

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

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

```
Out[2]: '1.26.4'
```

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

```
Out[3]: '3.12.7 | packaged by Anaconda, Inc. | (main, Oct 4 2024, 13:17:27) [MSC v.1929 6  
4 bit (AMD64)]'
```

## Creating Arrays

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

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

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

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

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

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

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

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

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

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

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

```
In [10]: np. # we Learn important function
```

```
Cell In[10], line 1  
np. # we learn important function  
^  
SyntaxError: invalid syntax
```

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

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

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

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

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

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

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

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

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

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

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

```
Out[16]: array([], dtype=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) # 1st arg always be < then 2nd arg
```

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

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

```
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 [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(10,30,5) # 10- starting from 30- end point 5 - step count
```

```
Out[26]: array([10, 15, 20, 25])
```

```
In [27]: np.arange(0,10,3)
```

```
Out[27]: array([0, 3, 6, 9])
```

```
In [28]: np.arange(10,30,5,8)
```

```
-----  
TypeError                                         Traceback (most recent call last)  
Cell In[28], line 1  
----> 1 np.arange(10,30,5,8)  
  
TypeError: Cannot interpret '8' as a data type
```

```
In [29]: np.zeros(3) # parameter tuning
```

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

```
In [30]: np.zeros(5, dtype=int) # hyperparameter tuning
```

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

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

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

```
In [32]: zero = np.zeros([2,2])  
print(zero)  
print(type(zero))
```

```
[[0. 0.]  
 [0. 0.]]  
<class 'numpy.ndarray'>
```

```
In [33]: zero = np.zeros([2,2])  
print(zero)  
  
print('####')  
  
print(type(zero))
```





```
[0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.],
[0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.]])
```

In [42]: `np.zeros((5,10)) # by default 1arge -- will give row & 2nd arg - columns`

Out[42]: `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.]])`

In [45]: `n = (6,7)
n1 = (6,8)
print(np.zeros(n1)) # parameter tuning`

```
[[0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 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 [46]: `n = (6,7)
n1 = (6,8)
print(np.zeros(n)) # parameter tuning`

```
[[0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 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 [47]: `print(np.zeros(n,dtype=int)) ## hyperparameter tuning`

```
[[0 0 0 0 0 0 0]
 [0 0 0 0 0 0 0]
 [0 0 0 0 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 [48]: `n`

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

In [49]: `n1`

Out[49]: `(6, 8)`

In [52]: `print(np.zeros(n1))`

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

```
In [53]: np.ones(3)
```

```
Out[53]: array([1., 1., 1.])
```

```
In [57]: np.ones(4, dtype=int)
```

```
Out[57]: array([1, 1, 1, 1])
```

```
In [58]: np.ones(4)
```

```
Out[58]: array([1., 1., 1., 1.])
```

```
In [59]: n
```

```
Out[59]: (6, 7)
```

```
In [60]: np.ones(n)
```

```
Out[60]: 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 [61]: np.ones((5,4), dtype=int) # by default 5- rows & 4 - columns
```

```
Out[61]: array([[1, 1, 1, 1],  
                 [1, 1, 1, 1],  
                 [1, 1, 1, 1],  
                 [1, 1, 1, 1],  
                 [1, 1, 1, 1]])
```

```
In [62]: np.
```

```
Cell In[62], line 1  
np.  
^  
SyntaxError: invalid syntax
```

```
In [63]: np.twos((2,3))
```

```
-----  
AttributeError  
Cell In[63], line 1  
----> 1 np.twos((2,3))  
  
File ~\anaconda2\Lib\site-packages\numpy\__init__.py:333, in __getattr__(attr)  
330     "Removed in NumPy 1.25.0"  
331     raise RuntimeError("Tester was removed in NumPy 1.25.")  
--> 333 raise AttributeError("module {!r} has no attribute "  
334             "{}!".format(__name__, attr))  
  
AttributeError: module 'numpy' has no attribute 'twos'
```

In [64]: np.three(2,3)

```
-----  
AttributeError  
Cell In[64], line 1  
----> 1 np.three(2,3)  
  
File ~\anaconda2\Lib\site-packages\numpy\__init__.py:333, in __getattr__(attr)  
330     "Removed in NumPy 1.25.0"  
331     raise RuntimeError("Tester was removed in NumPy 1.25.")  
--> 333 raise AttributeError("module {!r} has no attribute "  
334             "{}!".format(__name__, attr))  
  
AttributeError: module 'numpy' has no attribute 'three'
```

In [65]: np.ones(2)

Out[65]: array([1., 1.])

In [66]: np.ones((2,4))

Out[66]: array([[1., 1., 1., 1.],  
 [1., 1., 1., 1.]])

In [67]: np.ones((6,10), dtype = int)

Out[67]: 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 [68]: np.twos((2,4))

```
-----  
AttributeError  
Cell In[68], line 1  
----> 1 np.twos((2,4))  
  
File ~\anaconda2\Lib\site-packages\numpy\__init__.py:333, in __getattr__(attr)  
330     "Removed in NumPy 1.25.0"  
331     raise RuntimeError("Tester was removed in NumPy 1.25.")  
--> 333 raise AttributeError("module {!r} has no attribute "  
334             "{}!".format(__name__, attr))  
  
AttributeError: module 'numpy' has no attribute 'twos'
```

In [69]: np.

