

```
In [15]: import sys  
sys.version
```

```
Out[15]: '3.11.9 | packaged by Anaconda, Inc. | (main, Apr 19 2024, 16:40:41) [MSC  
v.1916 64 bit (AMD64)]'
```

```
In [16]: import numpy as np
```

```
In [17]: np.__version__
```

```
Out[17]: '1.24.3'
```

```
In [18]: #Creating List  
my_list = [0,1,2,3,4,5]  
my_list
```

```
Out[18]: [0, 1, 2, 3, 4, 5]
```

```
In [19]: type(my_list)
```

```
Out[19]: list
```

```
In [20]: arr = np.array(my_list)
```

```
In [21]: arr
```

```
Out[21]: array([0, 1, 2, 3, 4, 5])
```

```
In [22]: type(arr)
```

```
Out[22]: numpy.ndarray
```

```
In [23]: print(type(arr))  
print(type(my_list))  
  
<class 'numpy.ndarray'>  
<class 'list'>
```

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

```
Out[24]: array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])
```

```
In [25]: np.arange(10,20)
```

```
Out[25]: array([10, 11, 12, 13, 14, 15, 16, 17, 18, 19])
```

```
In [26]: np.arange(10,50,5)
```

```
Out[26]: array([10, 15, 20, 25, 30, 35, 40, 45])
```

```
In [27]: np.arange(10,30,3)
```

```
Out[27]: array([10, 13, 16, 19, 22, 25, 28])
```

```
In [28]: np.arange(10,30,30,3)
```

```
-----  
-  
TypeError                                Traceback (most recent call las  
t)  
Cell In[28], line 1  
----> 1 np.arange(10,30,30,3)  
  
TypeError: Cannot interpret '3' as a data type
```

```
In [29]: np.arange(20,8)
```

```
Out[29]: array([], dtype=int32)
```

```
In [30]: np.arange(8,20)
```

```
Out[30]: array([ 8,  9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19])
```

```
In [31]: np.arange(-20,8) # 1st arg < 2nd arg
```

```
Out[31]: 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 [32]: n = np.arange(-20,8)  
n
```

```
Out[32]: 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 [33]: np.zeros(3)
```

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

```
In [34]: np.zeros(3, dtype=int)
```

```
Out[34]: array([0, 0, 0])
```

```
In [35]: np.zeros(3, dtype=float)
```

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

```
In [36]: z = np.zeros(5) # 5 means 1 Argument  
z
```

```
Out[36]: array([0., 0., 0., 0., 0.])
```

```
In [37]: np.zeros((2,2))    #2D array
```

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

```
In [38]: np.zeros((3,3), dtype = int)    #(3,3) first 3 (row part) & 2nd 3 (column part)
```

```
Out[38]: array([[0, 0, 0],
               [0, 0, 0],
               [0, 0, 0]])
```

```
In [39]: nd = np.zeros((5,9), dtype=int)
nd
```

```
Out[39]: 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]])
```

```
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]: nd1 = np.ones((10,10), dtype=int)
nd1
```

```
Out[42]: 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],
               [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 [43]: arr
```

```
Out[43]: array([0, 1, 2, 3, 4, 5])
```

```
In [44]: nd
```

```
Out[44]: 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]])
```

```
In [45]: nd1
```

```
Out[45]: 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],
                [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 [46]: np.random.rand(2)
```

```
Out[46]: array([0.85189801, 0.57739679])
```

```
In [47]: np.random.rand(3)
```

```
Out[47]: array([0.75287222, 0.46845331, 0.84583532])
```

