

Numpy

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

```
Out[3]: '3.12.7 | packaged by Anaconda, Inc. | (main, Oct 4 2024, 13:17:27) [MSC v.192  
9 64 bit (AMD64)]'
```

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

```
Out[1]: '1.26.4'
```

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

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

```
In [3]: arr = np.array(my_list)  
arr
```

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

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

```
<class 'list'>  
<class 'numpy.ndarray'>
```

```
In [9]: np.arange(10)
```

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

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

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

```
In [11]: np.arange(10,50,5)
```

```
Out[11]: array([10, 15, 20, 25, 30, 35, 40, 45])
```

```
In [12]: np.arange(10,30,30, 3)
```

```
-----  
TypeError                                Traceback (most recent call last)  
Cell In[12], line 1  
----> 1 np.arange(10,30,30, 3)  
  
TypeError: Cannot interpret '3' as a data type
```

```
In [13]: np.arange(20,8)
```

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

```
In [14]: np.arange(-20,8)
```

```
Out[14]: 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])
```

```
In [15]: np.zeros(4)
```

```
Out[15]: array([0., 0., 0., 0.])
```

```
In [16]: np.zeros(4, dtype=int)
```

```
Out[16]: array([0, 0, 0, 0])
```

```
In [17]: np.zeros((2,2), dtype=int)
```

```
Out[17]: array([[0, 0],
               [0, 0]])
```

```
In [18]: np.zeros((3,3), dtype=int)
```

```
Out[18]: array([[0, 0, 0],
               [0, 0, 0],
               [0, 0, 0]])
```

```
In [26]: nd = np.zeros((6,9), dtype=int)
nd
```

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

```
In [20]: np.ones(
```

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

```
In [21]: np.ones(4, dtype=int)
```

```
Out[21]: array([1, 1, 1, 1])
```

```
In [22]: np.ones((4,3), dtype=int)
```

```
Out[22]: array([[1, 1, 1],
               [1, 1, 1],
               [1, 1, 1],
               [1, 1, 1]])
```

```
In [27]: nd1 = np.ones((5,7), dtype=int)
nd1
```

```
Out[27]: array([[1, 1, 1, 1, 1, 1, 1],
               [1, 1, 1, 1, 1, 1, 1],
               [1, 1, 1, 1, 1, 1, 1],
               [1, 1, 1, 1, 1, 1, 1],
               [1, 1, 1, 1, 1, 1, 1]])
```

In [28]: `print(nd)`

```
[[0 0 0 0 0 0 0 0]
 [0 0 0 0 0 0 0 0]
 [0 0 0 0 0 0 0 0]
 [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 [29]: `print(nd1)`

```
[[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]]
```

04-07-2025

In [19]: `np.random.rand(2,4)`

Out[19]: `array([[0.28119017, 0.28524358, 0.23693934, 0.89381696],
 [0.89846371, 0.74632344, 0.26853663, 0.43826583]])`

In [29]: `np.random.randint(2,10) # 2nd arg is exclusive`

Out[29]: `6`

In [34]: `np.random.randint(0,1)`

Out[34]: `0`

In [39]: `np.random.randint(10,20,5) # (st.index,end.index>Total no.of items)`

Out[39]: `array([13, 11, 14, 13, 17])`

In [45]: `np.random.randint(20,40,10)`

Out[45]: `array([23, 35, 25, 31, 28, 29, 35, 32, 27, 37])`

In [46]: `np.random.randint(40,30,5) # low >= high (1st value must be < 2nd value)`

```
-----
ValueError                                Traceback (most recent call last)
Cell In[46], line 1
----> 1 np.random.randint(40,30,5)

File numpy\random\mttrand.pyx:780, in numpy.random.mtrand.RandomState.randint()

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

ValueError: low >= high
```

In [52]: `np.random.randint(-30,20,8)`

```
Out[52]: array([ 0,  4, 13, -19,  7, -30, -17, -22])
```

```
In [64]: np.random.randint(5,9)
```

```
Out[64]: 6
```

```
In [67]: np.random.randint(10,40,(10,10))
```

```
Out[67]: array([[11, 37, 21, 20, 38, 20, 28, 25, 35, 17],
 [37, 11, 12, 27, 21, 21, 12, 30, 16, 32],
 [35, 17, 13, 23, 12, 35, 15, 31, 12, 37],
 [27, 37, 30, 28, 24, 31, 22, 20, 12, 13],
 [17, 18, 13, 10, 35, 20, 31, 36, 31, 38],
 [26, 25, 28, 23, 29, 19, 27, 32, 25, 14],
 [37, 26, 37, 18, 39, 10, 22, 24, 19, 31],
 [19, 37, 22, 30, 34, 25, 25, 24, 36, 10],
 [16, 14, 21, 12, 14, 11, 36, 21, 38, 11],
 [25, 11, 17, 26, 15, 29, 34, 23, 34, 20]])
```