```
Cell In[69], line 1  
np.  
^  
SyntaxError: invalid syntax
```

In [70]: range(5)

Out[70]: range(0, 5)

In [71]: r = range(5)  
r

Out[71]: range(0, 5)

In [72]: for i in r:  
 print(i)

```
0  
1  
2  
3  
4
```

In [76]: list(range(5))

Out[76]: [0, 1, 2, 3, 4]

In [77]: range(1,10)

Out[77]: range(1, 10)

In [78]: list(range(1,10,3))

Out[78]: [1, 4, 7]

In [79]: y = list(range(12))  
y

Out[79]: [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11]

```
In [80]: rand(3,2)
```

```
NameError Traceback (most recent call last)
Cell In[80], line 1
----> 1 rand(3,2)

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

```
In [81]: rand(3,2)
random.rand(3,2)
```

```
NameError Traceback (most recent call last)
Cell In[81], line 1
----> 1 rand(3,2)
      2 random.rand(3,2)

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

```
In [82]: np.random.rand(5)
```

```
Out[82]: array([0.56969234, 0.7436684 , 0.70852709, 0.35374865, 0.0724891 ])
```

```
In [83]: np.rand(4)
```

```
AttributeError Traceback (most recent call last)
Cell In[83], line 1
----> 1 np.rand(4)

File ~\anaconda2\Lib\site-packages\numpy\__init__.py:333, in __getattr__(attr)
 330     "Removed in NumPy 1.25.0"
 331     raise RuntimeError("Tester was removed in NumPy 1.25.")
--> 333 raise AttributeError("module {!r} has no attribute "
 334                 "{!r}".format(__name__, attr))