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

```
Out[48]: array([[0.5348519 , 0.59776546, 0.10352855],
                [0.04700912, 0.91485283, 0.54468897]])
```

```
In [49]: np.random.randint(3)
```

```
Out[49]: 1
```

```
In [50]: np.random.randint(2,10)
```

```
Out[50]: 9
```

```
In [51]: np.random.randint(2,10,3)
```

```
Out[51]: array([3, 6, 3])
```

```
In [52]: np.random.randint(2,10,4)
```

```
Out[52]: array([2, 3, 8, 6])
```

```
In [53]: np.random.randint(-30,20,10)
```

```
Out[53]: array([ 9, -6,  6, 15, -19, 18, -6, 18,  0, -25])
```

```
In [54]: np.random.randint(10,40,(10,10))
```

```
Out[54]: array([[13, 10, 18, 24, 22, 15, 30, 14, 31, 13],
 [36, 34, 27, 20, 12, 27, 18, 17, 38, 36],
 [39, 37, 39, 25, 24, 16, 35, 17, 33, 11],
 [30, 38, 15, 18, 22, 38, 17, 19, 30, 39],
 [29, 36, 36, 17, 30, 17, 30, 19, 10, 24],
 [15, 15, 12, 26, 39, 35, 31, 19, 26, 30],
 [29, 26, 24, 24, 12, 20, 22, 38, 20, 12],
 [35, 33, 33, 19, 14, 10, 37, 19, 17, 21],
 [30, 26, 37, 20, 26, 28, 10, 12, 10, 34],
 [35, 14, 21, 12, 39, 24, 14, 20, 13, 14]])
```

```
In [55]: m = np.random.randint(10,40,(10,10))
m
```

```
Out[55]: array([[15, 36, 12, 17, 37, 17, 29, 24, 16, 17],
 [32, 17, 31, 13, 30, 27, 36, 11, 20, 31],
 [30, 39, 35, 14, 16, 26, 16, 29, 23, 28],
 [12, 27, 15, 24, 15, 10, 15, 28, 33, 38],
 [30, 20, 24, 34, 20, 24, 28, 34, 23, 39],
 [29, 20, 39, 15, 21, 24, 33, 38, 21, 27],
 [37, 20, 22, 15, 25, 38, 26, 21, 34, 25],
 [17, 35, 15, 17, 22, 24, 37, 16, 36, 18],
 [18, 39, 31, 23, 25, 22, 14, 23, 24, 37],
 [15, 30, 14, 23, 38, 16, 36, 17, 13, 32]])
```

```
In [56]: arr
```

```
Out[56]: array([0, 1, 2, 3, 4, 5])
```

```
In [57]: arr.reshape(2,3)
```

```
Out[57]: array([[0, 1, 2],
 [3, 4, 5]])
```

```
In [58]: arr.reshape(3,3)
```

```
-----
-
ValueError                                Traceback (most recent call last)
Cell In[58], line 1
----> 1 arr.reshape(3,3)

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

```
In [59]: arr.reshape(6,1)
```

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

```
In [60]: arr.reshape(1,6)
```

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

## Slicing In matrix

```
In [61]: m
```

```
Out[61]: array([[15, 36, 12, 17, 37, 17, 29, 24, 16, 17],
                [32, 17, 31, 13, 30, 27, 36, 11, 20, 31],
                [30, 39, 35, 14, 16, 26, 16, 29, 23, 28],
                [12, 27, 15, 24, 15, 10, 15, 28, 33, 38],
                [30, 20, 24, 34, 20, 24, 28, 34, 23, 39],
                [29, 20, 39, 15, 21, 24, 33, 38, 21, 27],
                [37, 20, 22, 15, 25, 38, 26, 21, 34, 25],
                [17, 35, 15, 17, 22, 24, 37, 16, 36, 18],
                [18, 39, 31, 23, 25, 22, 14, 23, 24, 37],
                [15, 30, 14, 23, 38, 16, 36, 17, 13, 32]])
```

```
In [62]: b = np.random.randint(10,20,(5,4))
b
```

```
Out[62]: array([[15, 18, 11, 14],
                [14, 16, 12, 16],
                [14, 16, 18, 19],
                [15, 13, 19, 14],
                [10, 18, 18, 18]])
```

```
In [63]: b[:]
```

```
Out[63]: array([[15, 18, 11, 14],
                [14, 16, 12, 16],
                [14, 16, 18, 19],
                [15, 13, 19, 14],
                [10, 18, 18, 18]])
```

```
In [64]: b[1:4]
```

```
Out[64]: array([[14, 16, 12, 16],
                [14, 16, 18, 19],
                [15, 13, 19, 14]])
```

```
In [65]: b
```

```
Out[65]: array([[15, 18, 11, 14],
                [14, 16, 12, 16],
                [14, 16, 18, 19],
                [15, 13, 19, 14],
                [10, 18, 18, 18]])
```

