Numpy Crash Course

In [228…
```
import numpy as np
import sys
sys.version
```

Out[228…
```
'3.12.7 | packaged by Anaconda, Inc. | (main, Oct  4 2024, 13:17:27) [MSC v.192
9 64 bit (AMD64)]'
```

In [229…
```
np.__version__
```

Out[229…
```
'1.26.4'
```

Creating Arrays

In [231…
```
my_list = [0,1,2,3,4,5]
my_list
```

Out[231…
```
[0, 1, 2, 3, 4, 5]
```

In [232…
```
type(my_list)
```

Out[232…
```
list
```

In [233…
```
arr = np.array(my_list)
```

In [234…
```
arr
```

Out[234…
```
array([0, 1, 2, 3, 4, 5])
```

In [235…
```
type(arr)
```

Out[235…
```
numpy.ndarray
```

In [236…
```
type(my_list)
```

Out[236…
```
list
```

In [237…
```
np.arange(15)
```

Out[237…
```
array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14])
```

In [238…
```
np.arange(3.0)
```

Out[238…
```
array([0., 1., 2.])
```

In [239…
```
np.arange(10)
```

Out[239…
```
array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])
```

In [240…
```
np.arange(0,5)
```

Out[240… array([0, 1, 2, 3, 4])

In [241…
```
np.arange(10,20)
```

Out[241… array([10, 11, 12, 13, 14, 15, 16, 17, 18, 19])

In [242…
```
np.arange(20,10)
```

Out[242… array([], dtype=int32)

In [243…
```
np.arange(-20,10)
```

Out[243…
```
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 [244…
```
np.arange(-20,10,5)
```

Out[244… array([-20, -15, -10, -5,   0,   5])

In [245…
```
np.arange(-16,10)
```

Out[245…
```
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 [246…
```
np.arange(-20,-10)
```

Out[246… array([-20, -19, -18, -17, -16, -15, -14, -13, -12, -11])

In [247…
```
np.arange(30,20)  # 1st arg always be < then 2nd arg
```

Out[247… array([], dtype=int32)

In [248…
```
ar = np.arange(-30,20)
ar
```

Out[248…
```
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 [249…
```
np.arange(10,10)
```

Out[249… array([], dtype=int32)

In [250…
```
np.arange(10,11)
```

Out[250… array([10])

In [251…
```
np.arange()
```

```
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
Cell In[251], line 1
----> 1 np.arange()

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

In [ ]:
```
np.arange(10,30,5)  # 10- starting from 30- end point 5 - step count
```

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

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

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

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

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

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

In [376…
```
zero = np.zeros([2,2])
print(zero)

print('####')

print(type(zero))
```

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

In [378…
```
np.zeros((2,10))
```

Out[378…
```
array([[0., 0., 0., 0., 0., 0., 0., 0., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0.]])
```

In [380…
```
np.zeros((2,2))
```

Out[380…
```
array([[0., 0.],
       [0., 0.]])
```

In [381…
```
np.zeros((3,3))
```

Out[381…
```
array([[0., 0., 0.],
       [0., 0., 0.],
       [0., 0., 0.]])
```

In [382…
```
np.zeros((10,30))
```

Out[382…
```
array([[0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.],
       [0., 0., 0., 0., 0., 0., 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 [383…
```
np.zeros((5,10)) # bydefaul 1arge -- will give row & 2nd arg - columns
```

Out[383…
```
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 [384…
```
n = (6,7)
n1 = (6,8)
print(np.zeros(n1, dtype=int)) # parameter tunnin g
```

```
[[0 0 0 0 0 0 0 0]
 [0 0 0 0 0 0 0 0]
 [0 0 0 0 0 0 0 0]
 [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 [385…
```
print(n)
```

```
(6, 7)
```

In [386…
```
print(np.zeros(n,dtype=int)) ## hypyerparameter tunning
```

```
[[0 0 0 0 0 0 0]
 [0 0 0 0 0 0 0]
 [0 0 0 0 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 [387…
```
n
```

Out[387…
```
(6, 7)
```

In [388…
```
n1
```

Out[388…
```
(6, 8)
```

In [389…
```
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 [390…
```
np.ones(3)
```

Out[390…
```
array([1., 1., 1.])
```

In [391…
```
np.ones(4, dtype=int)
```

Out[391…
```
array([1, 1, 1, 1])
```

In [392…
```
np.ones(4)
```

Out[392…
```
array([1., 1., 1., 1.])
```

In [393…
```
n
```

Out[393…
```
(6, 7)
```

In [394…
```
np.ones(n)
```

Out[394…
```
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 [395…
```
np.ones((5,4),dtype=int) # by default 5- rows & 4 - columns
```

Out[395…
```
array([[1, 1, 1, 1],
       [1, 1, 1, 1],
       [1, 1, 1, 1],
       [1, 1, 1, 1],
       [1, 1, 1, 1]])
```