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

```
In [102... np.random.rand(2,4)
```

```
Out[102... array([[0.89630554, 0.26485741, 0.31069244, 0.23384982],
 [0.41961776, 0.37483916, 0.64770974, 0.90121424]])
```

```
In [103... np.random.randint(2,4)
```

```
Out[103... 2
```

```
In [104... np.random.randint(2,20) # 2nd argument is exclusive
```

```
Out[104... 16
```

```
In [105... np.random.randint(0,1)
```

```
Out[105... 0

In [106... np.random.randint(10,20,5)

Out[106... array([16, 18, 16, 12, 19])

In [107... np.random.randint(1,6,4)

Out[107... array([1, 1, 3, 4])

In [108... np.random.rand(3)

Out[108... array([0.26044543, 0.23881136, 0.81846028])

In [109... np.random.randint(1)

Out[109... 0

In [112... np.random.randint(30,20,10)

-----
ValueError                                         Traceback (most recent call last)
Cell In[112], line 1
      1 np.random.randint(30,20,10)
      2
      3 File numpy\random\mtrand.pyx:780, in numpy.random.mtrand.RandomState.randint()
      4
      5 File numpy\random\_bounded_integers.pyx:1425, in numpy.random._bounded_integers._rand_int32()
      6
      7 ValueError: low >= high

In [113... np.random.randint(3,20,10)

Out[113... array([14, 10, 17, 4, 17, 18, 11, 12, 14, 11])

In [114... np.random.randint(-30,20,10)

Out[114... array([-2, -9, 8, -28, -8, -10, 4, 16, -4, 7])

In [115... np.random.randint(20,30,10)

Out[115... array([23, 20, 22, 20, 22, 27, 26, 20, 20, 27])

In [124... np.random.randint(5,9) #GET THE VALUE <=1 & >=5

Out[124... 7

In [125... np.random.randint(10,21,3)

Out[125... array([17, 17, 10])
```

```
In [126... np.random.randint(1,12,10)
```

```
Out[126... array([ 4,  5,  3, 10, 11,  3,  7, 11,  9, 10])
```

```
In [135... np.random.randint(10,40,(10,10)) #generre the element 10 -30 with 4*4 mtri
```

```
Out[135... array([[12, 10, 33, 15, 37, 26, 38, 13, 14, 10],  
[28, 32, 24, 33, 16, 38, 15, 16, 23, 10],  
[18, 15, 29, 20, 12, 32, 10, 28, 38, 19],  
[16, 35, 32, 23, 17, 17, 32, 11, 36, 33],  
[20, 22, 34, 22, 24, 12, 12, 14, 34, 24],  
[22, 36, 22, 19, 25, 15, 24, 33, 36, 23],  
[12, 38, 30, 37, 34, 14, 34, 27, 13, 31],  
[16, 26, 29, 23, 26, 38, 31, 31, 16, 21],  
[14, 27, 35, 24, 37, 28, 15, 39, 22, 13],  
[23, 36, 20, 27, 30, 34, 30, 26, 22, 15]])
```

```
In [136... np.random.randint(1,1000,(20,25)) #generre the element 10 -30 with 4*4 mtri
```

```
Out[136... array([[201, 341, 60, 750, 516, 374, 921, 325, 323, 625, 15, 491, 991,
   929, 876, 317, 815, 413, 604, 64, 113, 41, 784, 835, 13],
  [486, 477, 895, 685, 632, 11, 168, 336, 166, 471, 723, 586, 835,
  165, 479, 487, 547, 912, 660, 847, 972, 488, 745, 896, 682],
  [ 36, 700, 767, 128, 625, 320, 317, 532, 808, 433, 311, 795, 924,
  56, 921, 199, 499, 231, 273, 589, 928, 904, 287, 13, 84],
  [805, 491, 98, 990, 508, 211, 275, 776, 50, 691, 194, 418, 602,
  861, 376, 246, 377, 203, 576, 604, 188, 93, 690, 242, 544],
  [604, 521, 737, 583, 872, 361, 528, 107, 465, 305, 29, 764, 67,
  601, 810, 42, 825, 553, 134, 157, 774, 92, 881, 452, 578],
  [673, 650, 873, 512, 903, 911, 409, 334, 49, 224, 50, 307, 387,
  484, 116, 652, 994, 492, 231, 814, 308, 435, 418, 374, 247],
  [390, 650, 442, 641, 23, 865, 150, 464, 767, 286, 837, 532, 93,
  250, 974, 787, 71, 772, 888, 427, 66, 45, 117, 632, 101],
  [759, 514, 675, 446, 401, 475, 3, 27, 195, 356, 202, 469, 39,
  155, 223, 167, 609, 353, 617, 531, 942, 97, 813, 496, 211],
  [956, 611, 194, 994, 895, 511, 9, 119, 319, 786, 874, 349, 237,
  63, 193, 103, 815, 888, 298, 468, 536, 201, 336, 775, 64],
  [500, 629, 832, 224, 718, 719, 702, 483, 563, 843, 374, 265, 44,
  273, 27, 24, 555, 19, 254, 970, 767, 483, 223, 213, 299],
  [965, 501, 582, 296, 460, 619, 794, 442, 209, 271, 535, 86, 358,
  953, 133, 575, 735, 915, 456, 513, 896, 272, 523, 710, 603],
  [700, 462, 808, 347, 628, 792, 850, 87, 373, 129, 948, 150, 647,
  765, 123, 576, 980, 713, 439, 301, 480, 517, 892, 846, 143],
  [480, 303, 866, 11, 47, 851, 682, 907, 289, 672, 862, 608, 375,
  735, 735, 418, 561, 936, 54, 434, 674, 364, 660, 305, 851],
  [792, 308, 724, 291, 218, 989, 174, 129, 281, 127, 879, 59, 965,
  144, 579, 688, 873, 795, 972, 516, 536, 578, 30, 191, 442],
  [379, 388, 413, 228, 264, 690, 140, 70, 587, 674, 540, 564, 92,