```
In [66]: b[-1:]
```

```
Out[66]: array([[10, 18, 18, 18]])
```

```
In [67]: b[:-1]
```

```
Out[67]: array([[15, 18, 11, 14],
                [14, 16, 12, 16],
                [14, 16, 18, 19],
                [15, 13, 19, 14]])
```

```
In [68]: b[-5, -3]
```

```
Out[68]: 18
```

```
In [69]: np.random.randint(10,20,(4,4))
```

```
Out[69]: array([[14, 18, 13, 19],
                [14, 13, 12, 16],
                [15, 17, 16, 13],
                [13, 18, 15, 18]])
```

```
In [70]: b
```

```
Out[70]: array([[15, 18, 11, 14],
                [14, 16, 12, 16],
                [14, 16, 18, 19],
                [15, 13, 19, 14],
                [10, 18, 18, 18]])
```

```
In [71]: b[-4, -2]
```

```
Out[71]: 12
```

```
In [72]: b
```

```
Out[72]: array([[15, 18, 11, 14],
                [14, 16, 12, 16],
                [14, 16, 18, 19],
                [15, 13, 19, 14],
                [10, 18, 18, 18]])
```

```
In [73]: b[-4:2]
```

```
Out[73]: array([[14, 16, 12, 16]])
```

```
In [74]: b[:]
```

```
Out[74]: array([[15, 18, 11, 14],
                [14, 16, 12, 16],
                [14, 16, 18, 19],
                [15, 13, 19, 14],
                [10, 18, 18, 18]])
```

## Operations

```
In [75]: a = np.random.randint(10,20,10)
a
```

```
Out[75]: array([11, 17, 11, 10, 16, 12, 18, 10, 16, 14])
```

```
In [76]: id(a)
```

```
Out[76]: 1615375186320
```

```
In [77]: arr
```

```
Out[77]: array([0, 1, 2, 3, 4, 5])
```

```
In [78]: arr2 = np.random.randint(0,100,(10,10))
```

```
In [82]: arr2
```

```
Out[82]: array([[96, 75, 83, 77, 57, 16, 96, 55,  8, 15],
                [86, 16, 88, 53, 38, 48, 54, 63,  2,  0],
                [29, 96, 32, 78, 68, 87, 24, 14, 26, 81],
                [18,  1, 19, 18, 25, 72, 58, 84, 58, 33],
                [22, 73, 83, 44, 36,  9, 54, 89, 59, 55],
                [25,  9, 45, 73, 66, 15, 13, 24, 76, 86],
                [27, 80, 97, 91, 53, 60, 16, 32, 25, 31],
                [39, 43, 41, 37,  6, 81, 15, 48, 64, 91],
                [89, 98, 52, 31, 26, 63, 25, 71, 16, 42],
                [ 9, 24, 35,  2, 55, 62, 26,  4, 63, 28]])
```

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

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

```
In [84]: arr[:]
```

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

```
In [85]: arr
```

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

```
In [86]: arr[:4]
```

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



```
In [88]: arr2[:]
```

```
Out[88]: array([[96, 75, 83, 77, 57, 16, 96, 55,  8, 15],
                [86, 16, 88, 53, 38, 48, 54, 63,  2,  0],
                [29, 96, 32, 78, 68, 87, 24, 14, 26, 81],
                [18,  1, 19, 18, 25, 72, 58, 84, 58, 33],
                [22, 73, 83, 44, 36,  9, 54, 89, 59, 55],
                [25,  9, 45, 73, 66, 15, 13, 24, 76, 86],
                [27, 80, 97, 91, 53, 60, 16, 32, 25, 31],
                [39, 43, 41, 37,  6, 81, 15, 48, 64, 91],
                [89, 98, 52, 31, 26, 63, 25, 71, 16, 42],
                [ 9, 24, 35,  2, 55, 62, 26,  4, 63, 28]])
```

```
In [89]: arr2[0:5]
```

```
Out[89]: array([[96, 75, 83, 77, 57, 16, 96, 55,  8, 15],
                [86, 16, 88, 53, 38, 48, 54, 63,  2,  0],
                [29, 96, 32, 78, 68, 87, 24, 14, 26, 81],
                [18,  1, 19, 18, 25, 72, 58, 84, 58, 33],
                [22, 73, 83, 44, 36,  9, 54, 89, 59, 55]])
```

