NUMPY - 1

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

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

Out[3]:
```
'3.12.7 | packaged by Anaconda, Inc. | (main, Oct  4 2024, 13:17:27) [MSC v.1
929 64 bit (AMD64)]'
```

In [4]:
```
np.__version__
```

Out[4]:
```
'1.26.4'
```

creating Arrays

In [5]:
```
myl = [0,1,2,3,4,5]    # creatin a list
myl
```

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

In [6]:
```
type(myl)
```

Out[6]:
```
list
```

In [7]:
```
arr = np.array(myl)
arr
```

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

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

```
<class 'numpy.ndarray'>
<class 'list'>
```

In [9]:
```
np.arange(10,20)
```

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

In [10]:
```
np.arange(10,20,5)   # [start,stop,step
```

Out[10]:
```
array([10, 15])
```

In [11]:
```
np.arange(10,50,5)
```

Out[11]:
```
array([10, 15, 20, 25, 30, 35, 40, 45])
```

In [12]:
```
np.arange(10,30,3)
```

Out[12]:
```
array([10, 13, 16, 19, 22, 25, 28])
```

In [13]:
```
np.arange(10,30,30,3)
```

```
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
Cell In[13], line 1
----> 1 np.arange(10,30,30,3)

TypeError: Cannot interpret '3' as a data type
```

In [15]:
```
np.arange(8,20)
```

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

In [16]:
```
np.arange(20,8)
```

Out[16]:
```
array([], dtype=int32)
```

In [17]:
```
np.arange(-20,8)   # list arg < 2nd arg
```

Out[17]:
```
array([-20, -19, -18, -17, -16, -15, -14, -13, -12, -11, -10,  -9,  -8,
        -7,  -6,  -5,  -4,  -3,  -2,  -1,   0,   1,   2,   3,   4,   5,
         6,   7])
```

In [18]:
```
n = np.arange(-20,8)
n
```

Out[18]:
```
array([-20, -19, -18, -17, -16, -15, -14, -13, -12, -11, -10,  -9,  -8,
        -7,  -6,  -5,  -4,  -3,  -2,  -1,   0,   1,   2,   3,   4,   5,
         6,   7])
```

In [19]:
```
np.zeros(3)
```

Out[19]:
```
array([0., 0., 0.])
```

In [20]:
```
np.zeros(3,dtype = int)
```

Out[20]:
```
array([0, 0, 0])
```

In [21]:
```
z = np.zeros(3)
z
```

Out[21]:
```
array([0., 0., 0.])
```

In [22]:
```
z = np.zeros((2,2))
z                          #  2nd array
```

Out[22]:
```
array([[0., 0.],
       [0., 0.]])
```

In [23]:
```
np.zeros((3,3),dtype = int)
```

Out[23]:
```
array([[0, 0, 0],
       [0, 0, 0],
       [0, 0, 0]])
```

In [24]:
```
nd = np.zeros((5,9), dtype = int)
nd
```

Out[24]:
```
array([[0, 0, 0, 0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0, 0, 0, 0]])
```

In [25]:
```
np.ones(3)
```

Out[25]:
```
array([1., 1., 1.])
```

In [26]:
```
np.ones(3, dtype = int)
```

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

In [27]:
```
np.ones((10,10))
```

Out[27]:
```
array([[1., 1., 1., 1., 1., 1., 1., 1., 1., 1.],
       [1., 1., 1., 1., 1., 1., 1., 1., 1., 1.],
       [1., 1., 1., 1., 1., 1., 1., 1., 1., 1.],
       [1., 1., 1., 1., 1., 1., 1., 1., 1., 1.],
       [1., 1., 1., 1., 1., 1., 1., 1., 1., 1.],
       [1., 1., 1., 1., 1., 1., 1., 1., 1., 1.],
       [1., 1., 1., 1., 1., 1., 1., 1., 1., 1.],
       [1., 1., 1., 1., 1., 1., 1., 1., 1., 1.],
       [1., 1., 1., 1., 1., 1., 1., 1., 1., 1.],
       [1., 1., 1., 1., 1., 1., 1., 1., 1., 1.]])
```

