Numpy Crash Course

In [198…
```
import numpy as np
```

In [199…
```
np.__version__
```

Out[199… '1.26.4'

In [200…
```
import sys
sys.version
```

Out[200… '3.12.7 | packaged by Anaconda, Inc. | (main, Oct 4 2024, 13:17:27) [MSC v.1929 6
4 bit (AMD64)]'

Creating Arrays

In [201…
```
my_list = [1,2,3,4,5]
my_list
```

Out[201… [1, 2, 3, 4, 5]

In [202…
```
type(my_list)
```

Out[202… list

In [203…
```
arr=np.array(my_list)
```

In [204…
```
arr
```

Out[204… array([1, 2, 3, 4, 5])

In [205…
```
type(arr)
```

Out[205… numpy.ndarray

In [206…
```
type(my_list)
```

Out[206… list

np. we learn important funtion

In [207…
```
np.arange(15)
```

Out[207… array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14])

In [208…
```
np.arange(50)
```

Out[208…
```
array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14, 15, 16,
       17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33,
       34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49])
```

In [209…
```
np.arange(3.0)
```

Out[209…
```
array([0., 1., 2.])
```

In [210…
```
np.arange(10)
```

Out[210…
```
array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])
```

In [211…
```
np.arange(0,5)
```

Out[211…
```
array([0, 1, 2, 3, 4])
```

In [212…
```
np.arange(10,20)
```

Out[212…
```
array([10, 11, 12, 13, 14, 15, 16, 17, 18, 19])
```

In [213…
```
 np.arange(20,10)   #1st arg < 2nd arg
```

Out[213…
```
array([], dtype=int32)
```

In [214…
```
np.arange(-20,10)
```

Out[214…
```
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 [215…
```
np.arange(-16,10)
```

Out[215…
```
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 [216…
```
np.arange(-20,-12)
```

Out[216…
```
array([-20, -19, -18, -17, -16, -15, -14, -13])
```

In [217…
```
np.arange(30,20)  # 1st arg always be < then 2nd arg
```

Out[217…
```
array([], dtype=int32)
```

In [218…
```
ar = np.arange(-30,20)
ar
```

Out[218…
```
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 [219…
```
np.arange(10,10)
```

Out[219…
```
array([], dtype=int32)
```

In [220…
```
np.arange()
```

```
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
Cell In[220], 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 [221…
```
np.arange(0,10,3)
```

Out[221…
```
array([0, 3, 6, 9])
```

In [222…
```
np.arange(10,30,5,8)
```

```
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
Cell In[222], line 1
----> 1 np.arange(10,30,5,8)

TypeError: Cannot interpret '8' as a data type
```

In [223…
```
np.zeros(3) # parameter  tunning
```

Out[223…
```
array([0., 0., 0.])
```

In [224…
```
np.zeros(5, dtype=int) # hyperparameter tunning
```

Out[224…
```
array([0, 0, 0, 0, 0])
```

In [225…
```
np.zeros((2,2), dtype=int)
```

Out[225…
```
array([[0, 0],
       [0, 0]])
```

In [226…
```
zero = np.zeros([2,2])
print(zero)
print(type(zero))
```

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

In [227…
```
zero = np.zeros([2,2])
print(zero)
print('&&&')
print(type(zero))
```

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

In [228…
```
np.zeros((2,2))
```

Out[228…
```
array([[0., 0.],
       [0., 0.]])
```

In [229…
```
np.zeros((3,3))
```

Out[229…
```
array([[0., 0., 0.],
       [0., 0., 0.],
       [0., 0., 0.]])
```

In [230…
```
np.zeros((10,30))
```

Out[230…
```
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 [231…
```
np.zeros((5,10)) # bydefaul 1arge -- will give row & 2nd arg - columns
```

Out[231…
```
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 [232…
```
n = (6,7)
n1 = (6,7)
print(np.zeros(n1))  #parameter 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 [233…
```
print(np.zeros(n,dtype=int))  #hyperparameter 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 [234…
```
n
```

Out[234…
```
(6, 7)
```

In [235…
```
n1
```

Out[235…
```
(6, 7)
```

In [236…
```
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.]]
```

In [237…
```
print(np.zeros(n))
```

```
[[0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 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 [238…
```
np.ones(3)
```

Out[238…
```
array([1., 1., 1.])
```

In [239…
```
np.ones(4,dtype=int)
```

Out[239…
```
array([1, 1, 1, 1])
```

In [240…
```
np.ones(4)
```

Out[240…
```
array([1., 1., 1., 1.])
```

In [241…
```
n
```

Out[241…
```
(6, 7)
```

In [242…
```
np.ones(n)
```

Out[242…
```
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 [243…
```
np.ones((5,4),dtype=int) # by default 5- rows & 4 - columns
```

