 [121... mat[6:]
```

```
Out[121... 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 [122... mat[5:7]
```

```
Out[122... array([[50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
   [60, 61, 62, 63, 64, 65, 66, 67, 68, 69]])
```

```
In [123... mat[0:10]
```

```
Out[123... 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 [124... mat[0:10:3]
```

```
Out[124... 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 [125... mat[4:]]
```

```
Out[125... 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 [126... mat[:4]]
```

```
Out[126... 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 [127... mat[::-1]]
```

```
Out[127... 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 [128... mat[::-3]]
```

```
Out[128...]: 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 [129...]: mat[::-2]
```

```
Out[129...]: 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 [130...]: mat[::-5]
```

```
Out[130...]: array([[90, 91, 92, 93, 94, 95, 96, 97, 98, 99],  
                   [40, 41, 42, 43, 44, 45, 46, 47, 48, 49]])
```

```
In [131...]: mat[2:6]
```

```
Out[131...]: 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 [132...]: mat[2:6,2:4]
```

```
Out[132...]: array([[22, 23],  
                   [32, 33],  
                   [42, 43],  
                   [52, 53]])
```

```
In [133...]: mat[0,1]
```

```
Out[133...]: 1
```

```
In [134...]: mat[1,6]
```

```
Out[134...]: 16
```

```
In [135...]: mat[1:6]
```

```
Out[135...]: 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 [136...]: mat[1:]
```

```
Out[136...]: 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 [137...]: mat

```
Out[137...]: array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
       [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
       [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
       [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
       [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
       [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
       [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
       [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
       [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

In [138...]: mat[:6]

```
Out[138...]: array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
       [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
       [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
       [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
       [50, 51, 52, 53, 54, 55, 56, 57, 58, 59]])
```

In [139...]: mat[0:1]

```
Out[139...]: array([[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]])
```

In [140...]: mat[3:5]

```
Out[140...]: array([[30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49]])
```

In [141...]: mat[3,5]

```
Out[141...]: 35
```

In [142...]: mat[1:2,2:4]

```
Out[142...]: array([[12, 13]])
```

In [143...]: mat

```
Out[143...]: array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
       [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
       [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
       [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
       [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
       [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
       [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
       [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
       [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

In [144...]: mat[3:5,2:4,]

```
Out[144...]: array([[32, 33],
       [42, 43]])
```

In [145...]: mat[2:3,4:5]

```
Out[145... array([[24]])
```

Masking

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

```
Out[147... array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
 [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
 [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
 [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
 [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
 [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
 [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
 [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
 [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
 [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [148... id(mat)
```

```
Out[148... 1967579503120
```

```
In [149... mat<50
```

```
Out[149... array([[ True,  True,  True,  True,  True,  True,  True,  True,  True,  True,
 [ True,  True,  True,  True,  True,  True,  True,  True,  True,  True],
 [ True,  True,  True,  True,  True,  True,  True,  True,  True,  True],
 [ True,  True,  True,  True,  True,  True,  True,  True,  True,  True],
 [ True,  True,  True,  True,  True,  True,  True,  True,  True,  True],
 [ True,  True,  True,  True,  True,  True,  True,  True,  True,  True,
 [False, False, False, False, False, False, False, False, False, False],
 [False, False, False, False, False, False, False, False, False, False],
 [False, False, False, False, False, False, False, False, False, False],
 [False, False, False, False, False, False, False, False, False, False]])
```

```
In [150... mat>50
```

```
Out[150... 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],  
 [True, True, True, True, True, True, True, True, True, True]]))
```

```
In [151... mat==50
```

```
Out[151... array([[False, False, False, False, False, False, False, False, False, False],  
 [False, False, False, False, False, False, False, False, False, False],  
 [False, False, False, False, False, False, False, False, False, False],  
 [False, False, False, False, False, False, False, False, False, False],  
 [False, False, False, False, False, False, False, False, False, False],  
 [False, False, False, False, False, False, False, False, False, False],  
 [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]]))
```

```
In [152... mat[mat==50]
```

```
Out[152... array([50])
```

```
In [153... a1=mat[mat<50]  
a1
```

```
Out[153... array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14, 15, 16,  
 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33,  
 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49])
```

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

```
Out[154... array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
       [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
       [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
       [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
       [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
       [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
       [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
       [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
       [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [155... a2=mat[mat>50]
a2
```

```
Out[155... 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 [156... a3=mat[mat>=50]
a3
```

```
Out[156... array([50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66,
       67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83,
       84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99])
```

```
In [157... a4=mat[mat==50]
a4
```

```
Out[157... array([50])
```

```
In [158... mat>50
```

```
Out[158... array([[False, False, False, False, False, False, False, False,
       False],
       [False, False, False, False, False, False, False, False, False],
       [False, False, False, False, False, False, False, False, False],
       [False, False, False, False, False, False, False, False, False],
       [False, False, False, False, False, False, False, False, False],
       [False, False, False, False, False, False, False, False, False],
       [False, True, True, True, True, True, True, True, True],
       [True, True, True, True, True, True, True, True, True],
       [True, True, True, True, True, True, True, True, True],
       [True, True, True, True, True, True, True, True, True]])
```

```
In [159... a1
```

```
Out[159... array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14, 15, 16,
       17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33,
       34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49])
```

In [160...]: a2

```
Out[160...]: 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])
```

Numpy Completed

In []: