

30th April 2025

Numpy

```
In [2]: import numpy as np
```

```
In [3]: np.__version__
```

```
Out[3]: '1.26.1'
```

```
In [4]: import sys  
sys.version
```

```
Out[4]: '3.12.4 | packaged by Anaconda, Inc. | (main, Jun 18 2024, 15:03:56) [MSC v.1929 6  
4 bit (AMD64)]'
```

Creating a List

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

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

```
In [6]: print(type(my_list))
```

```
<class 'list'>
```

Creating an Array using List

```
In [9]: np.array([my_list])
```

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

```
In [10]: np.array(10)
```

```
Out[10]: array(10)
```

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

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

```
In [13]: np.arange(5)
```

```
Out[13]: array([0, 1, 2, 3, 4])
```

```
In [14]: np.arange(5.0)
```

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 [18]: `np.arange(20,10) # first num < sec num`

Out[18]: array([], dtype=int32)

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

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

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

In [23]: `ar =np.arange(30,20) # 1st argg always < 2nd arg`
`ar`

Out[23]: array([], dtype=int32)

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

Out[24]: array([], dtype=int32)

In [25]: `np.arange()`

```
-----
TypeError                                Traceback (most recent call last)
Cell In[25], line 1
----> 1 np.arange()

TypeError: arange() requires stop to be specified.
```

In [26]: `np.arange(1,10,5)`

Out[26]: array([1, 6])

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 [30]: `np.zeros(10) # Parameter tuning`

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

```
In [31]: np.zeros(10, dtype=int)    # Hyperparameter tuning
```

```
Out[31]: array([0, 0, 0, 0, 0, 0, 0, 0, 0, 0])
```

```
In [32]: np.zeros((2,2), dtype=int)
```

```
Out[32]: array([[0, 0],  
               [0, 0]])
```

```
In [33]: np.zeros((3,3), dtype=int)
```

```
Out[33]: array([[0, 0, 0],  
               [0, 0, 0],  
               [0, 0, 0]])
```

```
In [34]: np.array([my_list])
```

```
Out[34]: array([[0, 1, 2, 3, 4, 5]])
```

```
In [35]: np.zeros((4,4), dtype=int)
```

```
Out[35]: array([[0, 0, 0, 0],  
               [0, 0, 0, 0],  
               [0, 0, 0, 0],  
               [0, 0, 0, 0]])
```

```
In [36]: np.zeros((5,5), dtype=int)
```

```
Out[36]: 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]])
```

```
In [37]: np.zeros((2,10))
```

```
Out[37]: array([[0., 0., 0., 0., 0., 0., 0., 0., 0., 0.],  
               [0., 0., 0., 0., 0., 0., 0., 0., 0., 0.]])
```

```
In [38]: np.zeros((10,30), dtype=int)
```

[illegible]

```
In [39]: np.zeros((10,10), dtype=int)
```

[illegible]

ONE Functions

```
In [40]: np.ones(3)
```

```
Out[40]: array([1., 1., 1.])
```

```
In [41]: np.ones(3, dtype=int)
```

```
Out[41]: array([1, 1, 1])
```

```
In [42]: np.ones((4,4))
```

```
Out[42]: array([[1., 1., 1., 1.],
                [1., 1., 1., 1.],
                [1., 1., 1., 1.],
                [1., 1., 1., 1.]])
```

```
In [43]: np.ones((3,3))
```

```
Out[43]: array([[1., 1., 1.],
               [1., 1., 1.],
               [1., 1., 1.]])
```

3 RAND Functions

```
In [44]: np.ones(4)
```

```
Out[44]: array([1., 1., 1., 1.])
```

```
In [45]: np.ones(4,dtype=int)
```

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

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

```
Out[48]: array([[0.53215214, 0.55113967],
               [0.01919176, 0.44031336],
               [0.56235325, 0.55182636]])
```

```
In [49]: np.random.rand(5)
```

```
Out[49]: array([0.24715308, 0.64198416, 0.02278619, 0.6869118 , 0.86693751])
```

```
In [52]: np.random.rand(3,5)
```

```
Out[52]: array([[0.84762806, 0.44238312, 0.52780289, 0.58573994, 0.93903461],
               [0.81864088, 0.62356401, 0.77740526, 0.45181751, 0.30339386],
               [0.53287994, 0.32679012, 0.58395963, 0.19686035, 0.61915998]])
```

```
In [55]: np.random.randint(5)
```

```
Out[55]: 3
```

```
In [58]: np.random.randint(2,5)
```

```
Out[58]: 2
```

```
In [59]: np.random.randint(5,2)  # 1st arg < 2nd arg
```

ValueError

Traceback (most recent call last)

Cell In[59], line 1

```
----> 1 np.random.randint(5,2)
```

File `numpy\random\mtrand.pyx:779`, in `numpy.random.mtrand.RandomState.randint()`

File `numpy\random_bounded_integers.pyx:2885`, in `numpy.random._bounded_integers._rand_int32()`

ValueError: low >= high

```
In [60]: np.random.randint(5,14)
```

```
Out[60]: 11
```

```
In [61]: np.random.randint(5,20,4,5)
```

```
-----
TypeError                                Traceback (most recent call last)
Cell In[61], line 1
----> 1 np.random.randint(5,20,4,5)

File numpy\\random\\mtrand.pyx:760, in numpy.random.mtrand.RandomState.randint()

TypeError: Cannot interpret '5' as a data type
```

```
In [62]: np.random.randint(5,15,3)
```

```
Out[62]: array([ 7, 14,  9])
```

```
In [64]: np.random.randint(5,10,(10,10))
```

```
Out[64]: array([[6, 6, 5, 8, 8, 6, 9, 6, 7, 9],
                [8, 7, 6, 6, 6, 5, 6, 9, 8, 7],
                [9, 8, 6, 9, 7, 7, 5, 7, 5, 7],
                [9, 5, 5, 5, 6, 9, 8, 5, 5, 5],
                [6, 7, 5, 8, 5, 8, 9, 8, 9, 8],
                [7, 9, 8, 5, 9, 9, 7, 7, 7, 8],
                [6, 9, 8, 7, 6, 5, 5, 7, 6, 8],
                [9, 5, 8, 9, 9, 9, 8, 8, 8, 8],
                [9, 5, 5, 6, 9, 8, 9, 7, 7, 8],
                [9, 8, 8, 7, 9, 8, 5, 5, 7, 8]])
```

```
In [65]: np.random.randint(1,100,(12,12))
```

```
Out[65]: array([[18, 50, 53, 17, 84,  7, 79, 56, 56, 75, 79, 47],
                [47, 34, 13, 44, 81, 27, 35, 60, 50, 37, 80, 78],
                [77, 73, 66, 96, 22, 82, 93, 10, 31, 45, 38, 56],
                [45, 88, 35, 23, 25, 16, 72, 97, 97, 69,  5, 37],
                [35, 90, 47, 67, 91, 11, 61, 75, 50, 57, 64, 79],
                [89, 30, 91, 61, 12, 18, 44, 69, 96, 22, 54, 34],
                [37,  5, 87, 57, 14, 88, 50, 49, 78, 96, 76, 91],
                [24, 13, 51, 69, 75, 52, 87,  4, 43, 50, 92, 35],
                [65, 88, 96, 79, 61, 81, 86, 92, 50, 91, 48, 91],
                [ 9, 72, 13, 99, 51, 57, 29, 65, 53, 85,  4, 33],
                [19, 24, 46, 18, 49, 88, 28, 84, 76, 47,  5, 39],
                [31, 99, 93, 20, 42, 42, 11, 37, 90,  6, 65, 63]])
```

```
In [66]: np.arange(1,13).reshape(4,3)
```

```
Out[66]: array([[ 1,  2,  3],
                [ 4,  5,  6],
                [ 7,  8,  9],
                [10, 11, 12]])
```

```
In [68]: b = np.random.randint(10,20,(5,4))  
b
```

```
Out[68]: array([[13, 13, 11, 17],  
               [17, 19, 10, 17],  
               [13, 17, 12, 12],  
               [10, 19, 13, 11],  
               [12, 14, 18, 16]])
```

01st May 2025

Slicing in Matrix

```
In [4]: import numpy as np  
b = np.random.randint(10,20,(5,4))    # 5 rows & 4 columns between 10 to 20  
print(b)
```

```
[[14 13 18 12]  
 [11 12 18 16]  
 [10 19 19 17]  
 [18 15 17 11]  
 [17 15 13 14]]
```

```
In [5]: print(type(b))  
  
<class 'numpy.ndarray'>
```

```
In [6]: b
```

```
Out[6]: array([[14, 13, 18, 12],  
               [11, 12, 18, 16],  
               [10, 19, 19, 17],  
               [18, 15, 17, 11],  
               [17, 15, 13, 14]])
```

```
In [7]: b[:]    # Slicing
```

```
Out[7]: array([[14, 13, 18, 12],  
               [11, 12, 18, 16],  
               [10, 19, 19, 17],  
               [18, 15, 17, 11],  
               [17, 15, 13, 14]])
```

```
In [11]: b[2:6]    # print the rows 2nd row till 5th row
```

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

```
In [10]: b[2,6]    # from the 2nd row print 6th column
```

```
Out[10]: 16
```

```
In [13]: b[1,-1]
```

```
Out[13]: 16
```

```
In [14]: b
```

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

```
In [18]: b[2:3]
```

```
Out[18]: array([[10, 19, 19, 17]])
```

```
In [19]: b[0:-2]
```

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

```
In [20]: b
```

```
Out[20]: array([[14, 13, 18, 12],
                [11, 12, 18, 16],
                [10, 19, 19, 17],
                [18, 15, 17, 11],
                [17, 15, 13, 14]])
```

```
In [21]: b[0,2]
```

```
Out[21]: 18
```

```
In [22]: b
```

```
Out[22]: array([[14, 13, 18, 12],
                [11, 12, 18, 16],
                [10, 19, 19, 17],
                [18, 15, 17, 11],
                [17, 15, 13, 14]])
```

```
In [23]: b[-5,-3]
```

```
Out[23]: 13
```

```
In [24]: b[-4,2]
```

```
Out[24]: 18
```

Operations


```
In [27]: a = np.random.randint(10,20,10)
a
```

```
Out[27]: array([17, 10, 15, 11, 10, 14, 11, 11, 12, 12])
```

```
In [28]: id(a)
```

```
Out[28]: 1685125318768
```

```
In [31]: arr2 = np.random.randint(0,100,(10,10))
arr2
```

```
Out[31]: array([[75, 44, 77, 48,  4, 77, 94, 35, 42, 12],
 [66, 99, 36, 42, 95, 33, 94, 98,  9, 60],
 [38, 99, 34, 42, 69, 13, 93,  2, 32, 27],
 [23, 30, 37, 82, 49, 72, 10,  3, 49, 96],
 [80, 77, 85, 75, 36, 98, 65, 12, 36, 28],
 [ 6, 34, 35, 59,  5,  7,  0, 55, 42, 10],
 [27, 50, 25, 92, 43, 21, 53, 24, 70, 16],
 [54, 97, 74, 59,  0, 40, 41, 52, 13, 96],
 [21, 12, 45,  3, 59, 60, 57, 22, 93, 72],
 [22, 64, 78, 93, 49, 66, 27, 44, 78, 18]])
```

```
In [33]: arr = [0,1,2,3,4,5]
np.array(arr)
```

```
Out[33]: array([0, 1, 2, 3, 4, 5])
```

```
In [34]: arr[:]
```

```
Out[34]: [0, 1, 2, 3, 4, 5]
```

```
In [35]: arr[:4]
```

```
Out[35]: [0, 1, 2, 3]
```

```
In [36]: arr2
```

```
Out[36]: array([[75, 44, 77, 48,  4, 77, 94, 35, 42, 12],
 [66, 99, 36, 42, 95, 33, 94, 98,  9, 60],
 [38, 99, 34, 42, 69, 13, 93,  2, 32, 27],
 [23, 30, 37, 82, 49, 72, 10,  3, 49, 96],
 [80, 77, 85, 75, 36, 98, 65, 12, 36, 28],
 [ 6, 34, 35, 59,  5,  7,  0, 55, 42, 10],
 [27, 50, 25, 92, 43, 21, 53, 24, 70, 16],
 [54, 97, 74, 59,  0, 40, 41, 52, 13, 96],
 [21, 12, 45,  3, 59, 60, 57, 22, 93, 72],
 [22, 64, 78, 93, 49, 66, 27, 44, 78, 18]])
```

```
In [37]: arr2[:]
```

```
Out[37]: array([[75, 44, 77, 48,  4, 77, 94, 35, 42, 12],
               [66, 99, 36, 42, 95, 33, 94, 98,  9, 60],
               [38, 99, 34, 42, 69, 13, 93,  2, 32, 27],
               [23, 30, 37, 82, 49, 72, 10,  3, 49, 96],
               [80, 77, 85, 75, 36, 98, 65, 12, 36, 28],
               [ 6, 34, 35, 59,  5,  7,  0, 55, 42, 10],
               [27, 50, 25, 92, 43, 21, 53, 24, 70, 16],
               [54, 97, 74, 59,  0, 40, 41, 52, 13, 96],
               [21, 12, 45,  3, 59, 60, 57, 22, 93, 72],
               [22, 64, 78, 93, 49, 66, 27, 44, 78, 18]])
```

```
In [38]: arr2[0:5]
```

```
Out[38]: array([[75, 44, 77, 48,  4, 77, 94, 35, 42, 12],
               [66, 99, 36, 42, 95, 33, 94, 98,  9, 60],
               [38, 99, 34, 42, 69, 13, 93,  2, 32, 27],
               [23, 30, 37, 82, 49, 72, 10,  3, 49, 96],
               [80, 77, 85, 75, 36, 98, 65, 12, 36, 28]])
```

```
In [39]: arr2[1,5]
```

```
Out[39]: 33
```

```
In [40]: arr2
```

```
Out[40]: array([[75, 44, 77, 48,  4, 77, 94, 35, 42, 12],
               [66, 99, 36, 42, 95, 33, 94, 98,  9, 60],
               [38, 99, 34, 42, 69, 13, 93,  2, 32, 27],
               [23, 30, 37, 82, 49, 72, 10,  3, 49, 96],
               [80, 77, 85, 75, 36, 98, 65, 12, 36, 28],
               [ 6, 34, 35, 59,  5,  7,  0, 55, 42, 10],
               [27, 50, 25, 92, 43, 21, 53, 24, 70, 16],
               [54, 97, 74, 59,  0, 40, 41, 52, 13, 96],
               [21, 12, 45,  3, 59, 60, 57, 22, 93, 72],
               [22, 64, 78, 93, 49, 66, 27, 44, 78, 18]])
```

```
In [41]: arr2[-5,5]
```

```
Out[41]: 7
```

```
In [42]: arr2[-1,-2]
```

```
Out[42]: 78
```

```