```
In [78]: np.random.randint(1,100,(12,12))
```

```
Out[78]: array([[75, 53, 54, 13, 86, 30, 61, 61, 79, 23, 47, 62],
 [89, 57, 70, 80, 34, 29, 37, 78, 79, 78, 84, 96],
 [96, 67, 65, 24, 28, 32, 63, 89, 75, 59, 24, 82],
 [37, 40, 94, 69, 97, 28, 43, 13, 28, 21, 97, 93],
 [57,  9, 52, 53, 17, 59, 85, 78, 69, 29, 82, 78],
 [71,  8, 93, 69, 44, 75, 24, 39,  1, 90, 48, 48],
 [41, 94, 61,  6, 76,  9, 77, 73, 82, 97, 18, 70],
 [23, 77, 41, 78, 29,  9,  2, 64, 72, 33, 84, 68],
 [ 9, 83, 33, 20,  6, 37,  2, 70, 42, 97, 42, 20],
 [40, 68, 68, 95, 13, 61, 11, 95, 91, 36, 97, 34],
 [34, 53, 63, 32, 73, 79, 63, 14,  6, 47, 40, 43],
 [52, 88, 57, 25,  3, 21, 60, 57, 16, 16, 14, 96]])
```

```
In [94]: np.arange(1,13).reshape(3,4)
```

```
Out[94]: array([[ 1,  2,  3,  4],
 [ 5,  6,  7,  8],
 [ 9, 10, 11, 12]])
```

```
In [84]: np.arange(1,13).reshape(12,1)
```

```
Out[84]: array([[ 1],
 [ 2],
 [ 3],
 [ 4],
 [ 5],
 [ 6],
 [ 7],
 [ 8],
 [ 9],
 [10],
 [11],
 [12]])
```

```
In [98]: b = np.random.randint(10,20,(5,4))
b
```

```
Out[98]: array([[14, 14, 16, 10],
               [11, 17, 14, 17],
               [15, 13, 12, 14],
               [14, 17, 11, 11],
               [18, 15, 17, 11]])
```

```
In [99]: type(b)
```

```
Out[99]: numpy.ndarray
```

```
In [100... b
```

```
Out[100... array([[14, 14, 16, 10],
               [11, 17, 14, 17],
               [15, 13, 12, 14],
               [14, 17, 11, 11],
               [18, 15, 17, 11]])
```

```
In [101... b[:]
```

```
Out[101... array([[14, 14, 16, 10],
               [11, 17, 14, 17],
               [15, 13, 12, 14],
               [14, 17, 11, 11],
               [18, 15, 17, 11]])
```

```
In [102... b[1:3]
```

```
Out[102... array([[11, 17, 14, 17],
               [15, 13, 12, 14]])
```

```
In [103... b
```

```
Out[103... array([[14, 14, 16, 10],
               [11, 17, 14, 17],
               [15, 13, 12, 14],
               [14, 17, 11, 11],
               [18, 15, 17, 11]])
```

```
In [104... b[1,2]
```

```
Out[104... 14
```

```
In [105... b[1,3]
```

```
Out[105... 17
```

```
In [106... b[1,-1]
```

```
Out[106... 17
```

```
In [107... b
```

```
Out[107... array([[14, 14, 16, 10],
               [11, 17, 14, 17],
               [15, 13, 12, 14],
               [14, 17, 11, 11],
               [18, 15, 17, 11]])
```

In [108... `b[2:3]`

Out[108... `array([[15, 13, 12, 14]])`

In [109... `b`

Out[109... `array([[14, 14, 16, 10],
[11, 17, 14, 17],
[15, 13, 12, 14],
[14, 17, 11, 11],
[18, 15, 17, 11]])`

In [110... `b[0:-2]`

Out[110... `array([[14, 14, 16, 10],
[11, 17, 14, 17],
[15, 13, 12, 14]])`

In [111... `b[0,2]`

Out[111... `16`

In [112... `b`

Out[112... `array([[14, 14, 16, 10],
[11, 17, 14, 17],
[15, 13, 12, 14],
[14, 17, 11, 11],
[18, 15, 17, 11]])`

In [113... `b[-5,-3]`

Out[113... `14`

In [114... `b[-4,2]`

Out[114... `14`

In [115... `b[-2,-3]`

Out[115... `17`

In [116... `b[-2,1]`

Out[116... `17`

In [117... `np.random.randint(10,20,(4,4))`

Out[117... `array([[15, 19, 15, 15],
[17, 19, 13, 19],
[12, 10, 10, 17],
[12, 18, 16, 12]])`

In [118... `b`

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