  949, 546, 146, 632, 281, 183, 961, 377, 280, 114, 281, 79],
  [944, 376, 613, 813, 119, 423, 191, 613, 548, 235, 161, 722, 821,
  171, 631, 448, 508, 304, 866, 956, 529, 428, 533, 981, 38],
  [330, 139, 897, 3, 626, 622, 782, 421, 472, 870, 339, 430, 980,
  249, 95, 419, 253, 5, 924, 711, 211, 433, 860, 440, 958],
  [ 28, 897, 351, 916, 251, 23, 29, 771, 674, 400, 79, 533, 961,
  757, 105, 969, 654, 107, 808, 921, 945, 926, 63, 207, 768],
  [500, 788, 422, 431, 57, 83, 26, 277, 650, 113, 444, 589, 136,
  989, 773, 946, 841, 545, 782, 800, 252, 112, 347, 106, 80],
  [959, 85, 524, 812, 577, 702, 941, 688, 567, 922, 359, 94, 29,
  991, 68, 691, 335, 898, 973, 639, 218, 599, 430, 695, 925]])
```

```
In [144... np.arange(1,13).reshape(3,4)
```

```
Out[144... array([[ 1,  2,  3,  4],
   [ 5,  6,  7,  8],
   [ 9, 10, 11, 12]])
```

```
In [145... np.arange(1,13).reshape(12, 1)
```

```
Out[145... array([[ 1],  
[ 2],  
[ 3],  
[ 4],  
[ 5],  
[ 6],  
[ 7],  
[ 8],  
[ 9],  
[10],  
[11],  
[12]])
```

```
In [149... b = np.random.randint(10,20,(5,4))  
b
```

```
Out[149... array([[14, 11, 17, 14],  
[17, 12, 11, 17],  
[18, 11, 10, 11],  
[16, 18, 11, 16],  
[12, 18, 15, 16]])
```

```
In [150... type(b)
```

```
Out[150... numpy.ndarray
```

```
In [151... b
```

```
Out[151... array([[14, 11, 17, 14],  
[17, 12, 11, 17],  
[18, 11, 10, 11],  
[16, 18, 11, 16],  
[12, 18, 15, 16]])
```

```
In [152... b[:]
```

```
Out[152... array([[14, 11, 17, 14],  
[17, 12, 11, 17],  
[18, 11, 10, 11],  
[16, 18, 11, 16],  
[12, 18, 15, 16]])
```

```
In [153... b[1:3]
```

```
Out[153... array([[17, 12, 11, 17],  
[18, 11, 10, 11]])
```

```
In [154... b
```

```
Out[154... array([[14, 11, 17, 14],  
[17, 12, 11, 17],  
[18, 11, 10, 11],  
[16, 18, 11, 16],  
[12, 18, 15, 16]])
```

```
In [155... b[1,2]
```

```
Out[155... 11
```

```
In [156... b
```

```
Out[156... array([[14, 11, 17, 14],  
                  [17, 12, 11, 17],  
                  [18, 11, 10, 11],  
                  [16, 18, 11, 16],  
                  [12, 18, 15, 16]])
```

```
In [157... b[1,3]
```

```
Out[157... 17
```

```
In [158... b[1,-1]
```

```
Out[158... 17
```

```
In [159... b
```

```
Out[159... array([[14, 11, 17, 14],  
                  [17, 12, 11, 17],  
                  [18, 11, 10, 11],  
                  [16, 18, 11, 16],  
                  [12, 18, 15, 16]])
```

```
In [163... b[2:5]
```

```
Out[163... array([[18, 11, 10, 11],  
                  [16, 18, 11, 16],  
                  [12, 18, 15, 16]])
```

```
In [164... b
```

```
Out[164... array([[14, 11, 17, 14],  
                  [17, 12, 11, 17],  
                  [18, 11, 10, 11],  
                  [16, 18, 11, 16],  
                  [12, 18, 15, 16]])
```

```
In [165... b[0:-2]
```

```
Out[165... array([[14, 11, 17, 14],  
                  [17, 12, 11, 17],  
                  [18, 11, 10, 11]])
```

```
In [166... b
```

```
Out[166... array([[14, 11, 17, 14],  
                   [17, 12, 11, 17],  
                   [18, 11, 10, 11],  
                   [16, 18, 11, 16],  
                   [12, 18, 15, 16]])
```

```
In [169... b[2,2]
```

```
Out[169... 10
```

```
In [168... b
```

```
Out[168... array([[14, 11, 17, 14],  
                   [17, 12, 11, 17],  
                   [18, 11, 10, 11],  
                   [16, 18, 11, 16],  
                   [12, 18, 15, 16]])
```

```
In [170... b[-5,-3]
```

```
Out[170... 11
```

```
In [171... b
```

```
Out[171... array([[14, 11, 17, 14],  
                   [17, 12, 11, 17],  
                   [18, 11, 10, 11],  
                   [16, 18, 11, 16],  
                   [12, 18, 15, 16]])
```

```
In [172... b[-4,2]
```

```
Out[172... 11
```

```
In [173... np.random.randint(10,20,(4,4))
```

```
Out[173... array([[15, 14, 15, 16],  
                   [12, 10, 10, 15],  
                   [14, 16, 12, 15],  
                   [16, 19, 10, 10]])
```

```
In [174... b[-4,-2]
```

```
Out[174... 11
```

```
In [175... b[-4:2]
```

```
Out[175... array([[17, 12, 11, 17]])
```

```
In [176... b[:]
```

```
Out[176... array([[14, 11, 17, 14],  
                   [17, 12, 11, 17],  
                   [18, 11, 10, 11],  
                   [16, 18, 11, 16],  
                   [12, 18, 15, 16]]))
```