In [28]:
```
np.zeros(3)
```

Out[28]:
```
array([0., 0., 0.])
```

In [29]:
```
np.arange(15)
```

Out[29]:
```
array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14])
```

In [30]:
```
np.arange(3.0)
```

Out[30]:
```
array([0., 1., 2.])
```

In [31]:
```
np.arange(10)
```

Out[31]:
```
array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])
```

In [32]:
```
np.arange(0,5)
```

Out[32]:
```
array([0, 1, 2, 3, 4])
```

In [33]:
```
np.arange(10,20)
```

Out[33]:
```
array([10, 11, 12, 13, 14, 15, 16, 17, 18, 19])
```

In [34]:
```
np.arange(-20,10)
```

Out[34]:
```
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 [35]:
```
np.arange(-16,10)
```

Out[35]:
```
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 [36]:
```
np.arange(-20,-10)
```

Out[36]:
```
array([-20, -19, -18, -17, -16, -15, -14, -13, -12, -11])
```

In [37]:
```
np.arange(30,20)   # 1st arg always be < than 2nd arg
```

Out[37]:
```
array([], dtype=int32)
```

In [38]:
```
ar = np.arange(-30,20)
ar
```

Out[38]:
```
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 [39]:
```
np.arange(10,10)
```

Out[39]:
```
array([], dtype=int32)
```

In [40]:
```
np.arange()
```

```
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
Cell In[40], line 1
----> 1 np.arange()

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

In [42]:
```
np.arange(10,30,5)  # 10  - strting
                    # 30   - end
                     # 5    - step count
```

Out[42]:
```
array([10, 15, 20, 25])
```

In [44]:
```
np.arange(10,30,5)
```

Out[44]:
```
array([10, 15, 20, 25])
```

In [46]:
```
np.arange(50,500,100)
```

Out[46]:
```
array([ 50, 150, 250, 350, 450])
```

In [47]:
```
np.arange(10,30,5,8)
```

```
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
Cell In[47], line 1
----> 1 np.arange(10,30,5,8)

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

In [48]:
```
np.zeros(3)    # parameter tunning
```

Out[48]:
```
array([0., 0., 0.])
```

In [49]:
```
np.zeros(5, dtype = int)  # hyper parameter tunning
```

Out[49]:
```
array([0, 0, 0, 0, 0])
```

In [52]:
```
np.zeros((2,2), dtype = int)
```

Out[52]:
```
array([[0, 0],
       [0, 0]])
```

In [53]:
```
zero = np.zeros([2,2])
print(zero)
print(type(zero))
```

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

In [54]:
```
zero = np.zeros([2,2])
print(zero)

print('####')

print(type(zero))
```

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

In [55]:
```
np.zeros((2,2))
```

Out[55]:
```
array([[0., 0.],
       [0., 0.]])
```

In [56]:
```
np.zeros((3,3))
```

Out[56]:
```
array([[0., 0., 0.],
       [0., 0., 0.],
       [0., 0., 0.]])
```

In [57]:
```
np.zeros((10,30))
```

Out[57]:
```
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 [58]:
```
np.zeros((5,10))    # by default large -- will give row and 2nd arg - columns
```

Out[58]:
```
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 [59]:
```
n = (6,7)
n1 = (6,8)
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. 0. 0. 0. 0. 0. 0.]]
```

In [60]:
```
print(np.zeros(n, dtype = int))   ## hyper 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 [61]:
```
n
```

Out[61]: (6, 7)

In [62]:
```
n1
```

Out[62]: (6, 8)