Out[243…
```
array([[1, 1, 1, 1],
       [1, 1, 1, 1],
       [1, 1, 1, 1],
       [1, 1, 1, 1],
       [1, 1, 1, 1]])
```

In [244…
```
np.ones(2)
```

Out[244…
```
array([1., 1.])
```

In [245…
```
np.ones((2,4))
```

Out[245…
```
array([[1., 1., 1., 1.],
       [1., 1., 1., 1.]])
```

In [246…
```
np.ones((6,10),dtype = int)
```

Out[246…
```
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 [247…
```
range(5)
```

Out[247…
```
range(0, 5)
```

In [248…
```
r=range(5)
r
```

Out[248…
```
range(0, 5)
```

In [249…
```
for i in r:
    print(i)
```

```
0
1
2
3
4
```

In [250…
```
list(range(5))
```

Out[250…
```
[0, 1, 2, 3, 4]
```

In [251…
```
range(1,10)
```

Out[251…
```
range(1, 10)
```

In [252…
```
list(range(1,10))
```

Out[252…
```
[1, 2, 3, 4, 5, 6, 7, 8, 9]
```

In [253…
```
list(range(1,10,3))
```

Out[253…
```
[1, 4, 7]
```

In [254…
```
y = list(range(12))
y
```

Out[254…
```
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11]
```

In [255…
```
rand(2,2)
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
Cell In[255], line 1
----> 1 rand(2,2)

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

In [256…
```
rand(2,2)
random.rand(2,2)
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
Cell In[256], line 1
----> 1 rand(2,2)
      2 random.rand(2,2)

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

In [257…
```
np.random.rand(5)
```

Out[257…
```
array([0.31053375, 0.62129583, 0.42730407, 0.02458523, 0.2619023 ])
```

In [258…
```
np.rand(4)
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[258], line 1
----> 1 np.rand(4)

File C:\ProgramData\anaconda3\Lib\site-packages\numpy\__init__.py:333, in __getattr_
_(attr)
    330     "Removed in NumPy 1.25.0"
    331     raise RuntimeError("Tester was removed in NumPy 1.25.")
--> 333 raise AttributeError("module {!r} has no attribute "
    334                       "{!r}".format(__name__, attr))

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

In [259…
```
np.random.rand(2,4)
```

Out[259…
```
array([[0.83272566, 0.61815659, 0.26526473, 0.66053138],
       [0.12536086, 0.18342566, 0.06352838, 0.6841602 ]])
```

In [260…
```
np.random.randint(2,4)
```

Out[260…
```
3
```

In [261…
```
np.random.randint(2,20) #2nd arg is exlisive
```

Out[261…
```
4
```

In [262…
```
np.random.randint(0,1)
```

Out[262…
```
0
```

In [263…
```
np.random.randint(10,20,5)
```

Out[263…
```
array([19, 16, 14, 18, 15])
```

In [264…
```
np.random.randint(1,6,4)
```

Out[264…
```
array([3, 2, 3, 3])
```

In [265…
```
np.random.rand(3)
```

Out[265…
```
array([0.96042304, 0.07721013, 0.02825635])
```

In [266…
```
np.random.randint(30,20,10)
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[266], line 1
----> 1 np.random.randint(30,20,10)

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

File numpy\\random\\_bounded_integers.pyx:1425, in numpy.random._bounded_integers._r
and_int32()

ValueError: low >= high
```

In [267…
```
np.random.randint(-30,20,10)
```

Out[267…
```
array([ -9,  -4, -19,  12,   5,  18,  19,   4,   1, -16])
```

In [268…
```
np.random.randint(20,30,10)
```

Out[268…
```
array([25, 20, 26, 26, 27, 25, 25, 29, 22, 20])
```

In [269…
```
np.random.randint(5,9)  #GET THE VALUE <=1 & >=5
```

Out[269…
```
8
```

In [270…
```
np.random.randint(10,21,3)
```

Out[270…
```
array([17, 20, 14])
```

In [271…
```
np.random.randint(1,12,10)
```

Out[271…
```
array([ 6,  5,  8, 10, 10, 10,  2,  4, 10,  5])
```

In [272…
```
np.random.randint(10,40,(10,10)) #generate the element 10 -30 with 4*4 matrix
```