```
In [90]: arr2
```

```
Out[90]: array([[96, 75, 83, 77, 57, 16, 96, 55,  8, 15],
                [86, 16, 88, 53, 38, 48, 54, 63,  2,  0],
                [29, 96, 32, 78, 68, 87, 24, 14, 26, 81],
                [18,  1, 19, 18, 25, 72, 58, 84, 58, 33],
                [22, 73, 83, 44, 36,  9, 54, 89, 59, 55],
                [25,  9, 45, 73, 66, 15, 13, 24, 76, 86],
                [27, 80, 97, 91, 53, 60, 16, 32, 25, 31],
                [39, 43, 41, 37,  6, 81, 15, 48, 64, 91],
                [89, 98, 52, 31, 26, 63, 25, 71, 16, 42],
                [ 9, 24, 35,  2, 55, 62, 26,  4, 63, 28]])
```

```
In [91]: arr2[1,4]
```

```
Out[91]: 38
```

```
In [92]: arr2[1,3]
```

```
Out[92]: 53
```

```
In [93]: arr2
```

```
Out[93]: array([[96, 75, 83, 77, 57, 16, 96, 55,  8, 15],
                [86, 16, 88, 53, 38, 48, 54, 63,  2,  0],
                [29, 96, 32, 78, 68, 87, 24, 14, 26, 81],
                [18,  1, 19, 18, 25, 72, 58, 84, 58, 33],
                [22, 73, 83, 44, 36,  9, 54, 89, 59, 55],
                [25,  9, 45, 73, 66, 15, 13, 24, 76, 86],
                [27, 80, 97, 91, 53, 60, 16, 32, 25, 31],
                [39, 43, 41, 37,  6, 81, 15, 48, 64, 91],
                [89, 98, 52, 31, 26, 63, 25, 71, 16, 42],
                [ 9, 24, 35,  2, 55, 62, 26,  4, 63, 28]])
```

```
In [94]: arr2[-5,5]
```

```
Out[94]: 15
```

```
In [95]: arr2
```

```
Out[95]: array([[96, 75, 83, 77, 57, 16, 96, 55,  8, 15],
                [86, 16, 88, 53, 38, 48, 54, 63,  2,  0],
                [29, 96, 32, 78, 68, 87, 24, 14, 26, 81],
                [18,  1, 19, 18, 25, 72, 58, 84, 58, 33],
                [22, 73, 83, 44, 36,  9, 54, 89, 59, 55],
                [25,  9, 45, 73, 66, 15, 13, 24, 76, 86],
                [27, 80, 97, 91, 53, 60, 16, 32, 25, 31],
                [39, 43, 41, 37,  6, 81, 15, 48, 64, 91],
                [89, 98, 52, 31, 26, 63, 25, 71, 16, 42],
                [ 9, 24, 35,  2, 55, 62, 26,  4, 63, 28]])
```

```
In [96]: arr2[-1,-2]
```

```
Out[96]: 63
```

```
In [97]: arr2
```

```
Out[97]: array([[96, 75, 83, 77, 57, 16, 96, 55,  8, 15],
                [86, 16, 88, 53, 38, 48, 54, 63,  2,  0],
                [29, 96, 32, 78, 68, 87, 24, 14, 26, 81],
                [18,  1, 19, 18, 25, 72, 58, 84, 58, 33],
                [22, 73, 83, 44, 36,  9, 54, 89, 59, 55],
                [25,  9, 45, 73, 66, 15, 13, 24, 76, 86],
                [27, 80, 97, 91, 53, 60, 16, 32, 25, 31],
                [39, 43, 41, 37,  6, 81, 15, 48, 64, 91],
                [89, 98, 52, 31, 26, 63, 25, 71, 16, 42],
                [ 9, 24, 35,  2, 55, 62, 26,  4, 63, 28]])
```