```
In [119...] b[-4,-2]
```

```
Out[119...] 14
```

```
In [120...] b[:]
```

```
Out[120...] array([[14, 14, 16, 10],
        [11, 17, 14, 17],
        [15, 13, 12, 14],
        [14, 17, 11, 11],
        [18, 15, 17, 11]])
```

Operations

```
In [122...] a = np.random.randint(10,20,10)
a
```

```
Out[122...] array([13, 16, 18, 18, 17, 14, 18, 19, 11, 13])
```

```
In [123...] id(a)
```

```
Out[123...] 2256720181072
```

```
In [124...] arr
```

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

```
In [125...] arr2 = np.random.randint(0,100,(10,10))
arr2
```

```
Out[125...] array([[43, 41, 48, 73, 18, 65, 54, 72, 46, 32],
        [ 5, 42, 13, 44,  0, 72, 98, 72, 67, 43],
        [45, 25, 95, 80, 89, 91, 92, 94, 63,  9],
        [34, 18, 78, 44, 17,  6, 25, 46, 27, 97],
        [56, 77, 73, 29, 76, 60, 69, 12, 74, 52],
        [34, 48, 90, 93, 15, 37, 31, 85, 94, 68],
        [40, 84, 60, 45, 19, 99,  7, 60,  8, 55],
        [ 4, 93,  9, 27, 34, 73, 97, 83, 27, 75],
        [48,  7, 97, 92, 85, 85, 20, 23, 24, 93],
        [49, 50, 34,  4, 48, 18,  9, 60, 68, 76]])
```

```
In [126...] arr
```

```
Out[126...] array([1, 2, 3, 4, 5])
```

```
In [127...] arr[:]
```

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