In [396…
```
np.twos((2,3))
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[396], line 1
----> 1 np.twos((2,3))

File C:\ProgramData\anaconda3\Lib\site-packages\numpy\__init__.py:333, in __getat
tr__(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 'twos'
```

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

In [ ]:
```
np.ones(2)
```

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

In [397…
```
np.ones((6,10),dtype = int)
```

Out[397…
```
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 [398…
```
arr= np.ones((6,10),dtype = int) *3
```

In [399…
```
arr/2
```

Out[399…
```
array([[1.5, 1.5, 1.5, 1.5, 1.5, 1.5, 1.5, 1.5, 1.5, 1.5],
       [1.5, 1.5, 1.5, 1.5, 1.5, 1.5, 1.5, 1.5, 1.5, 1.5],
       [1.5, 1.5, 1.5, 1.5, 1.5, 1.5, 1.5, 1.5, 1.5, 1.5],
       [1.5, 1.5, 1.5, 1.5, 1.5, 1.5, 1.5, 1.5, 1.5, 1.5],
       [1.5, 1.5, 1.5, 1.5, 1.5, 1.5, 1.5, 1.5, 1.5, 1.5],
       [1.5, 1.5, 1.5, 1.5, 1.5, 1.5, 1.5, 1.5, 1.5, 1.5]])
```

In [400…
```
range(5)
```

Out[400…
```
range(0, 5)
```

In [401…
```
r=range(5)
r
```

Out[401…
```
range(0, 5)
```

In [402…
```
for i in r:
    print(i)
```