```
In [98]: arr2[::-1]
```

```
Out[98]: array([[ 9, 24, 35,  2, 55, 62, 26,  4, 63, 28],
                [89, 98, 52, 31, 26, 63, 25, 71, 16, 42],
                [39, 43, 41, 37,  6, 81, 15, 48, 64, 91],
                [27, 80, 97, 91, 53, 60, 16, 32, 25, 31],
                [25,  9, 45, 73, 66, 15, 13, 24, 76, 86],
                [22, 73, 83, 44, 36,  9, 54, 89, 59, 55],
                [18,  1, 19, 18, 25, 72, 58, 84, 58, 33],
                [29, 96, 32, 78, 68, 87, 24, 14, 26, 81],
                [86, 16, 88, 53, 38, 48, 54, 63,  2,  0],
                [96, 75, 83, 77, 57, 16, 96, 55,  8, 15]])
```

```
In [99]: arr2
```

```
Out[99]: array([[96, 75, 83, 77, 57, 16, 96, 55,  8, 15],
                [86, 16, 88, 53, 38, 48, 54, 63,  2,  0],
                [29, 96, 32, 78, 68, 87, 24, 14, 26, 81],
                [18,  1, 19, 18, 25, 72, 58, 84, 58, 33],
                [22, 73, 83, 44, 36,  9, 54, 89, 59, 55],
                [25,  9, 45, 73, 66, 15, 13, 24, 76, 86],
                [27, 80, 97, 91, 53, 60, 16, 32, 25, 31],
                [39, 43, 41, 37,  6, 81, 15, 48, 64, 91],
                [89, 98, 52, 31, 26, 63, 25, 71, 16, 42],
                [ 9, 24, 35,  2, 55, 62, 26,  4, 63, 28]])
```

```
In [100]: arr2[:, -2]
```

```
Out[100]: array([[ 9, 24, 35,  2, 55, 62, 26,  4, 63, 28],
                 [39, 43, 41, 37,  6, 81, 15, 48, 64, 91],
                 [25,  9, 45, 73, 66, 15, 13, 24, 76, 86],
                 [18,  1, 19, 18, 25, 72, 58, 84, 58, 33],
                 [86, 16, 88, 53, 38, 48, 54, 63,  2,  0]])
```

```
In [101]: arr2
```

```
Out[101]: array([[96, 75, 83, 77, 57, 16, 96, 55,  8, 15],
                 [86, 16, 88, 53, 38, 48, 54, 63,  2,  0],
                 [29, 96, 32, 78, 68, 87, 24, 14, 26, 81],
                 [18,  1, 19, 18, 25, 72, 58, 84, 58, 33],
                 [22, 73, 83, 44, 36,  9, 54, 89, 59, 55],
                 [25,  9, 45, 73, 66, 15, 13, 24, 76, 86],
                 [27, 80, 97, 91, 53, 60, 16, 32, 25, 31],
                 [39, 43, 41, 37,  6, 81, 15, 48, 64, 91],
                 [89, 98, 52, 31, 26, 63, 25, 71, 16, 42],
                 [ 9, 24, 35,  2, 55, 62, 26,  4, 63, 28]])
```

```
In [102]: arr2[:, -3]
```

```
Out[102]: array([[ 9, 24, 35,  2, 55, 62, 26,  4, 63, 28],
                 [27, 80, 97, 91, 53, 60, 16, 32, 25, 31],
                 [18,  1, 19, 18, 25, 72, 58, 84, 58, 33],
                 [96, 75, 83, 77, 57, 16, 96, 55,  8, 15]])
```

```
In [109]: arr2
```

```
Out[109]: array([[96, 75, 83, 77, 57, 16, 96, 55,  8, 15],
                 [86, 16, 88, 53, 38, 48, 54, 63,  2,  0],
                 [29, 96, 32, 78, 68, 87, 24, 14, 26, 81],
                 [18,  1, 19, 18, 25, 72, 58, 84, 58, 33],
                 [22, 73, 83, 44, 36,  9, 54, 89, 59, 55],
                 [25,  9, 45, 73, 66, 15, 13, 24, 76, 86],
                 [27, 80, 97, 91, 53, 60, 16, 32, 25, 31],
                 [39, 43, 41, 37,  6, 81, 15, 48, 64, 91],
                 [89, 98, 52, 31, 26, 63, 25, 71, 16, 42],
                 [ 9, 24, 35,  2, 55, 62, 26,  4, 63, 28]])
```