In [63]:
```
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 [64]:
```
np.zeros(3)
```

Out[64]: array([0., 0., 0.])

In [66]:
```
np.ones(3)
```

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

In [68]:
```
np.ones(3, dtype = int)
```

Out[68]: array([1, 1, 1])

In [69]:
```
np.ones(4)
```

Out[69]: array([1., 1., 1., 1.])

In [72]:
```
np.ones(4)
```

Out[72]: array([1., 1., 1., 1.])

In [73]:
```
n
```

Out[73]: (6, 7)

In [74]:
```
np.ones(n)
```

Out[74]:
```
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 [75]:
```
np.ones((5,4),dtype = int)    # by default 5 - rows , 4- columns
```

Out[75]:
```
array([[1, 1, 1, 1],
       [1, 1, 1, 1],
       [1, 1, 1, 1],
       [1, 1, 1, 1],
       [1, 1, 1, 1]])
```

In [76]:
```
np.
```

```
  Cell In[76], line 1
    np.
       ^
SyntaxError: invalid syntax
```

In [77]:
```
np.twos((2,3))
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[77], line 1
----> 1 np.twos((2,3))

File ~\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 'twos'
```

In [78]:
```
np.three(2,3)
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[78], line 1
----> 1 np.three(2,3)

File ~\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 'three'
```

In [79]:
```
np.ones(2)
```

Out[79]:
```
array([1., 1.])
```

In [80]:
```
np.ones((2,4))
```

Out[80]:
```
array([[1., 1., 1., 1.],
       [1., 1., 1., 1.]])
```

In [81]:
```
np.ones((6,10),dtype = int)
```

Out[81]:
```
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 [82]:
```
np.twos((2,4))
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[82], line 1
----> 1 np.twos((2,4))

File ~\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 'twos'
```

In [83]:
```
range(5)
```

Out[83]:
```
range(0, 5)
```

In [84]:
```
r = range(5)
r
```

Out[84]:
```
range(0, 5)
```

In [85]:
```
for i in r:
    print(i)
```

```
0
1
2
3
4
```

In [86]:
```
list(range(5))
```

Out[86]:
```
[0, 1, 2, 3, 4]
```

In [87]:
```
range(1,10)
```

Out[87]:
```
range(1, 10)
```

In [88]:
```
list(range(1,10))
```

Out[88]:
```
[1, 2, 3, 4, 5, 6, 7, 8, 9]
```

In [89]:
```
range(1,10,3)
```

Out[89]:
```
range(1, 10, 3)
```

In [90]:
```
list(range(1,10,3))
```

Out[90]:
```
[1, 4, 7]
```

In [91]:
```
y = list(range(12))
y
```

Out[91]:
```
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11]
```

In [92]:
```
rand(3,2)
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
Cell In[92], line 1
----> 1 rand(3,2)

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

In [93]:
```
rand(3,2)
random.rand(3,2)
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
Cell In[93], line 1
----> 1 rand(3,2)
      2 random.rand(3,2)

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

In [94]:
```
np.random.rand(5)
```

Out[94]:
```
array([0.82866152, 0.00228972, 0.73298905, 0.92007892, 0.86272884])
```

In [95]:
```
np.rand(5)
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[95], line 1
----> 1 np.rand(5)

File ~\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 [96]:
```
np.random.rand(2,4)
```

Out[96]:
```
array([[0.70644457, 0.15981492, 0.63351097, 0.2707331 ],
       [0.864874  , 0.4626872 , 0.27935727, 0.23823273]])
```

In [97]:
```
np.random.randint(2,20)   # 2nd arg is exclusive
```

Out[97]:
```
8
```

In [99]:
```
np.random.randint(2,20) # 2nd argument is exlusive
```

Out[99]:
```
6
```

In [101…
```
np.random.randint(0,1)
```

Out[101…
```
0
```

In [103…
```
np.random.randint(10,20,5)
```

Out[103…
```
array([19, 13, 18, 18, 17])
```

In [104…
```
np.random.randint(10,20,5)
```

Out[104…
```
array([10, 15, 14, 11, 17])
```

In [105…
```
np.random.randint(1,6,4)
```

Out[105…
```
array([4, 1, 5, 5])
```

In [106…
```
np.random.randint(1)
```

Out[106…
```
0
```

In [107…
```
np.random.randint(3)
```

Out[107…
```
2
```

In [108…
```
np.random.randint(30,20,10)
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[108], line 1
----> 1 np.random.randint(30,20,10)

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

File numpy\\random\\_bounded_integers.pyx:1425, in numpy.random._bounded_intege
rs._rand_int32()

ValueError: low >= high
```