## Operations

```
In [177... a = np.random.randint(10,20,10)  
a
```

```
Out[177... array([18, 14, 13, 16, 10, 10, 16, 11, 11, 16])
```

```
In [178... id(a)
```

```
Out[178... 2174695178576
```

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

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

```
In [180... arr2 = np.random.randint(0,100,(10,10))
```

```
In [181... arr2
```

```
Out[181... array([[93, 79, 55, 39, 43, 12, 16, 84, 27, 47],  
                  [95, 31, 87, 97, 88, 69, 3, 45, 49, 88],  
                  [36, 70, 24, 10, 19, 5, 46, 40, 52, 91],  
                  [32, 37, 65, 87, 75, 73, 76, 98, 24, 8],  
                  [93, 82, 35, 56, 76, 51, 52, 86, 13, 84],  
                  [92, 32, 97, 83, 2, 64, 50, 74, 5, 58],  
                  [44, 1, 50, 18, 31, 34, 51, 30, 75, 40],  
                  [14, 13, 0, 41, 74, 42, 23, 8, 20, 54],  
                  [32, 10, 35, 41, 16, 82, 21, 50, 69, 5],  
                  [75, 57, 94, 43, 46, 67, 93, 32, 14, 86]]))
```

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

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

```
In [183... arr[:]
```

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

```
In [184... arr
```

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

```
In [185... arr[:4]
```

```
Out[185... array([0, 1, 2, 3])
```

```
In [186... arr2[:]
```

```
Out[186... array([[93, 79, 55, 39, 43, 12, 16, 84, 27, 47],  
[95, 31, 87, 97, 88, 69, 3, 45, 49, 88],  
[36, 70, 24, 10, 19, 5, 46, 40, 52, 91],  
[32, 37, 65, 87, 75, 73, 76, 98, 24, 8],  
[93, 82, 35, 56, 76, 51, 52, 86, 13, 84],  
[92, 32, 97, 83, 2, 64, 50, 74, 5, 58],  
[44, 1, 50, 18, 31, 34, 51, 30, 75, 40],  
[14, 13, 0, 41, 74, 42, 23, 8, 20, 54],  
[32, 10, 35, 41, 16, 82, 21, 50, 69, 5],  
[75, 57, 94, 43, 46, 67, 93, 32, 14, 86]])
```

```
In [187... arr2[0:5]
```

```
Out[187... array([[93, 79, 55, 39, 43, 12, 16, 84, 27, 47],  
[95, 31, 87, 97, 88, 69, 3, 45, 49, 88],  
[36, 70, 24, 10, 19, 5, 46, 40, 52, 91],  
[32, 37, 65, 87, 75, 73, 76, 98, 24, 8],  
[93, 82, 35, 56, 76, 51, 52, 86, 13, 84]])
```

```
In [188... arr2
```

```
Out[188... array([[93, 79, 55, 39, 43, 12, 16, 84, 27, 47],  
[95, 31, 87, 97, 88, 69, 3, 45, 49, 88],  
[36, 70, 24, 10, 19, 5, 46, 40, 52, 91],  
[32, 37, 65, 87, 75, 73, 76, 98, 24, 8],  
[93, 82, 35, 56, 76, 51, 52, 86, 13, 84],  
[92, 32, 97, 83, 2, 64, 50, 74, 5, 58],  
[44, 1, 50, 18, 31, 34, 51, 30, 75, 40],  
[14, 13, 0, 41, 74, 42, 23, 8, 20, 54],  
[32, 10, 35, 41, 16, 82, 21, 50, 69, 5],  
[75, 57, 94, 43, 46, 67, 93, 32, 14, 86]])
```

```
In [189... arr2[1,4]
```

```
Out[189... 88
```

```
In [190... arr2[-5,5]
```

```
Out[190... 64
```

```
In [191... arr2[-5,5]
```

```
Out[191... 64
```

```
In [192... arr2[-1,-2]
```