```
0
1
2
3
4
```

In [403…
```
list(range(5))
```

Out[403…
```
[0, 1, 2, 3, 4]
```

In [404…
```
range(1,10)
```

Out[404…
```
range(1, 10)
```

In [405…
```
list(range(1,10))
```

Out[405…
```
[1, 2, 3, 4, 5, 6, 7, 8, 9]
```

In [435…
```
list(range(1,10,3))
```

Out[435… [1, 4, 7]

In [436…
```
y = list(range(12))
y
```

Out[436… [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11]

In [437…
```
type(y)
```

Out[437… list

In [438…
```
arr = np.array(y)
```

In [439…
```
type(arr)
```

Out[439… numpy.ndarray

In [440…
```
arr
```

Out[440… array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11])

In [441…
```
np.random.rand(5)
```

Out[441… array([0.71695641, 0.0079872 , 0.8336547 , 0.11176447, 0.83909792])

In [442…
```
np.random.rand(2,4)
```

Out[442…
```
array([[0.82745016, 0.24039207, 0.84662194, 0.55446174],
       [0.28954548, 0.05352732, 0.99574468, 0.65674136]])
```

In [443…
```
np.random.randint(2,4)
```

Out[443… 3

In [444…
```
np.random.randint(2,20) # 2nd argument is exlusive
```

Out[444… 17

In [445…
```
np.random.randint(-1,1)
```

Out[445… 0

In [446…
```
np.random.randint(10,20,5)
```

Out[446… array([11, 19, 19, 15, 10])

In [447…
```
np.random.randint(1,6,4)
```

Out[447… array([4, 5, 5, 4])

In [448…
```
np.random.randint(1,6,(4,2))
```

Out[448…
```
array([[4, 1],
       [1, 5],
       [3, 1],
       [1, 1]])
```

In [449…
```
np.random.rand(3)
```
Out[449…
```
array([0.32502321, 0.7986049 , 0.16252514])
```
In [450…
```
np.random.randint(1)
```
Out[450…
```
0
```
In [451…
```
np.random.randint(-30,20,10)
```
Out[451…
```
array([-26, -10, -24,  -5,  -3,   3, -14,   2,  -4, -20])
```
In [452…
```
np.random.randint(20,30,10)
```
Out[452…
```
array([27, 27, 22, 25, 23, 27, 23, 25, 22, 21])
```
In [453…
```
np.random.randint(5,9)  #GET THE VALUE <9 & >=5
```
Out[453…
```
5
```
In [454…
```
np.random.randint(10,21,3)
```
Out[454…
```
array([16, 19, 13])
```
In [455…
```
np.random.randint(1,12,10)
```
Out[455…
```
array([10,  7,  8,  5,  9, 11,  3,  7,  1,  4])
```
In [456…
```
np.random.randint(10,40,(10,10)) #generre the element 10 -30 with 4*4 mtri
```
Out[456…
```
array([[21, 35, 20, 37, 37, 16, 10, 22, 36, 30],
       [38, 33, 28, 31, 20, 23, 10, 34, 38, 14],
       [26, 23, 39, 11, 34, 38, 30, 31, 17, 38],
       [27, 34, 26, 39, 27, 27, 24, 38, 23, 20],
       [19, 28, 38, 23, 37, 19, 17, 38, 27, 14],
       [24, 33, 10, 29, 28, 36, 14, 39, 31, 23],
       [31, 25, 36, 23, 36, 35, 32, 31, 22, 12],
       [17, 14, 38, 12, 19, 11, 25, 23, 26, 19],
       [13, 15, 16, 13, 26, 21, 15, 25, 22, 38],
       [27, 26, 34, 32, 30, 11, 32, 11, 27, 20]])
```
In [457…
```
np.random.randint(1,100,(12,12)) #generre the element 10 -30 with 4*4 mtri
```
Out[457…
```
array([[54, 54, 51, 24, 80, 56, 27, 66, 58, 92, 11, 83],
       [23, 72, 92, 39, 57, 20,  6, 71, 66, 46, 45,  5],
       [62, 71, 91, 17, 22, 32, 38, 99,  3, 30, 34, 46],
       [ 7, 32, 53, 83, 57, 29, 78, 27,  8, 44, 38,  7],
       [11, 84, 10, 83, 32, 16,  6, 20, 47, 68, 53, 58],
       [28, 68, 15,  3,  2, 83, 57, 15, 75,  6, 44, 20],
       [53, 25, 26, 64, 70, 56, 29, 45, 69, 90, 11,  4],
       [66, 29, 76, 57, 99, 97, 95, 64, 21, 31, 49, 44],
       [ 9, 77, 73, 12, 42, 36, 61, 62, 25, 77, 79, 16],
       [24, 16, 49, 25, 34, 70, 17, 74, 71, 51, 23, 58],
       [ 5, 85,  1, 21, 68, 68, 61, 11, 64, 47, 69, 73],
       [ 7, 14, 48, 34, 77, 46, 78, 77,  8, 31,  2, 47]])
```
In [458…
```
np.arange(1,13).reshape(3,4)
```

Out[458…
```
array([[ 1,  2,  3,  4],
       [ 5,  6,  7,  8],
       [ 9, 10, 11, 12]])
```

In [459…
```
np.arange(1,13).reshape(12, 1)
```

Out[459…
```
array([[ 1],
       [ 2],
       [ 3],
       [ 4],
       [ 5],
       [ 6],
       [ 7],
       [ 8],
       [ 9],
       [10],
       [11],
       [12]])
```

In [460…
```
b = np.random.randint(10,20,(5,4))
b
```

Out[460…
```
array([[14, 14, 19, 11],
       [19, 17, 13, 12],
       [16, 11, 11, 11],
       [10, 19, 10, 18],
       [13, 15, 10, 10]])
```

In [461…
```
type(b)
```

Out[461…
```
numpy.ndarray
```

In [462…
```
b
```

Out[462…
```
array([[14, 14, 19, 11],
       [19, 17, 13, 12],
       [16, 11, 11, 11],
       [10, 19, 10, 18],
       [13, 15, 10, 10]])
```

In [491…
```
b[:]
```

Out[491…
```
array([[14, 14, 19, 11],
       [19, 17, 13, 12],
       [16, 11, 11, 11],
       [10, 19, 10, 18],
       [13, 15, 10, 10]])
```

In [492…
```
b[1:3]
```

Out[492…
```
array([[19, 17, 13, 12],
       [16, 11, 11, 11]])
```

In [493…
```
b
```

Out[493…
```
array([[14, 14, 19, 11],
       [19, 17, 13, 12],
       [16, 11, 11, 11],