In [109…
```
np.random.randint(-30,20,10)
```

Out[109…
```
array([ 19, -30,  -3, -23, -12,   9, -22, -13, -20,   2])
```

In [110…
```
np.random.randint(20,30,10)
```

Out[110…
```
array([24, 22, 22, 22, 21, 26, 28, 22, 25, 27])
```

In [111…
```
np.random.randint(5,9)  #get the value <=1 & >=5
```

Out[111…
```
8
```

In [112…
```
np.random.randint(10,21,3)
```

Out[112…
```
array([17, 10, 17])
```

In [113…
```
np.random.randint(1,12,10)
```

Out[113…
```
array([ 5,  1,  9,  5, 10, 11,  1,  9,  8, 11])
```

In [114…
```
np.random.randint(10,40,(10,10))  # generate the element 10 - 30 with 4*4 metr
```

Out[114…
```
array([[10, 33, 32, 30, 27, 20, 32, 27, 39, 11],
       [32, 26, 19, 20, 17, 25, 38, 36, 17, 35],
       [16, 12, 29, 25, 33, 33, 27, 20, 38, 13],
       [17, 29, 14, 13, 27, 38, 13, 27, 17, 26],
       [29, 14, 11, 19, 35, 14, 10, 13, 20, 18],
       [33, 38, 10, 26, 10, 10, 27, 31, 27, 38],
       [27, 16, 11, 11, 35, 15, 16, 14, 18, 11],
       [38, 13, 20, 15, 22, 36, 22, 28, 30, 37],
       [18, 10, 27, 18, 36, 31, 26, 23, 37, 30],
       [31, 17, 28, 25, 29, 27, 25, 38, 22, 23]])
```

In [115…
```
np.random.randint(1,100,(12,12))  # generate the element 10 - 30 with 4 * 4 me
```

Out[115…
```
array([[83, 75, 11, 63, 24, 98, 91, 98, 59, 39, 86, 92],
       [27, 17, 90, 41, 38,  8, 45, 51, 17, 12, 59, 52],
       [71, 33, 66, 30, 86, 42, 94, 19, 81, 11, 29, 31],
       [98, 65, 26,  4, 70, 47, 59, 64, 85, 32, 37, 45],
       [ 7, 45, 85, 93, 50, 21, 61, 73, 26, 10, 40, 31],
       [32, 27, 46, 57, 41, 75, 61, 90,  2, 67, 74, 80],
       [73, 43, 26, 54,  7, 78, 46, 31, 70,  1, 43, 73],
       [33, 72,  6, 89, 48, 65, 60, 83, 22, 87, 36, 53],
       [31, 68, 55, 75, 78, 19, 12, 50, 95, 97, 22, 83],
       [93, 71, 29, 26, 12, 37, 35, 98,  2, 14, 40, 91],
       [ 3, 34, 70, 32, 17, 91, 88, 99, 69, 88, 38, 43],
       [19, 92, 56, 40, 38, 13, 91,  2, 79, 17, 69, 98]])
```

In [116…
```
np.arange(1,13).reshape(3,4)
```

Out[116…
```
array([[ 1,  2,  3,  4],
       [ 5,  6,  7,  8],
       [ 9, 10, 11, 12]])
```

In [117…
```
np.arange(1,13).reshape(12,1)
```

Out[117…
```
array([[ 1],
       [ 2],
       [ 3],
       [ 4],
       [ 5],
       [ 6],
       [ 7],
       [ 8],
       [ 9],
       [10],
       [11],
       [12]])
```

In [119…
```
b = np.random.randint(10,20,(5,4))
b
```

Out[119…
```
array([[17, 10, 18, 19],
       [19, 15, 17, 12],
       [19, 15, 13, 15],
       [15, 10, 16, 14],
       [14, 16, 14, 14]])
```