Out[272…
```
array([[25, 19, 22, 31, 29, 19, 11, 38, 36, 23],
       [25, 15, 16, 10, 30, 27, 19, 34, 24, 22],
       [18, 20, 39, 33, 17, 38, 33, 24, 18, 12],
       [22, 22, 12, 31, 32, 22, 17, 24, 35, 25],
       [39, 12, 20, 28, 27, 30, 38, 28, 24, 24],
       [26, 20, 26, 18, 17, 37, 39, 39, 30, 27],
       [19, 11, 11, 35, 16, 27, 28, 34, 18, 37],
       [14, 21, 23, 20, 19, 20, 11, 27, 23, 20],
       [11, 12, 13, 25, 26, 36, 29, 19, 20, 13],
       [34, 11, 24, 15, 39, 29, 37, 31, 36, 28]])
```

In [273…
```
np.arange(1,13).reshape(3,4)
```

Out[273…
```
array([[ 1,  2,  3,  4],
       [ 5,  6,  7,  8],
       [ 9, 10, 11, 12]])
```

In [274…
```
np.arange(1,13).reshape(12,1)
```

Out[274…
```
array([[ 1],
       [ 2],
       [ 3],
       [ 4],
       [ 5],
       [ 6],
       [ 7],
       [ 8],
       [ 9],
       [10],
       [11],
       [12]])
```

In [275…
```
b = np.random.randint(10,20,(5,4))
b
```

Out[275…
```
array([[17, 14, 16, 14],
       [17, 10, 19, 12],
       [18, 18, 17, 13],
       [12, 16, 13, 14],
       [12, 12, 10, 14]])
```

In [276…
```
type(b)
```

Out[276…
```
numpy.ndarray
```

In [277…
```
b
```

Out[277…
```
array([[17, 14, 16, 14],
       [17, 10, 19, 12],
       [18, 18, 17, 13],
       [12, 16, 13, 14],
       [12, 12, 10, 14]])
```

NUMPY Slicing

In [278…
```
b[:]
```

Out[278…
```
array([[17, 14, 16, 14],
       [17, 10, 19, 12],
       [18, 18, 17, 13],
       [12, 16, 13, 14],
       [12, 12, 10, 14]])
```

In [279…
```
b[1:3]
```

Out[279…
```
array([[17, 10, 19, 12],
       [18, 18, 17, 13]])
```

In [280…
```
b
```

Out[280…
```
array([[17, 14, 16, 14],
       [17, 10, 19, 12],
       [18, 18, 17, 13],
       [12, 16, 13, 14],
       [12, 12, 10, 14]])
```

In [281…
```
b[1,2]
```

Out[281… 19

In [282…
```
b
```

Out[282…
```
array([[17, 14, 16, 14],
       [17, 10, 19, 12],
       [18, 18, 17, 13],
       [12, 16, 13, 14],
       [12, 12, 10, 14]])
```

In [283…
```
b[1,3]
```

Out[283… 12

In [284…
```
b[2,-2]
```

Out[284… 17

In [285…
```
b[2,-1]
```

Out[285… 13

In [286…
```
b[3,-4]
```

Out[286… 12

In [287…
```
b[2,-2]
```

Out[287… 17

In [288…
```
b
```

Out[288…
```
array([[17, 14, 16, 14],
       [17, 10, 19, 12],
       [18, 18, 17, 13],
       [12, 16, 13, 14],
       [12, 12, 10, 14]])
```

In [289…
```
b[2:3]
```

Out[289…
```
array([[18, 18, 17, 13]])
```

In [290…
```
b
```

Out[290…
```
array([[17, 14, 16, 14],
       [17, 10, 19, 12],
       [18, 18, 17, 13],
       [12, 16, 13, 14],
       [12, 12, 10, 14]])
```

In [291…
```
b[-5,-3]
```

Out[291… 14

In [292…
```
b[-4,-2]
```

Out[292… 19

In [293…
```
b[-5,-1]
```

Out[293… 14

In [294…
```
b[-4,-4]
```

Out[294… 17

In [295…
```
b
```

Out[295…
```
array([[17, 14, 16, 14],
       [17, 10, 19, 12],
       [18, 18, 17, 13],
       [12, 16, 13, 14],
       [12, 12, 10, 14]])
```