       [10, 19, 10, 18],
       [13, 15, 10, 10]])
```

In [494…
```
b[1,2]
```

Out[494… 13

In [495…
```
b
```

Out[495…
```
array([[14, 14, 19, 11],
       [19, 17, 13, 12],
       [16, 11, 11, 11],
       [10, 19, 10, 18],
       [13, 15, 10, 10]])
```

In [496…
```
b[1,3]
```

Out[496… 12

In [497…
```
b[1,-1]
```

Out[497… 12

In [498…
```
b
```

Out[498…
```
array([[14, 14, 19, 11],
       [19, 17, 13, 12],
       [16, 11, 11, 11],
       [10, 19, 10, 18],
       [13, 15, 10, 10]])
```

In [499…
```
b[2:3]
```

Out[499…
```
array([[16, 11, 11, 11]])
```

In [500…
```
b[0:-2]
```

Out[500…
```
array([[14, 14, 19, 11],
       [19, 17, 13, 12],
       [16, 11, 11, 11]])
```

In [501…
```
b
```

Out[501…
```
array([[14, 14, 19, 11],
       [19, 17, 13, 12],
       [16, 11, 11, 11],
       [10, 19, 10, 18],
       [13, 15, 10, 10]])
```

In [502…
```
b[0,2]
```

Out[502… 19

In [503…
```
b[-5,-3]
```

Out[503… 14

In [504…
```
b[-4,2]
```

Out[504… 13

In [505…
```
np.random.randint(10,20,(4,4))
```

Out[505…
```
array([[12, 12, 17, 11],
       [18, 11, 15, 19],
       [18, 16, 16, 10],
       [13, 16, 13, 17]])
```

In [521…
```
b
```

Out[521…
```
array([[14, 14, 19, 11],
       [19, 17, 13, 12],
       [16, 11, 11, 11],
       [10, 19, 10, 18],
       [13, 15, 10, 10]])
```

In [522…
```
b[-4,-2]
```

Out[522… 13

In [523…
```
b[-4:2]
```

Out[523…
```
array([[19, 17, 13, 12]])
```

In [524…
```
b[3:2]
```

Out[524…
```
array([], shape=(0, 4), dtype=int32)
```

In [525…
```
b[:]
```

Out[525…
```
array([[14, 14, 19, 11],
       [19, 17, 13, 12],
       [16, 11, 11, 11],
       [10, 19, 10, 18],
       [13, 15, 10, 10]])
```

In [526…
```
b[1:3,1:3]
```

Out[526…
```
array([[17, 13],
       [11, 11]])
```

Operations

In [528…
```
a = np.random.randint(10,20,10)
a
```

Out[528…
```
array([10, 16, 17, 18, 14, 14, 17, 11, 13, 13])
```

In [529…
```
id(a)
```

Out[529… 1783460198992

In [530…
```
arr
```

Out[530…
```
array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11])
```

In [531…
```
arr2 = np.random.randint(0,100,(10,10))
```

In [532…
```
arr2
```

Out[532…
```
array([[35, 21, 93, 28, 25, 18, 33,  7,  3, 71],
       [94, 41, 58, 49,  9, 95,  1, 88,  3, 99],
       [38, 87, 94, 91, 95,  5, 44, 45, 64, 36],
       [62, 59, 79,  0, 10, 17, 16, 87, 95, 80],
       [64, 75, 85,  1, 55, 36, 14,  2, 33, 26],
       [14, 42, 26, 37, 26, 24, 65, 98, 22, 45],
       [92, 33, 86, 95, 41, 62, 71, 57, 39, 95],
       [81,  8,  7, 79, 66, 71,  1, 37,  2, 47],
       [72, 75, 67, 99, 45, 55, 15, 30, 64, 33],
       [48, 74, 81, 21, 11, 88, 11, 70, 98, 78]])
```

In [533…
```
arr
```

Out[533…
```
array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11])
```

In [534…
```
arr[:]
```

Out[534…
```
array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11])
```

In [535…
```
arr[:4]
```

Out[535…
```
array([0, 1, 2, 3])
```

In [550…
```
arr2[:]
```

Out[550…
```
array([[35, 21, 93, 28, 25, 18, 33,  7,  3, 71],
       [94, 41, 58, 49,  9, 95,  1, 88,  3, 99],
       [38, 87, 94, 91, 95,  5, 44, 45, 64, 36],
       [62, 59, 79,  0, 10, 17, 16, 87, 95, 80],
       [64, 75, 85,  1, 55, 36, 14,  2, 33, 26],
       [14, 42, 26, 37, 26, 24, 65, 98, 22, 45],
       [92, 33, 86, 95, 41, 62, 71, 57, 39, 95],
       [81,  8,  7, 79, 66, 71,  1, 37,  2, 47],
       [72, 75, 67, 99, 45, 55, 15, 30, 64, 33],
       [48, 74, 81, 21, 11, 88, 11, 70, 98, 78]])
```

In [551…
```
arr2[0:5]
```

Out[551…
```
array([[35, 21, 93, 28, 25, 18, 33,  7,  3, 71],
       [94, 41, 58, 49,  9, 95,  1, 88,  3, 99],
       [38, 87, 94, 91, 95,  5, 44, 45, 64, 36],
       [62, 59, 79,  0, 10, 17, 16, 87, 95, 80],
       [64, 75, 85,  1, 55, 36, 14,  2, 33, 26]])
```

In [552…
```
arr2
```

Out[552…
```
array([[35, 21, 93, 28, 25, 18, 33,  7,  3, 71],
       [94, 41, 58, 49,  9, 95,  1, 88,  3, 99],
       [38, 87, 94, 91, 95,  5, 44, 45, 64, 36],
       [62, 59, 79,  0, 10, 17, 16, 87, 95, 80],
       [64, 75, 85,  1, 55, 36, 14,  2, 33, 26],
       [14, 42, 26, 37, 26, 24, 65, 98, 22, 45],
       [92, 33, 86, 95, 41, 62, 71, 57, 39, 95],
       [81,  8,  7, 79, 66, 71,  1, 37,  2, 47],
       [72, 75, 67, 99, 45, 55, 15, 30, 64, 33],
       [48, 74, 81, 21, 11, 88, 11, 70, 98, 78]])
```

In [553…
```
arr2[1,4]
```

Out[553…
```
9
```

In [554…
```
arr2[-5,5]
```

Out[554…
```
24
```

In [555…
```
arr2
```

Out[555…
```
array([[35, 21, 93, 28, 25, 18, 33,  7,  3, 71],
       [94, 41, 58, 49,  9, 95,  1, 88,  3, 99],
       [38, 87, 94, 91, 95,  5, 44, 45, 64, 36],
       [62, 59, 79,  0, 10, 17, 16, 87, 95, 80],