```
In [110]: arr2[:-3]
```

```
Out[110]: array([[96, 75, 83, 77, 57, 16, 96, 55,  8, 15],
                 [86, 16, 88, 53, 38, 48, 54, 63,  2,  0],
                 [29, 96, 32, 78, 68, 87, 24, 14, 26, 81],
                 [18,  1, 19, 18, 25, 72, 58, 84, 58, 33],
                 [22, 73, 83, 44, 36,  9, 54, 89, 59, 55],
                 [25,  9, 45, 73, 66, 15, 13, 24, 76, 86],
                 [27, 80, 97, 91, 53, 60, 16, 32, 25, 31]])
```

```
In [111]: arr2[:,2]
```

```
Out[111]: array([[96, 75, 83, 77, 57, 16, 96, 55,  8, 15],
                 [29, 96, 32, 78, 68, 87, 24, 14, 26, 81],
                 [22, 73, 83, 44, 36,  9, 54, 89, 59, 55],
                 [27, 80, 97, 91, 53, 60, 16, 32, 25, 31],
                 [89, 98, 52, 31, 26, 63, 25, 71, 16, 42]])
```

```
In [112]: arr
```

```
Out[112]: array([0, 1, 2, 3, 4, 5])
```

```
In [113]: arr.max()
```

```
Out[113]: 5
```

```
In [114]: arr.min()
```

```
Out[114]: 0
```

```
In [115]: arr
```

```
Out[115]: array([0, 1, 2, 3, 4, 5])
```

```
In [116]: arr.mean()
```

```
Out[116]: 2.5
```

```
In [117]: arr
```

```
Out[117]: array([0, 1, 2, 3, 4, 5])
```

```
In [118]: arr.reshape(3,2)
```

```
Out[118]: array([[0, 1],
                 [2, 3],
                 [4, 5]])
```

```
In [119]: arr.reshape(6,1)
```

```
Out[119]: array([[0],  
                [1],  
                [2],  
                [3],  
                [4],  
                [5]])
```

```
In [120]: arr.reshape(1,6)
```

```
Out[120]: array([[0, 1, 2, 3, 4, 5]])
```

```
In [121]: arr
```

```
Out[121]: array([0, 1, 2, 3, 4, 5])
```

```
In [123]: arr
```

```
Out[123]: array([0, 1, 2, 3, 4, 5])
```

```
In [124]: arr.reshape(2,3,order='C')
```

```
Out[124]: array([[0, 1, 2],  
                [3, 4, 5]])
```

```
In [125]: arr.reshape(2,3,order='F')
```

```
Out[125]: array([[0, 2, 4],  
                [1, 3, 5]])
```

```
In [126]: arr.reshape(2,3,order='A')
```

```
Out[126]: array([[0, 1, 2],  
                [3, 4, 5]])
```

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

```
Out[127]: array([0, 1, 2, 3, 4, 5])
```

```
In [128]: arr.reshape(2,3)
```

```
Out[128]: array([[0, 1, 2],  
                [3, 4, 5]])
```

```
In [130]: arr.reshape(1,6)
```

```
Out[130]: array([[0, 1, 2, 3, 4, 5]])
```

```
In [131]: arr.reshape(6,1)
```

```
Out[131]: array([[0],
                 [1],
                 [2],
                 [3],
                 [4],
                 [5]])
```

```
In [134]: arr
```

```
Out[134]: array([0, 1, 2, 3, 4, 5])
```

```
In [135]: arr.reshape(3,2)
```

```
Out[135]: array([[0, 1],
                 [2, 3],
                 [4, 5]])
```

## Indexing

```
In [136]: mat = np.arange(0,100).reshape(10,10)
```

```
In [137]: mat
```

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

```
In [138]: row = 4
          col = 5
```

```
In [139]: col
```

```
Out[139]: 5
```

```
In [140]: row
```

```
Out[140]: 4
```

```
In [141]: mat
```

```
Out[141]: 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 [142]: mat[row,col]
```

```
Out[142]: 45
```

```
In [143]: mat[4,5]
```

```
Out[143]: 45
```

```
In [144]: mat
```

```
Out[144]: 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 [145]: mat[:]
```