In [120…
```
type(b)
```

Out[120…
```
numpy.ndarray
```

In [121…
```
b
```

Out[121…
```
array([[17, 10, 18, 19],
       [19, 15, 17, 12],
       [19, 15, 13, 15],
       [15, 10, 16, 14],
       [14, 16, 14, 14]])
```

In [123…
```
b[:]
```

Out[123…
```
array([[17, 10, 18, 19],
       [19, 15, 17, 12],
       [19, 15, 13, 15],
       [15, 10, 16, 14],
       [14, 16, 14, 14]])
```

In [124…
```
b[1:3]
```

Out[124…
```
array([[19, 15, 17, 12],
       [19, 15, 13, 15]])
```

In [125…
```
b
```

Out[125…
```
array([[17, 10, 18, 19],
       [19, 15, 17, 12],
       [19, 15, 13, 15],
       [15, 10, 16, 14],
       [14, 16, 14, 14]])
```

In [126…
```
b[1,2]
```

Out[126…
```
17
```

In [127…
```
b
```

Out[127…
```
array([[17, 10, 18, 19],
       [19, 15, 17, 12],
       [19, 15, 13, 15],
       [15, 10, 16, 14],
       [14, 16, 14, 14]])
```

In [128…
```
b[1,3]
```

Out[128…
```
12
```

In [129…
```
b[1,-1]
```

Out[129…
```
12
```

In [130…
```
b
```

Out[130…
```
array([[17, 10, 18, 19],
       [19, 15, 17, 12],
       [19, 15, 13, 15],
       [15, 10, 16, 14],
       [14, 16, 14, 14]])
```

In [131…
```
b[2:3]
```

Out[131…
```
array([[19, 15, 13, 15]])
```

In [132…
```
b
```

Out[132…
```
array([[17, 10, 18, 19],
       [19, 15, 17, 12],
       [19, 15, 13, 15],
       [15, 10, 16, 14],
       [14, 16, 14, 14]])
```

In [133…
```
b[0:-2]
```

Out[133…
```
array([[17, 10, 18, 19],
       [19, 15, 17, 12],
       [19, 15, 13, 15]])
```

In [134…
```
b
```

Out[134…
```
array([[17, 10, 18, 19],
       [19, 15, 17, 12],
       [19, 15, 13, 15],
       [15, 10, 16, 14],
       [14, 16, 14, 14]])
```

In [135…
```
b[0,2]
```

Out[135…
```
18
```

In [136…
```
b
```

Out[136…
```
array([[17, 10, 18, 19],
       [19, 15, 17, 12],
       [19, 15, 13, 15],
       [15, 10, 16, 14],
       [14, 16, 14, 14]])
```

In [137…
```
b[-5,-3]
```

Out[137…
```
10
```

In [138…
```
b[-4,2]
```

Out[138…
```
17
```

In [140…
```
np.random.randint(10,20,(4,4))
```

Out[140…
```
array([[15, 14, 19, 14],
       [13, 18, 12, 12],
       [13, 18, 16, 16],
       [18, 14, 17, 14]])
```

In [141…
```
b
```

Out[141…
```
array([[17, 10, 18, 19],
       [19, 15, 17, 12],
       [19, 15, 13, 15],
       [15, 10, 16, 14],
       [14, 16, 14, 14]])
```

In [142…
```
b[-4,-2]
```

Out[142…
```
17
```

In [143…
```
b
```

Out[143…
```
array([[17, 10, 18, 19],
       [19, 15, 17, 12],
       [19, 15, 13, 15],
       [15, 10, 16, 14],
       [14, 16, 14, 14]])
```

In [144…
```
b[-4:2]
```

Out[144…
```
array([[19, 15, 17, 12]])
```

In [146…
```
b[-4:3]
```

Out[146…
```
array([[19, 15, 17, 12],
       [19, 15, 13, 15]])
```

In [147…
```
b[:]
```

Out[147…
```
array([[17, 10, 18, 19],
       [19, 15, 17, 12],
       [19, 15, 13, 15],
       [15, 10, 16, 14],
       [14, 16, 14, 14]])
```