In [296…
```
b[2:3]
```

Out[296…
```
array([[18, 18, 17, 13]])
```

In [297…
```
b
```

Out[297…
```
array([[17, 14, 16, 14],
       [17, 10, 19, 12],
       [18, 18, 17, 13],
       [12, 16, 13, 14],
       [12, 12, 10, 14]])
```

In [298…
```
b[0:-2
]
```

Out[298…
```
array([[17, 14, 16, 14],
       [17, 10, 19, 12],
       [18, 18, 17, 13]])
```

In [299…
```
b
```

Out[299…
```
array([[17, 14, 16, 14],
       [17, 10, 19, 12],
       [18, 18, 17, 13],
       [12, 16, 13, 14],
       [12, 12, 10, 14]])
```

In [300…
```
b[0,2]
```

Out[300…
```
16
```

In [301…
```
b
```

Out[301…
```
array([[17, 14, 16, 14],
       [17, 10, 19, 12],
       [18, 18, 17, 13],
       [12, 16, 13, 14],
       [12, 12, 10, 14]])
```

In [302…
```
b[-5,-3]
```

Out[302…
```
14
```

In [303…
```
b
```

Out[303…
```
array([[17, 14, 16, 14],
       [17, 10, 19, 12],
       [18, 18, 17, 13],
       [12, 16, 13, 14],
       [12, 12, 10, 14]])
```

In [305…
```
b[-4,2]
```

Out[305…
```
19
```

In [306…
```
np.random.randint(10,20,(4,4))
```

Out[306…
```
array([[18, 10, 19, 16],
       [10, 17, 19, 11],
       [15, 18, 12, 18],
       [10, 13, 12, 16]])
```

In [307…
```
b
```

Out[307…
```
array([[17, 14, 16, 14],
       [17, 10, 19, 12],
       [18, 18, 17, 13],
       [12, 16, 13, 14],
       [12, 12, 10, 14]])
```

In [308…
```
b[-4,2]
```

Out[308…
```
19
```

In [309…
```
b
```

Out[309…
```
array([[17, 14, 16, 14],
       [17, 10, 19, 12],
       [18, 18, 17, 13],
       [12, 16, 13, 14],
       [12, 12, 10, 14]])
```

In [310…
```
b[-4:2]
```

Out[310…
```
array([[17, 10, 19, 12]])
```

In [311…
```
b[:]
```

Out[311…
```
array([[17, 14, 16, 14],
       [17, 10, 19, 12],
       [18, 18, 17, 13],
       [12, 16, 13, 14],
       [12, 12, 10, 14]])
```

OPERATIONS

In [312…
```
a = np.random.randint(10,20,10)
a
```

Out[312…
```
array([17, 11, 17, 10, 14, 14, 12, 16, 15, 12])
```

In [313…
```
id(a)
```

Out[313…
```
1852832235664
```

In [314…
```
arr
```

Out[314…
```
array([1, 2, 3, 4, 5])
```

In [315…
```
arr2 = np.random.randint(0,100,(10,10))
```

In [316…
```
arr2
```

Out[316…
```
array([[96, 46, 42, 15, 78, 36, 73,  3, 84, 59],
       [59, 46, 78,  6,  0, 79, 90, 75, 96, 35],
       [34, 41, 74, 27, 83, 80, 85, 68, 77, 16],
       [28, 27, 43, 81, 68, 86,  7, 98, 23, 30],
       [99, 26,  7, 37, 17, 91, 84, 74, 43, 99],
       [23, 36, 46, 53, 87, 76, 32, 94, 57,  7],
       [69, 96, 46, 40, 85, 55, 18, 23, 93, 74],
       [58, 71, 97, 41, 21, 28, 51, 46,  2, 97],
       [90, 48, 69, 41, 25, 83, 68, 32, 11,  6],
       [62, 85, 24, 83, 73, 63, 90, 43, 57, 80]])
```

In [317…
```
arr
```

Out[317…
```
array([1, 2, 3, 4, 5])
```

In [318…
```
arr[:]
```

Out[318… array([1, 2, 3, 4, 5])

In [319…
```
arr
```

Out[319… array([1, 2, 3, 4, 5])

In [320…
```
arr[:4]
```

Out[320… array([1, 2, 3, 4])