```
Out[145]: 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 [146]: col = 6
```

```
In [147]: mat
```

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

```
In [148]: mat[6]
```

```
Out[148]: array([60, 61, 62, 63, 64, 65, 66, 67, 68, 69])
```

```
In [149]: mat
```

```
Out[149]: 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 [150]: mat[:,col]
```

```
Out[150]: array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])
```

```
In [151]: mat
```

```
Out[151]: 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 [152]: mat[row,:]
```

```
Out[152]: array([40, 41, 42, 43, 44, 45, 46, 47, 48, 49])
```



```
In [153]: mat
```

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

```
Out[154]: array([ 8, 18, 28, 38, 48, 58, 68, 78, 88, 98])
```

```
In [155]: mat
```

```
Out[155]: 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 [156]: mat[:,col]
```

```
Out[156]: 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 [157]: mat[:6]
```

```
Out[157]: 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 [158]: row
```

```
Out[158]: 4
```

```
In [159]: mat
```

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

```
Out[160]: 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 [161]: mat
```

```
Out[161]: 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 [162]: mat[row:]
```

```
Out[162]: 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 [163]: mat[:]
```

```
Out[163]: 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 [164]: mat[:,8]
```

```
Out[164]: array([ 8, 18, 28, 38, 48, 58, 68, 78, 88, 98])
```

```
In [165]: mat
```

```
Out[165]: 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 [166]: mat[:, -1]
```

```
Out[166]: array([ 9, 19, 29, 39, 49, 59, 69, 79, 89, 99])
```

```
In [167]: mat
```

```
Out[167]: 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 [168]: row
```

```
Out[168]: 4
```

```
In [169]: col
```

```
Out[169]: 6
```

```
In [170]: mat[:,col]
```

```
Out[170]: array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])
```

```
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]: mat[1,4]
```

```
Out[172]: 14
```

```
In [173]: mat
```

```
Out[173]: 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 [174]: mat[1:4]
```

```
Out[174]: 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 [175]: mat
```

```
Out[175]: 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 [176]: mat[3:-3]
```

```
Out[176]: 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 [177]: mat
```

```
Out[177]: 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 [178]: mat[0]
```

```
Out[178]: array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])
```

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

```
Out[179]: array([60, 61, 62, 63, 64, 65, 66, 67, 68, 69])
```

```
In [180]: mat
```

```
Out[180]: 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 [181]: mat[6:]
```

```
Out[181]: 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 [182]: mat[:6]
```

```
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],
                 [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
                 [50, 51, 52, 53, 54, 55, 56, 57, 58, 59]])
```

```
In [183]: mat
```

```
Out[183]: 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 [184]: mat[5:7]
```

```
Out[184]: array([[50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
                 [60, 61, 62, 63, 64, 65, 66, 67, 68, 69]])
```

```
In [185]: mat
```

```
Out[185]: 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 [186]: mat[0:10]
```

```
Out[186]: 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 [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]: mat[0:10:3]
```

```
Out[188]: 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 [189]: mat[0:10]
```

```
Out[189]: 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 [190]: mat
```

```
Out[190]: 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 [191]: mat[4:]
```

```
Out[191]: 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 [192]: mat
```

```
Out[192]: array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
                 [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
                 [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
                 [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
                 [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
                 [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
                 [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
                 [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
                 [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
                 [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [193]: mat[:4]
```

```
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]])
```

```
In [194]: mat
```

```
Out[194]: 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 [195]: mat[::-1]
```

```
Out[195]: 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 [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[::-3]
```

```
Out[197]: 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 [198]: mat
```

```
Out[198]: 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 [199]: mat[::-3]
```

```
Out[199]: 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 [200]: mat
```

```
Out[200]: array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
                 [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
                 [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
                 [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
                 [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
                 [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
                 [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
                 [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
                 [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
                 [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [201]: mat[::-5]
```

```
Out[201]: array([[90, 91, 92, 93, 94, 95, 96, 97, 98, 99],
                 [40, 41, 42, 43, 44, 45, 46, 47, 48, 49]])
```