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

```
In [193... arr2[::-1]
```

```
Out[193... array([[75, 57, 94, 43, 46, 67, 93, 32, 14, 86],  
   [32, 10, 35, 41, 16, 82, 21, 50, 69, 5],  
   [14, 13, 0, 41, 74, 42, 23, 8, 20, 54],  
   [44, 1, 50, 18, 31, 34, 51, 30, 75, 40],  
   [92, 32, 97, 83, 2, 64, 50, 74, 5, 58],  
   [93, 82, 35, 56, 76, 51, 52, 86, 13, 84],  
   [32, 37, 65, 87, 75, 73, 76, 98, 24, 8],  
   [36, 70, 24, 10, 19, 5, 46, 40, 52, 91],  
   [95, 31, 87, 97, 88, 69, 3, 45, 49, 88],  
   [93, 79, 55, 39, 43, 12, 16, 84, 27, 47]])
```

```
In [194... arr2
```

```
Out[194... array([[93, 79, 55, 39, 43, 12, 16, 84, 27, 47],  
   [95, 31, 87, 97, 88, 69, 3, 45, 49, 88],  
   [36, 70, 24, 10, 19, 5, 46, 40, 52, 91],  
   [32, 37, 65, 87, 75, 73, 76, 98, 24, 8],  
   [93, 82, 35, 56, 76, 51, 52, 86, 13, 84],  
   [92, 32, 97, 83, 2, 64, 50, 74, 5, 58],  
   [44, 1, 50, 18, 31, 34, 51, 30, 75, 40],  
   [14, 13, 0, 41, 74, 42, 23, 8, 20, 54],  
   [32, 10, 35, 41, 16, 82, 21, 50, 69, 5],  
   [75, 57, 94, 43, 46, 67, 93, 32, 14, 86]])
```

```
In [199... arr2[::3]
```

```
Out[199... array([[93, 79, 55, 39, 43, 12, 16, 84, 27, 47],  
   [32, 37, 65, 87, 75, 73, 76, 98, 24, 8],  
   [44, 1, 50, 18, 31, 34, 51, 30, 75, 40],  
   [75, 57, 94, 43, 46, 67, 93, 32, 14, 86]])
```

```
In [200... arr2[::1]
```

```
Out[200... array([[93, 79, 55, 39, 43, 12, 16, 84, 27, 47],  
   [95, 31, 87, 97, 88, 69, 3, 45, 49, 88],  
   [36, 70, 24, 10, 19, 5, 46, 40, 52, 91],  
   [32, 37, 65, 87, 75, 73, 76, 98, 24, 8],  
   [93, 82, 35, 56, 76, 51, 52, 86, 13, 84],  
   [92, 32, 97, 83, 2, 64, 50, 74, 5, 58],  
   [44, 1, 50, 18, 31, 34, 51, 30, 75, 40],  
   [14, 13, 0, 41, 74, 42, 23, 8, 20, 54],  
   [32, 10, 35, 41, 16, 82, 21, 50, 69, 5],  
   [75, 57, 94, 43, 46, 67, 93, 32, 14, 86]])
```

```
In [201... arr2[:::-1]
```

```
Out[201... array([[75, 57, 94, 43, 46, 67, 93, 32, 14, 86],  
   [32, 10, 35, 41, 16, 82, 21, 50, 69, 5],  
   [14, 13, 0, 41, 74, 42, 23, 8, 20, 54],  
   [44, 1, 50, 18, 31, 34, 51, 30, 75, 40],  
   [92, 32, 97, 83, 2, 64, 50, 74, 5, 58],  
   [93, 82, 35, 56, 76, 51, 52, 86, 13, 84],  
   [32, 37, 65, 87, 75, 73, 76, 98, 24, 8],  
   [36, 70, 24, 10, 19, 5, 46, 40, 52, 91],  
   [95, 31, 87, 97, 88, 69, 3, 45, 49, 88],  
   [93, 79, 55, 39, 43, 12, 16, 84, 27, 47]])
```

```
In [202... arr2[::-3]]
```

```
Out[202... array([[75, 57, 94, 43, 46, 67, 93, 32, 14, 86],  
[44, 1, 50, 18, 31, 34, 51, 30, 75, 40],  
[32, 37, 65, 87, 75, 73, 76, 98, 24, 8],  
[93, 79, 55, 39, 43, 12, 16, 84, 27, 47]])
```

```
In [203... arr2[::-1]]
```

```
Out[203... array([[75, 57, 94, 43, 46, 67, 93, 32, 14, 86],  
[32, 10, 35, 41, 16, 82, 21, 50, 69, 5],  
[14, 13, 0, 41, 74, 42, 23, 8, 20, 54],  
[44, 1, 50, 18, 31, 34, 51, 30, 75, 40],  
[92, 32, 97, 83, 2, 64, 50, 74, 5, 58],  
[93, 82, 35, 56, 76, 51, 52, 86, 13, 84],  
[32, 37, 65, 87, 75, 73, 76, 98, 24, 8],  
[36, 70, 24, 10, 19, 5, 46, 40, 52, 91],  
[95, 31, 87, 97, 88, 69, 3, 45, 49, 88],  
[93, 79, 55, 39, 43, 12, 16, 84, 27, 47]])
```

```
In [204... arr2[::-2]]
```

```
Out[204... array([[75, 57, 94, 43, 46, 67, 93, 32, 14, 86],  
[14, 13, 0, 41, 74, 42, 23, 8, 20, 54],  
[92, 32, 97, 83, 2, 64, 50, 74, 5, 58],  
[32, 37, 65, 87, 75, 73, 76, 98, 24, 8],  
[95, 31, 87, 97, 88, 69, 3, 45, 49, 88]])
```

```
In [205... arr]
```

```
Out[205... array([0, 1, 2, 3, 4, 5])]
```

```
In [206... arr.max())
```

```
Out[206... 5
```

```
In [207... arr.min())
```

```
Out[207... 0
```

```
In [208... arr]
```

```
Out[208... array([0, 1, 2, 3, 4, 5])]
```

```
In [209... arr.mean())
```

```
Out[209... 2.5
```

```
In [210... arr.median())
```

```
-----  
AttributeError  
Cell In[210], line 1  
----> 1 arr.median()
```

Traceback (most recent call last)

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

```
In [212... from numpy import *  
a = array([0,1,2,3,4,9])  
median(a)
```

```
Out[212... 2.5
```

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

```
In [213... arr
```

```
Out[213... array([0, 1, 2, 3, 4, 5])
```

```
In [214... arr.reshape(3,2)
```

```
Out[214... array([[0, 1],  
[2, 3],  
[4, 5]])
```

```
In [215... arr.reshape(6,1)
```

```
Out[215... array([[0],  
[1],  
[2],  
[3],  
[4],  
[5]])
```

```
In [216... arr.reshape(1,6)
```

```
Out[216... array([[0, 1, 2, 3, 4, 5]])
```

```
In [217... arr.reshape(2,4)
```

```
-----  
ValueError  
Cell In[217], line 1  
----> 1 arr.reshape(2,4)
```

Traceback (most recent call last)