In [321…
```
arr2[:]
```

Out[321…
```
array([[96, 46, 42, 15, 78, 36, 73,  3, 84, 59],
       [59, 46, 78,  6,  0, 79, 90, 75, 96, 35],
       [34, 41, 74, 27, 83, 80, 85, 68, 77, 16],
       [28, 27, 43, 81, 68, 86,  7, 98, 23, 30],
       [99, 26,  7, 37, 17, 91, 84, 74, 43, 99],
       [23, 36, 46, 53, 87, 76, 32, 94, 57,  7],
       [69, 96, 46, 40, 85, 55, 18, 23, 93, 74],
       [58, 71, 97, 41, 21, 28, 51, 46,  2, 97],
       [90, 48, 69, 41, 25, 83, 68, 32, 11,  6],
       [62, 85, 24, 83, 73, 63, 90, 43, 57, 80]])
```

In [323…
```
arr2[0:5]
```

Out[323…
```
array([[96, 46, 42, 15, 78, 36, 73,  3, 84, 59],
       [59, 46, 78,  6,  0, 79, 90, 75, 96, 35],
       [34, 41, 74, 27, 83, 80, 85, 68, 77, 16],
       [28, 27, 43, 81, 68, 86,  7, 98, 23, 30],
       [99, 26,  7, 37, 17, 91, 84, 74, 43, 99]])
```

In [324…
```
arr2[1,4]
```

Out[324… 0

In [325…
```
arr2
```

Out[325…
```
array([[96, 46, 42, 15, 78, 36, 73,  3, 84, 59],
       [59, 46, 78,  6,  0, 79, 90, 75, 96, 35],
       [34, 41, 74, 27, 83, 80, 85, 68, 77, 16],
       [28, 27, 43, 81, 68, 86,  7, 98, 23, 30],
       [99, 26,  7, 37, 17, 91, 84, 74, 43, 99],
       [23, 36, 46, 53, 87, 76, 32, 94, 57,  7],
       [69, 96, 46, 40, 85, 55, 18, 23, 93, 74],
       [58, 71, 97, 41, 21, 28, 51, 46,  2, 97],
       [90, 48, 69, 41, 25, 83, 68, 32, 11,  6],
       [62, 85, 24, 83, 73, 63, 90, 43, 57, 80]])
```

In [326…
```
arr2[-5,-5]
```

Out[326… 76

In [327…
```
arr2
```

Out[327…
```
array([[96, 46, 42, 15, 78, 36, 73,  3, 84, 59],
       [59, 46, 78,  6,  0, 79, 90, 75, 96, 35],
       [34, 41, 74, 27, 83, 80, 85, 68, 77, 16],
       [28, 27, 43, 81, 68, 86,  7, 98, 23, 30],
       [99, 26,  7, 37, 17, 91, 84, 74, 43, 99],
       [23, 36, 46, 53, 87, 76, 32, 94, 57,  7],
       [69, 96, 46, 40, 85, 55, 18, 23, 93, 74],
       [58, 71, 97, 41, 21, 28, 51, 46,  2, 97],
       [90, 48, 69, 41, 25, 83, 68, 32, 11,  6],
       [62, 85, 24, 83, 73, 63, 90, 43, 57, 80]])
```

In [328…
```
arr2[-1,-2]
```

Out[328…
```
57
```

In [329…
```
arr2
```

Out[329…
```
array([[96, 46, 42, 15, 78, 36, 73,  3, 84, 59],
       [59, 46, 78,  6,  0, 79, 90, 75, 96, 35],
       [34, 41, 74, 27, 83, 80, 85, 68, 77, 16],
       [28, 27, 43, 81, 68, 86,  7, 98, 23, 30],
       [99, 26,  7, 37, 17, 91, 84, 74, 43, 99],
       [23, 36, 46, 53, 87, 76, 32, 94, 57,  7],
       [69, 96, 46, 40, 85, 55, 18, 23, 93, 74],
       [58, 71, 97, 41, 21, 28, 51, 46,  2, 97],
       [90, 48, 69, 41, 25, 83, 68, 32, 11,  6],
       [62, 85, 24, 83, 73, 63, 90, 43, 57, 80]])
```