       [64, 75, 85,  1, 55, 36, 14,  2, 33, 26],
       [14, 42, 26, 37, 26, 24, 65, 98, 22, 45],
       [92, 33, 86, 95, 41, 62, 71, 57, 39, 95],
       [81,  8,  7, 79, 66, 71,  1, 37,  2, 47],
       [72, 75, 67, 99, 45, 55, 15, 30, 64, 33],
       [48, 74, 81, 21, 11, 88, 11, 70, 98, 78]])
```

In [556…
```
arr2[-5,-5]
```

Out[556…
```
24
```

In [557…
```
arr2[-1,-2]
```

Out[557…
```
98
```

In [558…
```
arr2
```

Out[558…
```
array([[35, 21, 93, 28, 25, 18, 33,  7,  3, 71],
       [94, 41, 58, 49,  9, 95,  1, 88,  3, 99],
       [38, 87, 94, 91, 95,  5, 44, 45, 64, 36],
       [62, 59, 79,  0, 10, 17, 16, 87, 95, 80],
       [64, 75, 85,  1, 55, 36, 14,  2, 33, 26],
       [14, 42, 26, 37, 26, 24, 65, 98, 22, 45],
       [92, 33, 86, 95, 41, 62, 71, 57, 39, 95],
       [81,  8,  7, 79, 66, 71,  1, 37,  2, 47],
       [72, 75, 67, 99, 45, 55, 15, 30, 64, 33],
       [48, 74, 81, 21, 11, 88, 11, 70, 98, 78]])
```

In [559…
```
arr2[::-1]
```

Out[559…
```
array([[48, 74, 81, 21, 11, 88, 11, 70, 98, 78],
       [72, 75, 67, 99, 45, 55, 15, 30, 64, 33],
       [81,  8,  7, 79, 66, 71,  1, 37,  2, 47],
       [92, 33, 86, 95, 41, 62, 71, 57, 39, 95],
       [14, 42, 26, 37, 26, 24, 65, 98, 22, 45],
       [64, 75, 85,  1, 55, 36, 14,  2, 33, 26],
       [62, 59, 79,  0, 10, 17, 16, 87, 95, 80],
       [38, 87, 94, 91, 95,  5, 44, 45, 64, 36],
       [94, 41, 58, 49,  9, 95,  1, 88,  3, 99],
       [35, 21, 93, 28, 25, 18, 33,  7,  3, 71]])
```

In [560…
```
arr2[:,::-1]
```

Out[560…
```
array([[71,  3,  7, 33, 18, 25, 28, 93, 21, 35],
       [99,  3, 88,  1, 95,  9, 49, 58, 41, 94],
       [36, 64, 45, 44,  5, 95, 91, 94, 87, 38],
       [80, 95, 87, 16, 17, 10,  0, 79, 59, 62],
       [26, 33,  2, 14, 36, 55,  1, 85, 75, 64],
       [45, 22, 98, 65, 24, 26, 37, 26, 42, 14],
       [95, 39, 57, 71, 62, 41, 95, 86, 33, 92],
       [47,  2, 37,  1, 71, 66, 79,  7,  8, 81],
       [33, 64, 30, 15, 55, 45, 99, 67, 75, 72],
       [78, 98, 70, 11, 88, 11, 21, 81, 74, 48]])
```

In [561…
```
arr2
```

Out[561…
```
array([[35, 21, 93, 28, 25, 18, 33,  7,  3, 71],
       [94, 41, 58, 49,  9, 95,  1, 88,  3, 99],
       [38, 87, 94, 91, 95,  5, 44, 45, 64, 36],
       [62, 59, 79,  0, 10, 17, 16, 87, 95, 80],
       [64, 75, 85,  1, 55, 36, 14,  2, 33, 26],
       [14, 42, 26, 37, 26, 24, 65, 98, 22, 45],
       [92, 33, 86, 95, 41, 62, 71, 57, 39, 95],
       [81,  8,  7, 79, 66, 71,  1, 37,  2, 47],
       [72, 75, 67, 99, 45, 55, 15, 30, 64, 33],
       [48, 74, 81, 21, 11, 88, 11, 70, 98, 78]])
```

In [562…
```
arr2[::-2]
```

Out[562…
```
array([[48, 74, 81, 21, 11, 88, 11, 70, 98, 78],
       [81,  8,  7, 79, 66, 71,  1, 37,  2, 47],
       [14, 42, 26, 37, 26, 24, 65, 98, 22, 45],
       [62, 59, 79,  0, 10, 17, 16, 87, 95, 80],
       [94, 41, 58, 49,  9, 95,  1, 88,  3, 99]])
```

In [563…
```
arr2[::-3]
```

Out[563…
```
array([[48, 74, 81, 21, 11, 88, 11, 70, 98, 78],
       [92, 33, 86, 95, 41, 62, 71, 57, 39, 95],
       [62, 59, 79,  0, 10, 17, 16, 87, 95, 80],
       [35, 21, 93, 28, 25, 18, 33,  7,  3, 71]])
```

In [564…
```
arr2
```

Out[564…
```
array([[35, 21, 93, 28, 25, 18, 33,  7,  3, 71],
       [94, 41, 58, 49,  9, 95,  1, 88,  3, 99],
       [38, 87, 94, 91, 95,  5, 44, 45, 64, 36],
       [62, 59, 79,  0, 10, 17, 16, 87, 95, 80],
       [64, 75, 85,  1, 55, 36, 14,  2, 33, 26],
       [14, 42, 26, 37, 26, 24, 65, 98, 22, 45],
       [92, 33, 86, 95, 41, 62, 71, 57, 39, 95],
       [81,  8,  7, 79, 66, 71,  1, 37,  2, 47],
       [72, 75, 67, 99, 45, 55, 15, 30, 64, 33],
       [48, 74, 81, 21, 11, 88, 11, 70, 98, 78]])
```

In [565…
```
arr2[:-3]
```

Out[565…
```
array([[35, 21, 93, 28, 25, 18, 33,  7,  3, 71],
       [94, 41, 58, 49,  9, 95,  1, 88,  3, 99],
       [38, 87, 94, 91, 95,  5, 44, 45, 64, 36],
       [62, 59, 79,  0, 10, 17, 16, 87, 95, 80],
       [64, 75, 85,  1, 55, 36, 14,  2, 33, 26],
       [14, 42, 26, 37, 26, 24, 65, 98, 22, 45],
       [92, 33, 86, 95, 41, 62, 71, 57, 39, 95]])
```

In [566…
```
arr
```

Out[566…
```
array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11])
```

In [567…
```
arr.max()
```

Out[567…
```
11
```

In [568…
```
arr.min()
```

Out[568…
```
0
```

In [588…
```
arr
```

Out[588…
```
array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11])
```

In [589…
```
arr.mean()
```

Out[589…
```
5.5
```

In [590…
```
arr
```

Out[590…
```
array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11])
```

In [591…
```
arr.median()
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[591], line 1
----> 1 arr.median()