```
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[2:6]
```

```
Out[203]: 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 [204]: `mat`

```
Out[204]: array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
                 [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
                 [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
                 [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
                 [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
                 [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
                 [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
                 [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
                 [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
                 [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

In [205]: `mat[2:6,2:4]`

```
Out[205]: array([[22, 23],
                 [32, 33],
                 [42, 43],
                 [52, 53]])
```

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[0,1]`

```
Out[207]: 1
```

In [208]: `mat[1,6]`

```
Out[208]: 16
```

In [209]: `mat`

```
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],
                 [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 [210]: mat[1:6]
```

```
Out[210]: 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 [211]: mat[1:]
```

```
Out[211]: 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 [212]: mat
```

```
Out[212]: 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 [213]: mat[:6]
```

```
Out[213]: array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
                 [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
                 [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
                 [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
                 [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
                 [50, 51, 52, 53, 54, 55, 56, 57, 58, 59]])
```

```
In [214]: mat[0:1]
```

```
Out[214]: array([[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]])
```

```
In [215]: mat
```

```
Out[215]: array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
                 [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
                 [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
                 [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
                 [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
                 [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
                 [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
                 [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
                 [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
                 [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [216]: mat[3:5]
```

```
Out[216]: array([[30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
                 [40, 41, 42, 43, 44, 45, 46, 47, 48, 49]])
```

```
In [217]: mat[3,5]
```

```
Out[217]: 35
```

```
In [218]: mat
```

```
Out[218]: 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 [219]: mat[1:2,2:4]
```

```
Out[219]: array([[12, 13]])
```

```
In [220]: mat
```

```
Out[220]: 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 [221]: mat[2:3,2:3]
```

```
Out[221]: array([[22]])
```

```
In [222]: mat
```

```
Out[222]: 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 [223]: mat[2:4,3:5]
```

```
Out[223]: array([[23, 24],
                 [33, 34]])
```

```
In [224]: mat[3:5,2:4]
```

```
Out[224]: array([[32, 33],
                 [42, 43]])
```

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

```
Out[226]: array([[24]])
```

## Masking

```
In [227]: mat
```

```
Out[227]: array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
                 [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
                 [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
                 [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
                 [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
                 [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
                 [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
                 [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
                 [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
                 [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [228]: id(mat)
```

```
Out[228]: 1615375581904
```

```
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[mat<50]
```

```
Out[230]: 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 [231]: mat[mat<40]
```

```
Out[231]: array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14, 15, 16,
                  17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33,
                  34, 35, 36, 37, 38, 39])
```

```
In [232]: mat[mat<=50]
```

```
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, 5
                  0])
```

```
In [233]: mat > 50
```

```
Out[233]: 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 [234]: mat[mat==50]
```

```
Out[234]: array([50])
```

```
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 == 50
```

```
Out[236]: 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 [237]: mat
```

```
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]: a1 = mat[mat<50]
a1
```

```
Out[238]: array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14, 15, 16,
                 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33,
                 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49])
```

```
In [239]: mat
```

```
Out[239]: array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
                 [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
                 [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
                 [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
                 [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
                 [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
                 [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
                 [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
                 [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
                 [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```



```
In [240]: a2 = mat[mat>50]
a2
```

```
Out[240]: 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 [241]: a3 = mat[mat<=50]
a3
```

```
Out[241]: array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14, 15, 16,
        17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33,
        34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49,  5
        0])
```

```
In [242]: a4 = mat[mat==50]
a4
```

```
Out[242]: array([50])
```

## python program to generate OTP

```
In [250]: import random
def generate_otp(length=4):
    digits = '012345'
    otp = ''.join(random.choice(digits) for _ in range(length))
    return otp
otp_length = 4
otp = generate_otp(otp_length)
print(f"Your OTP is: {otp}")
```

Your OTP is: 0503

```
In [251]: 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 [252]: def wish():  
          print('good even')  
          wish()  
  
          wish()  
  
          wish()
```

```
good even  
good even  
good even
```

```
In [253]: list1=['a','b','g',1,5]  
          print(list1.pop)
```

```
<built-in method pop of list object at 0x000001781BE25B00>
```

```
In [254]: x = [1, 2, 3]  
          y = x.copy()  
          x.append(4)  
          print(x)
```

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