In [43]: arr2[:, :-1]
```

```
Out[43]: array([[22, 64, 78, 93, 49, 66, 27, 44, 78, 18],
               [21, 12, 45,  3, 59, 60, 57, 22, 93, 72],
               [54, 97, 74, 59,  0, 40, 41, 52, 13, 96],
               [27, 50, 25, 92, 43, 21, 53, 24, 70, 16],
               [ 6, 34, 35, 59,  5,  7,  0, 55, 42, 10],
               [80, 77, 85, 75, 36, 98, 65, 12, 36, 28],
               [23, 30, 37, 82, 49, 72, 10,  3, 49, 96],
               [38, 99, 34, 42, 69, 13, 93,  2, 32, 27],
               [66, 99, 36, 42, 95, 33, 94, 98,  9, 60],
               [75, 44, 77, 48,  4, 77, 94, 35, 42, 12]])
```

```
In [44]: arr2
```

```
Out[44]: array([[75, 44, 77, 48,  4, 77, 94, 35, 42, 12],
               [66, 99, 36, 42, 95, 33, 94, 98,  9, 60],
               [38, 99, 34, 42, 69, 13, 93,  2, 32, 27],
               [23, 30, 37, 82, 49, 72, 10,  3, 49, 96],
               [80, 77, 85, 75, 36, 98, 65, 12, 36, 28],
               [ 6, 34, 35, 59,  5,  7,  0, 55, 42, 10],
               [27, 50, 25, 92, 43, 21, 53, 24, 70, 16],
               [54, 97, 74, 59,  0, 40, 41, 52, 13, 96],
               [21, 12, 45,  3, 59, 60, 57, 22, 93, 72],
               [22, 64, 78, 93, 49, 66, 27, 44, 78, 18]])
```

```
In [45]: arr2[:, :-2]
```

```
Out[45]: array([[22, 64, 78, 93, 49, 66, 27, 44, 78, 18],
               [54, 97, 74, 59,  0, 40, 41, 52, 13, 96],
               [ 6, 34, 35, 59,  5,  7,  0, 55, 42, 10],
               [23, 30, 37, 82, 49, 72, 10,  3, 49, 96],
               [66, 99, 36, 42, 95, 33, 94, 98,  9, 60]])
```

```
In [46]: arr2[:, :-3]
```

```
Out[46]: array([[22, 64, 78, 93, 49, 66, 27, 44, 78, 18],
               [27, 50, 25, 92, 43, 21, 53, 24, 70, 16],
               [23, 30, 37, 82, 49, 72, 10,  3, 49, 96],
               [75, 44, 77, 48,  4, 77, 94, 35, 42, 12]])
```

```
In [50]: np.array(arr)
```

```
Out[50]: array([0, 1, 2, 3, 4, 5])
```

```
In [55]: arr2
```

```
Out[55]: array([[75, 44, 77, 48,  4, 77, 94, 35, 42, 12],
               [66, 99, 36, 42, 95, 33, 94, 98,  9, 60],
               [38, 99, 34, 42, 69, 13, 93,  2, 32, 27],
               [23, 30, 37, 82, 49, 72, 10,  3, 49, 96],
               [80, 77, 85, 75, 36, 98, 65, 12, 36, 28],
               [ 6, 34, 35, 59,  5,  7,  0, 55, 42, 10],
               [27, 50, 25, 92, 43, 21, 53, 24, 70, 16],
               [54, 97, 74, 59,  0, 40, 41, 52, 13, 96],
               [21, 12, 45,  3, 59, 60, 57, 22, 93, 72],
               [22, 64, 78, 93, 49, 66, 27, 44, 78, 18]])
```

```
In [56]: arr2.max()
```

```
Out[56]: 99
```

```
In [57]: arr2.min()
```

```
Out[57]: 0
```

```
In [60]: np.array(arr)
```

```
Out[60]: array([0, 1, 2, 3, 4, 5])
```

```
In [62]: arr2.mean()
```

```
Out[62]: 48.15
```

```
In [63]: arr2.median()
```

```
-----  
AttributeError                                Traceback (most recent call last)  
Cell In[63], line 1  
----> 1 arr2.median()  
  
AttributeError: 'numpy.ndarray' object has no attribute 'median'
```

```
In [66]: from numpy import *  
a = array([1,2,3,4,9])  
median(a)
```

```
Out[66]: 3.0
```

```
In [68]: np.array(arr)
```