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

In [ ]:
```
median(arr)
```

In [592…
```
from numpy import *
a = array([1,2,3,4,9])
```

```
median(a)
```

Out[592… 3.0

Without working on import* find the median, mode)

In [594…
```
arr
```

Out[594… array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11])

In [595…
```
median(arr)
```

Out[595… 5.5

In [596…
```
arr.reshape(3,2)
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[596], line 1
----> 1 arr.reshape(3,2)

ValueError: cannot reshape array of size 12 into shape (3,2)
```

In [597…
```
arr.reshape(6,1)
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[597], line 1
----> 1 arr.reshape(6,1)

ValueError: cannot reshape array of size 12 into shape (6,1)
```

In [598…
```
arr.reshape(1,6)
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[598], line 1
----> 1 arr.reshape(1,6)

ValueError: cannot reshape array of size 12 into shape (1,6)
```

In [599…
```
arr
```

Out[599… array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11])

In [600…
```
arr.reshape(2,4)
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[600], line 1
----> 1 arr.reshape(2,4)

ValueError: cannot reshape array of size 12 into shape (2,4)
```

In [601…
```
arr.reshape(2,3)
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[601], line 1
----> 1 arr.reshape(2,3)

ValueError: cannot reshape array of size 12 into shape (2,3)
```

In [602…
```
arr.reshape(2,3,order='C')
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[602], line 1
----> 1 arr.reshape(2,3,order='C')

ValueError: cannot reshape array of size 12 into shape (2,3)
```

In [603…
```
arr.reshape(2,3,order='F') # print element with fortran
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[603], line 1
----> 1 arr.reshape(2,3,order='F')

ValueError: cannot reshape array of size 12 into shape (2,3)
```

In [604…
```
arr.reshape(2,3,order='A') # A almost give you c type output
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[604], line 1
----> 1 arr.reshape(2,3,order='A')

ValueError: cannot reshape array of size 12 into shape (2,3)
```