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

```
In [218... arr
```

```
Out[218... array([0, 1, 2, 3, 4, 5])
```

```
In [219... arr.reshape(2,3,order='C')
```

```
Out[219... array([[0, 1, 2],  
[3, 4, 5]])
```

```
In [220... arr.reshape(2,3,order='F') # print element with fortran
```

```
Out[220... array([[0, 2, 4],  
[1, 3, 5]])
```

```
In [221... arr.reshape(2,3,order='A') # A almost give you c type output
```

```
Out[221... array([[0, 1, 2],  
[3, 4, 5]])
```

```
In [223... arr
```

```
Out[223... array([0, 1, 2, 3, 4, 5])
```

```
In [224... arr.reshape(2,3)
```

```
Out[224... array([[0, 1, 2],  
[3, 4, 5]])
```

```
In [225... arr.reshape(1,4)
```

-----  
**ValueError**  
Cell In[225], line 1  
----> 1 arr.reshape(1,4)

Traceback (most recent call last)

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

```
In [226... arr.reshape(1,6)
```

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

## Indexing

```
In [241... mat = np.arange(0,100).reshape(10,10)
```

```
In [249... mat
```

```
Out[249... array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],  
[10, 11, 12, 13, 14, 15, 16, 17, 18, 19],  
[20, 21, 22, 23, 24, 25, 26, 27, 28, 29],  
[30, 31, 32, 33, 34, 35, 36, 37, 38, 39],  
[40, 41, 42, 43, 44, 45, 46, 47, 48, 49],  
[50, 51, 52, 53, 54, 55, 56, 57, 58, 59],  
[60, 61, 62, 63, 64, 65, 66, 67, 68, 69],  
[70, 71, 72, 73, 74, 75, 76, 77, 78, 79],  
[80, 81, 82, 83, 84, 85, 86, 87, 88, 89],  
[90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [250...]: row = 4  
          col = 5
```

```
In [251...]: col
```

```
Out[251...]: 5
```

```
In [252...]: row
```

```
Out[252...]: 4
```

```
In [253...]: mat
```

```
Out[253...]: array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],  
                     [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],  
                     [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],  
                     [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],  
                     [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],  
                     [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],  
                     [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],  
                     [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],  
                     [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],  
                     [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [254...]: mat[row,col]
```

```
Out[254...]: 45
```

```
In [255...]: mat[4,5]
```

```
Out[255...]: 45
```

```
In [256...]: mat
```

```
Out[256...]: 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 [257...]: mat[:,:]
```

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

In [258... col = 6

In [259... mat

```
Out[259... array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
       [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
       [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
       [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
       [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
       [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
       [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
       [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
       [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

In [260... mat[6] # default it represent to rows

```
Out[260... array([60, 61, 62, 63, 64, 65, 66, 67, 68, 69])
```

In [261... mat

```
Out[261... array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
       [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
       [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
       [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
       [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
       [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
       [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
       [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
       [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

## With Slices

mat[:,col]

In [262... mat

```
Out[262... array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
   [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
   [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
   [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
   [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
   [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
   [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
   [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
   [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
   [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [263... mat[row,:]
```

```
Out[263... array([40, 41, 42, 43, 44, 45, 46, 47, 48, 49])
```

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

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

```
In [265... mat[:,8]
```

```
Out[265... array([ 8, 18, 28, 38, 48, 58, 68, 78, 88, 98])
```

```
In [268... mat[:col]
```

```
Out[268... array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
   [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
   [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
   [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
   [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
   [50, 51, 52, 53, 54, 55, 56, 57, 58, 59]])
```

```
In [269... mat[:6]
```

```
Out[269... 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 [270... row
```

```
Out[270... 4
```

```
In [271... mat
```

```
Out[271... 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 [272... mat[:row]
```

```
Out[272... 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 [273... mat[:, :]
```

```
Out[273... array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
   [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
   [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
   [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
   [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
   [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
   [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
   [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
   [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
   [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [274... mat[:, 8]
```

```
Out[274... array([ 8, 18, 28, 38, 48, 58, 68, 78, 88, 98])
```

```
In [275... mat[:, -1]
```

```
Out[275... array([ 9, 19, 29, 39, 49, 59, 69, 79, 89, 99])
```

```
In [276... col
```

```
Out[276... 6
```

```
In [277... mat[:, col]
```

```
Out[277... array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])
```

```
In [278... mat[1, 4]
```

```
Out[278... 14
```

```
In [279... mat[3:-3]
```

```
Out[279... 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 [280... mat[0]
```

```
Out[280... array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])
```

```
In [281... mat[6]
```

```
Out[281... array([60, 61, 62, 63, 64, 65, 66, 67, 68, 69])
```

```
In [282... mat[6:]
```

```
Out[282... 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 [283... mat[:6]
```

```
Out[283... 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 [284... mat
```

```
Out[284... array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],  
                  [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],  
                  [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],  
                  [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],  
                  [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],  
                  [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],  
                  [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],  
                  [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],  
                  [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],  
                  [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [289... mat[0:8]
```

```
Out[289... array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],  
                  [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],  
                  [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],  
                  [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],  
                  [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],  
                  [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],  
                  [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],  
                  [70, 71, 72, 73, 74, 75, 76, 77, 78, 79]])
```

```
In [290... mat[0:10:3]
```

```
Out[290... 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 [291... mat
```

```
Out[291... array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
   [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
   [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
   [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
   [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
   [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
   [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
   [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
   [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
   [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [292... mat[4:]]
```

```
Out[292... 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 [293... mat[::-1]]
```

```
Out[293... 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 [294... mat[::-3]]
```

```
Out[294... 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 [295... mat[::-5]]
```

```
Out[295... array([[90, 91, 92, 93, 94, 95, 96, 97, 98, 99],
   [40, 41, 42, 43, 44, 45, 46, 47, 48, 49]])
```

```
In [296... mat[2:6]]
```

```
Out[296... 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 [297... mat