In [332…
```
arr2[::-1]
```

Out[332…
```
array([[62, 85, 24, 83, 73, 63, 90, 43, 57, 80],
       [90, 48, 69, 41, 25, 83, 68, 32, 11,  6],
       [58, 71, 97, 41, 21, 28, 51, 46,  2, 97],
       [69, 96, 46, 40, 85, 55, 18, 23, 93, 74],
       [23, 36, 46, 53, 87, 76, 32, 94, 57,  7],
       [99, 26,  7, 37, 17, 91, 84, 74, 43, 99],
       [28, 27, 43, 81, 68, 86,  7, 98, 23, 30],
       [34, 41, 74, 27, 83, 80, 85, 68, 77, 16],
       [59, 46, 78,  6,  0, 79, 90, 75, 96, 35],
       [96, 46, 42, 15, 78, 36, 73,  3, 84, 59]])
```

In [333…
```
arr2
```

Out[333…
```
array([[96, 46, 42, 15, 78, 36, 73,  3, 84, 59],
       [59, 46, 78,  6,  0, 79, 90, 75, 96, 35],
       [34, 41, 74, 27, 83, 80, 85, 68, 77, 16],
       [28, 27, 43, 81, 68, 86,  7, 98, 23, 30],
       [99, 26,  7, 37, 17, 91, 84, 74, 43, 99],
       [23, 36, 46, 53, 87, 76, 32, 94, 57,  7],
       [69, 96, 46, 40, 85, 55, 18, 23, 93, 74],
       [58, 71, 97, 41, 21, 28, 51, 46,  2, 97],
       [90, 48, 69, 41, 25, 83, 68, 32, 11,  6],
       [62, 85, 24, 83, 73, 63, 90, 43, 57, 80]])
```

In [334…
```
arr2[::-2]
```

Out[334…
```
array([[62, 85, 24, 83, 73, 63, 90, 43, 57, 80],
       [58, 71, 97, 41, 21, 28, 51, 46,  2, 97],
       [23, 36, 46, 53, 87, 76, 32, 94, 57,  7],
       [28, 27, 43, 81, 68, 86,  7, 98, 23, 30],
       [59, 46, 78,  6,  0, 79, 90, 75, 96, 35]])
```

In [335…
```
arr2
```

Out[335…
```
array([[96, 46, 42, 15, 78, 36, 73,  3, 84, 59],
       [59, 46, 78,  6,  0, 79, 90, 75, 96, 35],
       [34, 41, 74, 27, 83, 80, 85, 68, 77, 16],
       [28, 27, 43, 81, 68, 86,  7, 98, 23, 30],
       [99, 26,  7, 37, 17, 91, 84, 74, 43, 99],
       [23, 36, 46, 53, 87, 76, 32, 94, 57,  7],
       [69, 96, 46, 40, 85, 55, 18, 23, 93, 74],
       [58, 71, 97, 41, 21, 28, 51, 46,  2, 97],
       [90, 48, 69, 41, 25, 83, 68, 32, 11,  6],
       [62, 85, 24, 83, 73, 63, 90, 43, 57, 80]])
```

In [337…
```
arr2[::-3]
```

Out[337…
```
array([[62, 85, 24, 83, 73, 63, 90, 43, 57, 80],
       [69, 96, 46, 40, 85, 55, 18, 23, 93, 74],
       [28, 27, 43, 81, 68, 86,  7, 98, 23, 30],
       [96, 46, 42, 15, 78, 36, 73,  3, 84, 59]])
```

In [339…
```
arr2
```

Out[339…
```
array([[96, 46, 42, 15, 78, 36, 73,  3, 84, 59],
       [59, 46, 78,  6,  0, 79, 90, 75, 96, 35],
       [34, 41, 74, 27, 83, 80, 85, 68, 77, 16],
       [28, 27, 43, 81, 68, 86,  7, 98, 23, 30],
       [99, 26,  7, 37, 17, 91, 84, 74, 43, 99],
       [23, 36, 46, 53, 87, 76, 32, 94, 57,  7],
       [69, 96, 46, 40, 85, 55, 18, 23, 93, 74],
       [58, 71, 97, 41, 21, 28, 51, 46,  2, 97],
       [90, 48, 69, 41, 25, 83, 68, 32, 11,  6],
       [62, 85, 24, 83, 73, 63, 90, 43, 57, 80]])
```

In [340…
```
arr2[:-3]
```

Out[340…
```
array([[96, 46, 42, 15, 78, 36, 73,  3, 84, 59],
       [59, 46, 78,  6,  0, 79, 90, 75, 96, 35],
       [34, 41, 74, 27, 83, 80, 85, 68, 77, 16],
       [28, 27, 43, 81, 68, 86,  7, 98, 23, 30],
       [99, 26,  7, 37, 17, 91, 84, 74, 43, 99],
       [23, 36, 46, 53, 87, 76, 32, 94, 57,  7],
       [69, 96, 46, 40, 85, 55, 18, 23, 93, 74]])
```