```
In [128...] arr[:4]
```

Out[128... array([1, 2, 3, 4])

In [129... arr2[:]

Out[129... array([[43, 41, 48, 73, 18, 65, 54, 72, 46, 32],
[5, 42, 13, 44, 0, 72, 98, 72, 67, 43],
[45, 25, 95, 80, 89, 91, 92, 94, 63, 9],
[34, 18, 78, 44, 17, 6, 25, 46, 27, 97],
[56, 77, 73, 29, 76, 60, 69, 12, 74, 52],
[34, 48, 90, 93, 15, 37, 31, 85, 94, 68],
[40, 84, 60, 45, 19, 99, 7, 60, 8, 55],
[4, 93, 9, 27, 34, 73, 97, 83, 27, 75],
[48, 7, 97, 92, 85, 85, 20, 23, 24, 93],
[49, 50, 34, 4, 48, 18, 9, 60, 68, 76]])

In [130... arr2[0:5]

Out[130... array([[43, 41, 48, 73, 18, 65, 54, 72, 46, 32],
[5, 42, 13, 44, 0, 72, 98, 72, 67, 43],
[45, 25, 95, 80, 89, 91, 92, 94, 63, 9],
[34, 18, 78, 44, 17, 6, 25, 46, 27, 97],
[56, 77, 73, 29, 76, 60, 69, 12, 74, 52]])

In [131... arr2

Out[131... array([[43, 41, 48, 73, 18, 65, 54, 72, 46, 32],
[5, 42, 13, 44, 0, 72, 98, 72, 67, 43],
[45, 25, 95, 80, 89, 91, 92, 94, 63, 9],
[34, 18, 78, 44, 17, 6, 25, 46, 27, 97],
[56, 77, 73, 29, 76, 60, 69, 12, 74, 52],
[34, 48, 90, 93, 15, 37, 31, 85, 94, 68],
[40, 84, 60, 45, 19, 99, 7, 60, 8, 55],
[4, 93, 9, 27, 34, 73, 97, 83, 27, 75],
[48, 7, 97, 92, 85, 85, 20, 23, 24, 93],
[49, 50, 34, 4, 48, 18, 9, 60, 68, 76]])

In [132... arr2[1,4]

Out[132... 0

In [133... arr2[-5,5]

Out[133... 37

In [134... arr2

Out[134... array([[43, 41, 48, 73, 18, 65, 54, 72, 46, 32],
[5, 42, 13, 44, 0, 72, 98, 72, 67, 43],
[45, 25, 95, 80, 89, 91, 92, 94, 63, 9],
[34, 18, 78, 44, 17, 6, 25, 46, 27, 97],
[56, 77, 73, 29, 76, 60, 69, 12, 74, 52],
[34, 48, 90, 93, 15, 37, 31, 85, 94, 68],
[40, 84, 60, 45, 19, 99, 7, 60, 8, 55],
[4, 93, 9, 27, 34, 73, 97, 83, 27, 75],
[48, 7, 97, 92, 85, 85, 20, 23, 24, 93],
[49, 50, 34, 4, 48, 18, 9, 60, 68, 76]])

In [135... arr2[-5,-5]

Out[135... 37

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

Out[136... 68

In [137... `arr2`

Out[137... `array([[43, 41, 48, 73, 18, 65, 54, 72, 46, 32],
[5, 42, 13, 44, 0, 72, 98, 72, 67, 43],
[45, 25, 95, 80, 89, 91, 92, 94, 63, 9],
[34, 18, 78, 44, 17, 6, 25, 46, 27, 97],
[56, 77, 73, 29, 76, 60, 69, 12, 74, 52],
[34, 48, 90, 93, 15, 37, 31, 85, 94, 68],
[40, 84, 60, 45, 19, 99, 7, 60, 8, 55],
[4, 93, 9, 27, 34, 73, 97, 83, 27, 75],
[48, 7, 97, 92, 85, 85, 20, 23, 24, 93],
[49, 50, 34, 4, 48, 18, 9, 60, 68, 76]])`

In [138... `arr2[::-1]`

Out[138... `array([[49, 50, 34, 4, 48, 18, 9, 60, 68, 76],
[48, 7, 97, 92, 85, 85, 20, 23, 24, 93],
[4, 93, 9, 27, 34, 73, 97, 83, 27, 75],
[40, 84, 60, 45, 19, 99, 7, 60, 8, 55],
[34, 48, 90, 93, 15, 37, 31, 85, 94, 68],
[56, 77, 73, 29, 76, 60, 69, 12, 74, 52],
[34, 18, 78, 44, 17, 6, 25, 46, 27, 97],
[45, 25, 95, 80, 89, 91, 92, 94, 63, 9],
[5, 42, 13, 44, 0, 72, 98, 72, 67, 43],
[43, 41, 48, 73, 18, 65, 54, 72, 46, 32]])`

In [139... `arr2[::-2]`

Out[139... `array([[49, 50, 34, 4, 48, 18, 9, 60, 68, 76],
[4, 93, 9, 27, 34, 73, 97, 83, 27, 75],
[34, 48, 90, 93, 15, 37, 31, 85, 94, 68],
[34, 18, 78, 44, 17, 6, 25, 46, 27, 97],
[5, 42, 13, 44, 0, 72, 98, 72, 67, 43]])`

In [140... `arr2`

Out[140... `array([[43, 41, 48, 73, 18, 65, 54, 72, 46, 32],
[5, 42, 13, 44, 0, 72, 98, 72, 67, 43],
[45, 25, 95, 80, 89, 91, 92, 94, 63, 9],
[34, 18, 78, 44, 17, 6, 25, 46, 27, 97],
[56, 77, 73, 29, 76, 60, 69, 12, 74, 52],
[34, 48, 90, 93, 15, 37, 31, 85, 94, 68],
[40, 84, 60, 45, 19, 99, 7, 60, 8, 55],
[4, 93, 9, 27, 34, 73, 97, 83, 27, 75],
[48, 7, 97, 92, 85, 85, 20, 23, 24, 93],
[49, 50, 34, 4, 48, 18, 9, 60, 68, 76]])`

In [141... `arr2[::-3]`

Out[141... `array([[49, 50, 34, 4, 48, 18, 9, 60, 68, 76],
[40, 84, 60, 45, 19, 99, 7, 60, 8, 55],
[34, 18, 78, 44, 17, 6, 25, 46, 27, 97],
[43, 41, 48, 73, 18, 65, 54, 72, 46, 32]])`

In [142... `arr2[:-3]`

Out[142... `array([[43, 41, 48, 73, 18, 65, 54, 72, 46, 32],
[5, 42, 13, 44, 0, 72, 98, 72, 67, 43],
[45, 25, 95, 80, 89, 91, 92, 94, 63, 9],
[34, 18, 78, 44, 17, 6, 25, 46, 27, 97],
[56, 77, 73, 29, 76, 60, 69, 12, 74, 52],
[34, 48, 90, 93, 15, 37, 31, 85, 94, 68],
[40, 84, 60, 45, 19, 99, 7, 60, 8, 55]])`

In [143... `arr`

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

In [144... `arr.max()`

Out[144... `5`

In [148... `arr.min()`

Out[148... `1`

In [149... `arr`

Out[149... `array([1, 2, 3, 4, 5])`

In [150... `arr.mean()`

Out[150... `3.0`

In [153... `arr.median()`