Operations

In [148…
```
a = np.random.randint(10,20,10)
a
```

Out[148…
```
array([19, 11, 19, 14, 17, 17, 19, 18, 19, 18])
```

In [149…
```
id(a)
```

Out[149…
```
1858833097872
```

In [150…
```
arr
```

Out[150…
```
array([0, 1, 2, 3, 4, 5])
```

In [151…
```
arr2 = np.random.randint(0,100,(10,10))
arr2
```

Out[151…
```
array([[91, 61,  3, 21,  8,  6, 62, 18, 82, 73],
       [83, 36, 45, 64, 90, 91, 53, 41, 44, 36],
       [23, 37, 40, 59, 89, 80, 83, 23, 86, 66],
       [ 6,  2, 97, 89, 47, 26, 87, 75, 12, 42],
       [84, 44, 72, 81, 14, 37, 48, 94, 94, 54],
       [21, 42,  1, 44, 28, 90, 69, 72, 69, 18],
       [14, 40, 85, 45, 79, 37,  6, 35, 90, 25],
       [52, 63, 45, 90, 78, 67, 61, 51, 17, 79],
       [61, 39, 82, 61, 76, 15, 29, 72, 27, 43],
       [71, 56, 50, 83, 25, 93,  9, 50, 54, 64]])
```

In [152…
```
arr
```

Out[152…
```
array([0, 1, 2, 3, 4, 5])
```

In [154…
```
arr[:]
```

Out[154…
```
array([0, 1, 2, 3, 4, 5])
```

In [155…
```
arr
```

Out[155…
```
array([0, 1, 2, 3, 4, 5])
```

In [156…
```
arr[:4]
```

Out[156…
```
array([0, 1, 2, 3])
```

In [157…
```
arr2[:]
```

Out[157…
```
array([[91, 61,  3, 21,  8,  6, 62, 18, 82, 73],
       [83, 36, 45, 64, 90, 91, 53, 41, 44, 36],
       [23, 37, 40, 59, 89, 80, 83, 23, 86, 66],
       [ 6,  2, 97, 89, 47, 26, 87, 75, 12, 42],
       [84, 44, 72, 81, 14, 37, 48, 94, 94, 54],
       [21, 42,  1, 44, 28, 90, 69, 72, 69, 18],
       [14, 40, 85, 45, 79, 37,  6, 35, 90, 25],
       [52, 63, 45, 90, 78, 67, 61, 51, 17, 79],
       [61, 39, 82, 61, 76, 15, 29, 72, 27, 43],
       [71, 56, 50, 83, 25, 93,  9, 50, 54, 64]])
```

In [158…
```
arr2[0:5]
```

Out[158…
```
array([[91, 61,  3, 21,  8,  6, 62, 18, 82, 73],
       [83, 36, 45, 64, 90, 91, 53, 41, 44, 36],
       [23, 37, 40, 59, 89, 80, 83, 23, 86, 66],
       [ 6,  2, 97, 89, 47, 26, 87, 75, 12, 42],
       [84, 44, 72, 81, 14, 37, 48, 94, 94, 54]])
```

In [159…
```
arr2
```

Out[159…
```
array([[91, 61,  3, 21,  8,  6, 62, 18, 82, 73],
       [83, 36, 45, 64, 90, 91, 53, 41, 44, 36],
       [23, 37, 40, 59, 89, 80, 83, 23, 86, 66],
       [ 6,  2, 97, 89, 47, 26, 87, 75, 12, 42],
       [84, 44, 72, 81, 14, 37, 48, 94, 94, 54],
       [21, 42,  1, 44, 28, 90, 69, 72, 69, 18],
       [14, 40, 85, 45, 79, 37,  6, 35, 90, 25],
       [52, 63, 45, 90, 78, 67, 61, 51, 17, 79],
       [61, 39, 82, 61, 76, 15, 29, 72, 27, 43],
       [71, 56, 50, 83, 25, 93,  9, 50, 54, 64]])
```