In [341…
```
arr
```

Out[341…
```
array([1, 2, 3, 4, 5])
```

In [342…
```
arr.max()
```

Out[342… 5

In [343…
```
arr.min()
```

Out[343… 1

In [344…
```
arr
```

Out[344… array([1, 2, 3, 4, 5])

In [345…
```
arr.mean()
```

Out[345… 3.0

In [346…
```
arr
```

Out[346… array([1, 2, 3, 4, 5])

In [347…
```
arr.median()
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[347], line 1
----> 1 arr.median()

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

In [350…
```
from numpy import *
a = array([0,1,2,3,4,9])
median(a)
```

Out[350… 2.5

In [352…
```
a
```

Out[352… array([0, 1, 2, 3, 4, 9])

In [353…
```
a.reshape(3,2)
```

Out[353…
```
array([[0, 1],
       [2, 3],
       [4, 9]])
```

In [354…
```
a.reshape(6,1)
```

Out[354…
```
array([[0],
       [1],
       [2],
       [3],
       [4],
       [9]])
```

In [355…
```
a.reshape(1,6)
```

Out[355… array([[0, 1, 2, 3, 4, 9]])

In [356…
```
a
```

Out[356… array([0, 1, 2, 3, 4, 9])

In [357…
```
a.reshape(2,3,order='C')
```

Out[357…
```
array([[0, 1, 2],
       [3, 4, 9]])
```

In [358…
```
a.reshape(2,3,order='F')  # print element with fortran
```

Out[358…
```
array([[0, 2, 4],
       [1, 3, 9]])
```

In [359…
```
a.reshape(2,3,order='A') # A almost give you c type output
```

Out[359…
```
array([[0, 1, 2],
       [3, 4, 9]])
```

In [360…
```
a
```

Out[360… array([0, 1, 2, 3, 4, 9])

In [361…
```
a.reshape(2,3)
```

Out[361…
```
array([[0, 1, 2],
       [3, 4, 9]])
```

In [363…
```
a.reshape(1,6)
```

Out[363… array([[0, 1, 2, 3, 4, 9]])

In [364…
```
a
```

Out[364… array([0, 1, 2, 3, 4, 9])

In [365…
```
a.reshape(3,2)
```

Out[365…
```
array([[0, 1],
       [2, 3],
       [4, 9]])
```

INDEXING

In [366…
```
mat = np.arange(0,100).reshape(10,10)
```

In [367…
```
mat
```

Out[367…
```
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 [368…
```
row=4
col=5
```

In [369…
```
col
```

Out[369… 5

In [370…
```
row
```

Out[370… 4

In [371…
```
mat
```

Out[371…
```
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 [372…
```
mat[row,col]
```

Out[372… 45

In [373…
```
mat[4,5]
```

Out[373… 45

In [374…
```
mat
```

Out[374…
```
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 [375…
```
mat[:]
```

Out[375…
```
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 [377…
```
col=6
```

In [378…
```
mat
```

Out[378…
```
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 [379…
```
mat[6]
```

Out[379…
```
array([60, 61, 62, 63, 64, 65, 66, 67, 68, 69])
```

In [380…
```
mat
```

Out[380…
```
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 [381…
```
#with sliCes
mat[:,col]
```

Out[381…
```
array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])
```

In [382…
```
mat
```

Out[382…
```
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 [383…
```
mat[row,:]
```

Out[383…
```
array([40, 41, 42, 43, 44, 45, 46, 47, 48, 49])
```

In [384…
```
mat
```

Out[384…
```
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 [385…
```
mat[:,8]
```

Out[385…
```
array([ 8, 18, 28, 38, 48, 58, 68, 78, 88, 98])
```

In [386…
```
mat
```

Out[386…
```
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 [387…
```
mat[:col]
```

Out[387…
```
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 [388…
```
mat[:6]
```

Out[388…
```
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 [389…
```
row
```

Out[389…
```
4
```

In [390…
```
mat[:row]
```

Out[390…
```
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 [391…
```
mat
```

Out[391…
```
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 [392…
```
mat[row:]
```

Out[392…
```
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 [393…
```
mat[:]
```

Out[393…
```
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 [394…
```
mat[:,8]
```