```
Out[297... 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 [298... mat[2:6,2:4] # 1:5 --> only row part /// 1:3 -- it indicates only column parts

```
Out[298... array([[22, 23],
   [32, 33],
   [42, 43],
   [52, 53]])
```

In [299... mat[0,1]

```
Out[299... 1
```

In [300... mat[1,6]

```
Out[300... 16
```

In [301... mat

```
Out[301... array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
   [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
   [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
   [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
   [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
   [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
   [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
   [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
   [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
   [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

In [302... mat[1:6]

```
Out[302... 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 [303... mat[1:]

```
Out[303... 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 [304... mat
```

```
Out[304... array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],  
   [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],  
   [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],  
   [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],  
   [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],  
   [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],  
   [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],  
   [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],  
   [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],  
   [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [305... mat[:6]
```

```
Out[305... 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 [306... mat[0:1]
```

```
Out[306... array([[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]])
```

```
In [307... mat[3:5]
```

```
Out[307... array([[30, 31, 32, 33, 34, 35, 36, 37, 38, 39],  
   [40, 41, 42, 43, 44, 45, 46, 47, 48, 49]])
```

```
In [314... mat[1:2,2:4]
```

```
Out[314... array([[12, 13]])
```

```
In [315... mat
```

```
Out[315... 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 [316... mat[2:3,1:3]
```

```
Out[316... array([[21, 22]])
```

```
In [317... mat[2:4,3:5]
```

```
Out[317... array([[23, 24],
   [33, 34]])
```

```
In [318... mat[3:5,2:4]
```

```
Out[318... array([[32, 33],
   [42, 43]])
```

```
In [321... mat[0:1,0:1]
```

```
Out[321... array([[0]])
```

```
In [322... mat
```

```
Out[322... 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 [323... mat[2:3,4:5]
```

```
Out[323... array([[24]])
```

```
In [324... mat[2:4,3:5]
```

```
Out[324... array([[23, 24],
   [33, 34]])
```

```
In [325... mat[3:5,2:4]
```

```
Out[325... array([[32, 33],
   [42, 43]])
```

# Masking

In [327...]

mat

```
Out[327...]: 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 [328...]

id(mat)

Out[328...]: 2174695322608

In [329...]

mat[mat&lt;50]

```
Out[329...]: 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 [330...]

mat[mat&lt;=50]

```
Out[330...]: 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 [331...]

mat

```
Out[331...]: 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 [332...]

mat &gt; 50

```
Out[332... 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, True, True, True, True],
       [True, True, True, True, True, True, True, True, True, True]])
```

```
In [333... mat[mat==50]
```

```
Out[333... array([50])
```

```
In [334... mat
```

```
Out[334... 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 [335... mat == 50
```

```
Out[335... 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, 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, False, False, False]]))
```

In [336... mat

```
Out[336... 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 [337... a1 = mat[mat<50]
a1

```
Out[337... 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 [338... a2 = mat[mat>50]
a2

```
Out[338... 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 [339... a4 = mat[mat==50]
a4

```
Out[339... array([50])
```

## python program to generate otp

In [350...]

```
import random

def generate_otp(length=4):

    digits = '0123456789'
    otp = ''.join(random.choice(digits))
    for _ in range(length))
    return otp

# Example usage
otp_length = 4 # You can change this to any Length you prefer
otp = generate_otp(otp_length)
print(f"Your OTP is: {otp}")
```

Your OTP is: 0430

In [351...]

```
def wish():
    print('good even')
wish()

def wish():
    print('good even')
wish()

def wish():
    print('good even')
wish()
```

good even  
good even  
good even

In [352...]

```
def wish():
    print('good even')
wish()

wish()

wish()
```

good even  
good even  
good even

In [353...]

```
list1=['a','b','g',1,5]
print(list1.pop)
```

&lt;built-in method pop of list object at 0x000001FA55F39E00&gt;

In [354...]

```
x = [1, 2, 3]
y = x.copy()
x.append(4)
print(x)
```

[1, 2, 3, 4]

```
In [355... print(y)
```

```
[1, 2, 3]
```

```
In [ ]:
```