```
-----  
AttributeError                                Traceback (most recent call last)  
Cell In[153], line 1  
----> 1 arr.median()  
  
AttributeError: 'numpy.ndarray' object has no attribute 'median'
```

In [154... `from numpy import *
a = ([1,2,3,4,5])
median(a)`

Out[154... `3.0`

In [155... `arr`

Out[155... `array([1, 2, 3, 4, 5])`

In [160... `arr3 = ([0,1,2,3,4,5])
arr3`

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

In [163... `arr3.reshape(3,2)`

```
-----  
AttributeError                                Traceback (most recent call last)  
Cell In[163], line 1  
----> 1 arr3.reshape(3,2)  
  
AttributeError: 'list' object has no attribute 'reshape'
```

```
In [164... arr.reshape(2,3,order='C')
```

```
-----  
ValueError                                Traceback (most recent call last)  
Cell In[164], line 1  
----> 1 arr.reshape(2,3,order='C')  
  
ValueError: cannot reshape array of size 5 into shape (2,3)
```

Indexing

```
In [166... mat = np.arange(0,100).reshape(10,10)  
mat
```

```
Out[166... array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],  
        [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],  
        [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],  
        [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],  
        [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],  
        [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],  
        [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],  
        [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],  
        [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],  
        [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [167... row = 4  
col = 5
```

```
In [168... row
```

```
Out[168... 4
```

```
In [169... col
```

```
Out[169... 5
```

```
In [170... mat[row,col]
```

```
Out[170... 45
```

```
In [171... mat
```

```
Out[171...] array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
        [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
        [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
        [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
        [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
        [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
        [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
        [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
        [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
        [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [172...] col = 6
```

```
In [173...] mat[6]
```

```
Out[173...] array([60, 61, 62, 63, 64, 65, 66, 67, 68, 69])
```

```
In [174...] mat[row,:]
```

```
Out[174...] array([40, 41, 42, 43, 44, 45, 46, 47, 48, 49])
```

```
In [175...] mat[row::]
```

```
Out[175...] array([[40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
        [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
        [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
        [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
        [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
        [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [176...] mat
```

```
Out[176...] array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
        [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
        [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
        [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
        [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
        [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
        [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
        [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
        [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
        [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [177...] mat[:,8]
```

```
Out[177...] array([ 8, 18, 28, 38, 48, 58, 68, 78, 88, 98])
```

```
In [178...] mat[:,col]
```

```
Out[178...] array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])
```

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

```
Out[179...] array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
        [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
        [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
        [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
        [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
        [50, 51, 52, 53, 54, 55, 56, 57, 58, 59]])
```

```
In [180...] row
```

```
Out[180...] 4
```

```
In [181...] mat
```

```
Out[181...] array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
        [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
        [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
        [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
        [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
        [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
        [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
        [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
        [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
        [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [182...] mat[:row]
```

```
Out[182...] 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 [183...] mat[row:]
```

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

```
Out[184...] 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 [185...] mat[:,8]
```

```
Out[185...] array([ 8, 18, 28, 38, 48, 58, 68, 78, 88, 98])
```

```
In [186...] mat[:, -1]
```

```
Out[186...] array([ 9, 19, 29, 39, 49, 59, 69, 79, 89, 99])
```

```
In [187...] mat
```

```
Out[187...] 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 [188...] row
```