Out[394…
```
array([ 8, 18, 28, 38, 48, 58, 68, 78, 88, 98])
```

In [395…
```
mat
```

Out[395…
```
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 [396…
```
mat[:,-1]
```

Out[396…
```
array([ 9, 19, 29, 39, 49, 59, 69, 79, 89, 99])
```

In [397…
```
mat
```

Out[397…
```
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 [398…
```
row
```

Out[398…
```
4
```

In [399…
```
col
```

Out[399…
```
6
```

In [400…
```
mat[:,col]
```

Out[400… array([6, 16, 26, 36, 46, 56, 66, 76, 86, 96])

In [401…
```
mat
```

Out[401…
```
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 [402…
```
mat[1,4]
```

Out[402… 14

In [403…
```
mat
```

Out[403…
```
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 [405…
```
mat[3:-4]
```

Out[405…
```
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]])
```

In [406…
```
mat
```

Out[406…
```
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 [407…
```
mat[0]
```

Out[407… array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])

In [408…
```
mat[6]
```

Out[408…
```
array([60, 61, 62, 63, 64, 65, 66, 67, 68, 69])
```

In [409…
```
mat[6:]
```

Out[409…
```
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 [410…
```
mat[:6]
```

Out[410…
```
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 [411…
```
mat
```

Out[411…
```
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 [412…
```
mat[5:7]
```

Out[412…
```
array([[50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
       [60, 61, 62, 63, 64, 65, 66, 67, 68, 69]])
```

In [413…
```
mat
```

Out[413…
```
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 [414…
```
mat[0:10]
```

Out[414…
```
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 [415…
```
mat
```

Out[415…
```
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 [416…
```
mat[0:10:3]
```

Out[416…
```
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 [417…
```
mat
```

Out[417…
```
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 [418…
```
mat[4:]
```

Out[418…
```
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 [419…
```
mat
```

Out[419…
```
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 [420…
```
mat[:4]
```

Out[420…
```
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 [421…
```
mat[::-1]
```

Out[421…
```
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 [422…
```
mat[::-3]
```

Out[422…
```
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 [424…
```
mat[::-1]
```

Out[424…
```
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 [425…
```
mat[::-5]
```

Out[425…
```
array([[90, 91, 92, 93, 94, 95, 96, 97, 98, 99],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49]])
```

In [426…
```
mat
```

Out[426…
```
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 [427…
```
mat[2:6]
```

Out[427…
```
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 [428…
```
mat
```

Out[428…
```
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 [429…
```
mat[2:6,2:4]  # 1:5 --> only row part /// 1:3 -- it indicates only column parts
```

Out[429…
```
array([[22, 23],
       [32, 33],
       [42, 43],
       [52, 53]])
```

In [430…
```
mat
```

Out[430…
```
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 [431…
```
mat[0,1]
```

Out[431… 1

In [432…
```
mat[1,6]
```

Out[432… 16

In [433…
```
mat[1:]
```

Out[433…
```
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 [434…
```
mat
```

Out[434…
```
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 [435…
```
mat[3:5]
```

Out[435…
```
array([[30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49]])
```

In [436…
```
mat[3,5]
```

Out[436… 35

In [437…
```
mat
```

Out[437…
```
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 [438…
```
mat[1:2,2:4]
```

Out[438… array([[12, 13]])

In [439…
```
mat
```

Out[439…
```
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 [440…
```
mat[2:4,3:5]
```

Out[440…
```
array([[23, 24],
       [33, 34]])
```

In [441…
```
mat
```

Out[441…
```
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]])
```

MASKING

In [442…
```
mat   #we also called as filter
```

Out[442…
```
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 [443…
```
id(mat)
```

Out[443… 1852832797616

In [444…
```
mat
```

Out[444…
```
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 [445…
```
mat[mat<50]
```

Out[445…
```
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 [446…
```
mat>50
```

Out[446…
```
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 [447…
```
mat[mat==50]
```

Out[447…
```
array([50])
```

In [448…
```
mat
```

Out[448…
```
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 [449…
```
mat==50
```

Out[449…
```
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 [450…
```
mat
```

Out[450…
```
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 [451…
```
a1 = mat[mat<50]
a1
```

Out[451…
```
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 [452…
```
mat
```

Out[452…
```
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 [455…
```
a2=mat[mat>50]
a2
```

Out[455…
```
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 [457…
```
a3=mat[mat<=50]
a3
```

Out[457…
```
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 [458…
```
a4=mat[mat==50]
a4
```

Out[458…
```
array([50])
```