In [605…
```
arr
```

Out[605… array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11])

In [606…
```
arr.reshape(2,3)
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[606], line 1
----> 1 arr.reshape(2,3)

ValueError: cannot reshape array of size 12 into shape (2,3)
```

In [607…
```
arr.reshape(1,4)
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[607], line 1
----> 1 arr.reshape(1,4)

ValueError: cannot reshape array of size 12 into shape (1,4)
```

In [608…
```
arr.reshape(1,6)
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[608], line 1
----> 1 arr.reshape(1,6)

ValueError: cannot reshape array of size 12 into shape (1,6)
```

In [609…
```
arr.reshape(6,1)
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[609], line 1
----> 1 arr.reshape(6,1)

ValueError: cannot reshape array of size 12 into shape (6,1)
```

In [610…
```
arr.reshape(2,6)
```

Out[610…
```
array([[ 0,  1,  2,  3,  4,  5],
       [ 6,  7,  8,  9, 10, 11]])
```

In [611…
```
arr.reshape(3,3)
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[611], line 1
----> 1 arr.reshape(3,3)

ValueError: cannot reshape array of size 12 into shape (3,3)
```

In [612…
```
arr
```

Out[612…
```
array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11])
```

In [613…
```
arr.reshape(3,2)
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[613], line 1
----> 1 arr.reshape(3,2)

ValueError: cannot reshape array of size 12 into shape (3,2)
```

Indexing

In [641…
```
mat = np.arange(0,100).reshape(10,10)
```

In [642…
```
mat
```

Out[642…
```
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 [643…
```
row = 4
col = 5
```

In [644…
```
col
```

Out[644… 5

In [685…
```
mat[row,col]
```

Out[685… 46

In [646…
```
mat[4,5]
```

Out[646… 45

In [647…
```
mat
```

Out[647…
```
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 [648…
```
mat[:]
```

Out[648…
```
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 [659…
```
col = 6
```

In [661…
```
mat
```

Out[661…
```
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 [663…
```
mat[6] # default it represent to rows
```

Out[663…
```
array([60, 61, 62, 63, 64, 65, 66, 67, 68, 69])
```

In [665…
```
mat
```

Out[665…
```
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 [667…
```
# With Slices
mat[:,col]
```

Out[667…
```
array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])
```

In [669…
```
mat
```

Out[669…
```
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 [681…
```
mat[row,:]
```

Out[681…
```
array([40, 41, 42, 43, 44, 45, 46, 47, 48, 49])
```

In [673…
```
mat
```

Out[673…
```
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 [675…
```
mat[:,8]
```

Out[675…
```
array([ 8, 18, 28, 38, 48, 58, 68, 78, 88, 98])
```

In [677…
```
mat
```

Out[677…
```
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 [687…
```
mat[:col]
```

Out[687…
```
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 [689…
```
mat[:6]
```

Out[689…
```
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 [695…
```
row, col
```

Out[695…
```
(4, 6)
```

In [697…
```
mat
```

Out[697…
```
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 [699…
```
mat[:row]
```

Out[699…
```
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 [701…
```
mat
```

Out[701…
```
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 [703…
```
mat[row:]
```

Out[703…
```
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 [705…
```
mat[:]
```

Out[705…
```
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 [723…
```
mat[:,8]
```

Out[723…
```
array([ 8, 18, 28, 38, 48, 58, 68, 78, 88, 98])
```

In [725…
```
mat[:,8].reshape(10,1)
```

Out[725…
```
array([[ 8],
       [18],
       [28],
       [38],
       [48],
       [58],
       [68],
       [78],
       [88],
       [98]])
```

In [727…
```
mat
```

Out[727…
```
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 [729…
```
row
```

Out[729…
```
4
```

In [731…
```
col
```

Out[731…
```
6
```

In [733…
```
mat[:,col]
```

Out[733…
```
array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])
```

In [735…
```
mat
```

Out[735…
```
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 [737…
```
mat[1,4]
```

Out[737…
```
14
```

In [739…
```
mat[1:4]
```

Out[739…
```
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 [741…
```
mat
```

Out[741…
```
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 [743…
```
mat[3:-3]
```

Out[743…
```
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 [746…
```
mat
```

Out[746…
```
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 [748…
```
mat[0]
```

Out[748…
```
array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])
```

In [750…
```
mat[6]
```

Out[750…
```
array([60, 61, 62, 63, 64, 65, 66, 67, 68, 69])
```

In [752…
```
mat
```

Out[752…
```
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 [754…
```
mat[6:]
```

Out[754…
```
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 [756…
```
mat[:6]
```

Out[756…
```
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 [758…
```
mat
```