```
Out[188...] 4
```

```
In [189...] col
```

```
Out[189...] 6
```

```
In [191...] mat[:,col]
```

```
Out[191...] array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])
```

```
In [192...] mat[1,4]
```

```
Out[192...] 14
```

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

```
Out[193...] array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
 [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
 [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
 [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
 [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
 [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
 [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
 [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
 [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
 [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [194...] mat[1:4]
```

```
Out[194...] array([[10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
 [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
 [30, 31, 32, 33, 34, 35, 36, 37, 38, 39]])
```

```
In [195...] mat[3:-3]
```

```
Out[195...] 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 [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[0]
```

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

```
In [198...] mat[6]
```

```
Out[198...] array([60, 61, 62, 63, 64, 65, 66, 67, 68, 69])
```

```
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[6:]
```

```
Out[200...] 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 [201...] mat[:6]
```

```
Out[201...] array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
          [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
          [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
          [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
          [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
          [50, 51, 52, 53, 54, 55, 56, 57, 58, 59]])
```

```
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[5:7]
```

```
Out[203...] array([[50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
          [60, 61, 62, 63, 64, 65, 66, 67, 68, 69]])
```

```
In [204...] mat[0:10]
```

```
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[0:10:3]
```

```
Out[205...] 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 [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[4:]
```

```
Out[207...] 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 [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[:,4]
```

```
Out[209...] array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
        [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
        [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
        [30, 31, 32, 33, 34, 35, 36, 37, 38, 39]])
```

```
In [210...] mat[::-1]
```

```
Out[210...] 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 [211...] mat[::-3]
```

```
Out[211...] 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 [213...] mat[::-5]
```

```
Out[213...] array([[90, 91, 92, 93, 94, 95, 96, 97, 98, 99],
        [40, 41, 42, 43, 44, 45, 46, 47, 48, 49]])
```

```
In [214...] mat
```

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

```
Out[215...] 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 [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 [216...] mat[2:6,2:4]
```

```
Out[216...] array([[22, 23],
        [32, 33],
        [42, 43],
        [52, 53]])
```

```
In [218...] mat[3:6,6:9]
```

```
Out[218...] array([[36, 37, 38],
        [46, 47, 48],
        [56, 57, 58]])
```

```
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[0,1]
```

```
Out[220...] 1
```

```
In [221...] mat[1,6]
```

```
Out[221...] 16
```

```
In [222...] mat[1:6]
```

```
Out[222...] 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 [223... `mat[1:]`

Out[223... `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 [224... `mat[:6]`

Out[224... `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 [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[0:1]`

Out[226... `array([[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]])`

In [227... `mat[3:5]`

Out[227... `array([[30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
[40, 41, 42, 43, 44, 45, 46, 47, 48, 49]])`

In [228... `mat[3,5]`

Out[228... `35`

In [229... `mat`

Out[229... `array([[0, 1, 2, 3, 4, 5, 6, 7, 8, 9],
[10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
[20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
[30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
[40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
[50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
[60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
[70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
[80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
[90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])`

```
In [230...] mat[1:2,2:4]
```

```
Out[230...] array([[12, 13]])
```

```
In [231...] mat[2:3,2:3]
```

```
Out[231...] array([[22]])
```

```
In [232...] mat
```

```
Out[232...] 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 [233...] mat[2:4,3:5]
```

```
Out[233...] array([[23, 24],
                  [33, 34]])
```

```
In [234...] mat[3:5,2:4]
```

```
Out[234...] array([[32, 33],
                  [42, 43]])
```

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

```
Out[235...] array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
                  [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
                  [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
                  [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
                  [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
                  [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
                  [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
                  [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
                  [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
                  [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [236...] mat[2:3,4:5]
```

```
Out[236...] array([[24]])
```

Masking

```
In [237...] mat # We also called as filter
```

```
Out[237...] 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 [238...] id(mat)
```

```
Out[238...] 2256746782448
```

```
In [239...] type(mat)
```

```
Out[239...] numpy.ndarray
```

```
In [240...] mat
```

```
Out[240...] 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[mat<50]
```

```
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])
```

```
In [245...] mat>50
```

```
Out[245...] 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 [244...] mat[mat>50]
```

```
Out[244...] 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 [246...] mat[mat==50]
```

```
Out[246...] array([50])
```

```
In [248...] a = mat[mat<=50]
a
```

```
Out[248...] 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 [249...] b = mat[mat>=50]
b
```

```
Out[249...] 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 [ ]:
```

```
In [ ]:
```