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

Indexing

```
In [75]: mat = np.arange(0,100).reshape(10,10)  
mat
```

```
Out[75]: 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 [76]: row = 4  
        col = 5
```

```
In [77]: row
```

```
Out[77]: 4
```

```
In [78]: col
```

```
Out[78]: 5
```

```
In [79]: mat
```

```
Out[79]: 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 [80]: mat[row,col]
```

```
Out[80]: 45
```

```
In [81]: mat[4,5]
```

```
Out[81]: 45
```

```
In [82]: mat[:,]
```

```
Out[82]: 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 [83]: col = 6
```

```
In [84]: mat
```

```
Out[84]: 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]])
```

With Slices

```
In [85]: mat[:,col]
```

```
Out[85]: array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])
```

```
In [86]: mat
```

```
Out[86]: 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 [87]: mat[row,:]
```

```
Out[87]: array([40, 41, 42, 43, 44, 45, 46, 47, 48, 49])
```

```
In [88]: mat
```

```
Out[88]: 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 [89]: mat[:,col]
```

```
Out[89]: array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])
```

```
In [90]: mat[:,col]
```

```
Out[90]: 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 [91]: row
```

```
Out[91]: 4
```

```
In [92]: 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]: mat[:row]
```

```
Out[93]: 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 [94]: mat[row:]
```

```
Out[94]: 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 [95]: mat[:]
```

```
Out[95]: 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 [96]: mat[:,8]
```

```
Out[96]: array([ 8, 18, 28, 38, 48, 58, 68, 78, 88, 98])
```

```
In [97]: mat
```

```
Out[97]: 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[:, -1]
```

```
Out[98]: array([ 9, 19, 29, 39, 49, 59, 69, 79, 89, 99])
```

```
In [99]: mat
```

```
Out[99]: 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 [100... mat[:, col]
```

```
Out[100... array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])
```

```
In [101... mat[1,4]
```

```
Out[101... 14
```

```
In [102... mat[1:4]
```

```
Out[102... 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 [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[3,-3]
```

```
Out[104...] 37
```

```
In [105...] mat[3:-3]
```

```
Out[105...] 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 [106...] mat
```

```
Out[106...] 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 [107...] mat[0]
```

```
Out[107...] array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])
```

```
In [108...] mat[6]
```

```
Out[108...] array([60, 61, 62, 63, 64, 65, 66, 67, 68, 69])
```

```
In [109...] mat
```

```
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],
          [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 [110...] mat[6:]
```

```
Out[110...] 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 [111...] mat[:6]
```

```
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]])
```

```
In [112...] mat
```

```
Out[112...] 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 [113...] mat[5:7]
```

```
Out[113...] array([[50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
        [60, 61, 62, 63, 64, 65, 66, 67, 68, 69]])
```

```
In [114...] mat[0:10]
```

```
Out[114...] 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 [115...] mat[0:10:3]
```

```
Out[115...] 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 [116...] mat
```

```
Out[116...] 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 [117...] mat[::-1]
```

```
Out[117...] 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 [118...] mat[::-2]
```

```
Out[118...] 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 [119...] mat[::-5]
```

```
Out[119...] array([[90, 91, 92, 93, 94, 95, 96, 97, 98, 99],
        [40, 41, 42, 43, 44, 45, 46, 47, 48, 49]])
```

```
In [120...] mat
```

```
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],
        [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 [121...] mat[2:6,2:4]
```

```
Out[121...] array([[22, 23],
        [32, 33],
        [42, 43],
        [52, 53]])
```

```
In [122... mat[0,1]
```

```
Out[122... 1
```

```
In [123... mat
```

```
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[1:2,2:4]
```

```
Out[124... array([[12, 13]])
```

```
In [126... mat[3:5,2:4]
```

```
Out[126... array([[32, 33],
        [42, 43]])
```

```
In [127... mat[2:3,4:5]
```

```
Out[127... array([[24]])
```

Masking

- Also called as Filter

```
In [128... mat
```

```
Out[128... 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 [129... id(mat)
```

```
Out[129... 1685127704144
```

```
In [130... mat < 50
```

```
Out[130...] 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],
       [False, False, False, False, False, False, False, False, False,
        False],
       [False, False, False, False, False, False, False, False, False,
        False],
       [False, False, False, False, False, False, False, False, False,
        False],
       [False, False, False, False, False, False, 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 [131...] mat > 50
```

```
Out[131...] 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 [132...] mat == 50
```

```
Out[132...] 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 [133...] mat[mat==50]
```

```
Out[133...] array([50])
```

```
In [134...] a1 = mat[mat<50]
a1
```

```
Out[134...] 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 [135...] a2 = mat[mat>50]
a2
```

```
Out[135...] 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 [136...] a3 = mat[mat>=50]
a3
```

```
Out[136...] 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 [137...] a4 = mat[mat==50]
a4
```

```
Out[137...] array([50])
```

```
In [138...] mat>50
```

```
Out[138...] 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 [139...] a1
```

```
Out[139...] 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 [140...] a2
```

```
Out[140...] 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])
```