Out[758…
```
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 [760…
```
mat[5:7]
```

Out[760…
```
array([[50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
       [60, 61, 62, 63, 64, 65, 66, 67, 68, 69]])
```

In [762…
```
mat
```

Out[762…
```
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 [764…
```
mat[0:10]
```

Out[764…
```
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 [766…
```
mat
```

Out[766…
```
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 [768…
```
mat[0:10:3]
```

Out[768…
```
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 [770…
```
mat[0:10]
```

Out[770…
```
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 [772…
```
mat
```

Out[772…
```
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 [774…
```
mat[4:]
```

Out[774…
```
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 [776…
```
mat
```

Out[776…
```
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 [778…
```
mat[:4]
```

Out[778…
```
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 [780…
```
mat
```

Out[780…
```
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 [782…
```
mat[::-1]
```

Out[782…
```
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 [784…
```
mat
```

Out[784…
```
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 [786…
```
mat[::-3]
```

Out[786…
```
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 [788…
```
mat[::-5]
```

Out[788…
```
array([[90, 91, 92, 93, 94, 95, 96, 97, 98, 99],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49]])
```

In [790…
```
mat
```

Out[790…
```
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 [792…
```
mat[2:6]
```

Out[792…
```
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 [794…
```
mat
```

Out[794…
```
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 [796…
```
mat[2:6,2:4] # 1:5 --> only row part /// 1:3 -- it indicates only column parts
```

Out[796…
```
array([[22, 23],
       [32, 33],
       [42, 43],
       [52, 53]])
```

In [798…
```
mat
```

Out[798…
```
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 [800…
```
mat[0,1]
```

Out[800…
```
1
```

In [802…
```
mat[1,6]
```

Out[802…
```
16
```

In [804…
```
mat[1:6]
```

Out[804…
```
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 [806…
```
mat[1:]
```

Out[806…
```
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 [808…
```
mat
```

Out[808…
```
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 [810…
```
mat[:6]
```

Out[810…
```
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 [812…
```
mat[0:1]
```

Out[812…
```
array([[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]])
```

In [814…
```
mat
```

Out[814…
```
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 [816…
```
mat[3:5]
```

Out[816…
```
array([[30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49]])
```

In [818…
```
mat[3,5]
```

Out[818…
```
35
```

In [820…
```
mat
```

Out[820…
```
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 [822…
```
mat[1:2,2:4]
```

Out[822…
```
array([[12, 13]])
```

In [824…
```
mat
```

Out[824…
```
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 [826…
```
mat[2:3,2:3]
```

Out[826…
```
array([[22]])
```

In [828…
```
mat
```

Out[828…
```
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 [830…
```
mat[2:4,3:5]
```

Out[830…
```
array([[23, 24],
       [33, 34]])
```

In [832…
```
mat[3:5,2:4]
```

Out[832…
```
array([[32, 33],
       [42, 43]])
```

In [834…
```
mat
```

Out[834…
```
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 [836…
```
mat[2:3,4:5]
```

Out[836…
```
array([[24]])
```

Masking

In [839…
```
mat # we also called as filter
```

Out[839…
```
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 [841…
```
id(mat)
```

Out[841…
```
1783462585872
```

In [843…
```
mat
```

Out[843…
```
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 [845…
```
mat[mat<50]
```

Out[845…
```
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 [847…
```
mat[mat<=50]
```

Out[847…
```
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 [849…
```
mat > 50
```

Out[849…
```
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 [851…
```
mat[mat==50]
```

Out[851…
```
array([50])
```

In [853…
```
mat
```

Out[853…
```
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 [855…
```
mat == 50
```

Out[855…
```
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]])
```

In [857…
```
mat
```

Out[857…
```
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 [859…
```
a1 = mat[mat<50]
a1
```

Out[859…
```
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 [861…
```
mat
```

Out[861…
```
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 [863…
```
a2 = mat[mat>50]
a2
```

Out[863…
```
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 [865…
```
a3 = mat[mat<=50]
a3
```

Out[865…
```
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 [875…
```
a4 = mat[mat==50]
a4
```

Out[875…
```
array([50])
```

python program to generat otp

In [894…
```
import random
def generate_otp(length=4):
    """Generate a numeric OTP of a specified length."""
    digits = '012345'
    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: 4013
```

In [882…
```
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 [896…
```
def wish():
    print('good even')
wish()

wish()

wish()
```

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

In [900…
```
list1=['a','b','g',1,5]
print(list1.pop)
```

```
list1
```

```
<built-in method pop of list object at 0x0000019F3F646100>
```

Out[900… ['a', 'b', 'g', 1, 5]

In [906…
```
list1.pop()
list1
```

Out[906… ['a', 'b', 'g', 1]

In [908…
```
x = [1, 2, 3]
y = x.copy()
x.append(4)
print(x)
```

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

In [910…
```
y
```

Out[910… [1, 2, 3]