In [160…
```
arr2[1,4]
```

Out[160…
```
90
```

In [161…
```
arr2
```

Out[161…
```
array([[91, 61,  3, 21,  8,  6, 62, 18, 82, 73],
       [83, 36, 45, 64, 90, 91, 53, 41, 44, 36],
       [23, 37, 40, 59, 89, 80, 83, 23, 86, 66],
       [ 6,  2, 97, 89, 47, 26, 87, 75, 12, 42],
       [84, 44, 72, 81, 14, 37, 48, 94, 94, 54],
       [21, 42,  1, 44, 28, 90, 69, 72, 69, 18],
       [14, 40, 85, 45, 79, 37,  6, 35, 90, 25],
       [52, 63, 45, 90, 78, 67, 61, 51, 17, 79],
       [61, 39, 82, 61, 76, 15, 29, 72, 27, 43],
       [71, 56, 50, 83, 25, 93,  9, 50, 54, 64]])
```

In [162…
```
arr2[-5,-5]
```

Out[162…
```
90
```

In [163…
```
arr2
```

Out[163…
```
array([[91, 61,  3, 21,  8,  6, 62, 18, 82, 73],
       [83, 36, 45, 64, 90, 91, 53, 41, 44, 36],
       [23, 37, 40, 59, 89, 80, 83, 23, 86, 66],
       [ 6,  2, 97, 89, 47, 26, 87, 75, 12, 42],
       [84, 44, 72, 81, 14, 37, 48, 94, 94, 54],
       [21, 42,  1, 44, 28, 90, 69, 72, 69, 18],
       [14, 40, 85, 45, 79, 37,  6, 35, 90, 25],
       [52, 63, 45, 90, 78, 67, 61, 51, 17, 79],
       [61, 39, 82, 61, 76, 15, 29, 72, 27, 43],
       [71, 56, 50, 83, 25, 93,  9, 50, 54, 64]])
```

In [164…
```
arr2[-1,-2]
```

Out[164…
```
54
```

In [165…
```
arr2[::-1]
```

Out[165…
```
array([[71, 56, 50, 83, 25, 93,  9, 50, 54, 64],
       [61, 39, 82, 61, 76, 15, 29, 72, 27, 43],
       [52, 63, 45, 90, 78, 67, 61, 51, 17, 79],
       [14, 40, 85, 45, 79, 37,  6, 35, 90, 25],
       [21, 42,  1, 44, 28, 90, 69, 72, 69, 18],
       [84, 44, 72, 81, 14, 37, 48, 94, 94, 54],
       [ 6,  2, 97, 89, 47, 26, 87, 75, 12, 42],
       [23, 37, 40, 59, 89, 80, 83, 23, 86, 66],
       [83, 36, 45, 64, 90, 91, 53, 41, 44, 36],
       [91, 61,  3, 21,  8,  6, 62, 18, 82, 73]])
```

In [166…
```
arr2
```

Out[166…
```
array([[91, 61,  3, 21,  8,  6, 62, 18, 82, 73],
       [83, 36, 45, 64, 90, 91, 53, 41, 44, 36],
       [23, 37, 40, 59, 89, 80, 83, 23, 86, 66],
       [ 6,  2, 97, 89, 47, 26, 87, 75, 12, 42],
       [84, 44, 72, 81, 14, 37, 48, 94, 94, 54],
       [21, 42,  1, 44, 28, 90, 69, 72, 69, 18],
       [14, 40, 85, 45, 79, 37,  6, 35, 90, 25],
       [52, 63, 45, 90, 78, 67, 61, 51, 17, 79],
       [61, 39, 82, 61, 76, 15, 29, 72, 27, 43],
       [71, 56, 50, 83, 25, 93,  9, 50, 54, 64]])
```

In [167…
```
arr2[::-2]
```

Out[167…
```
array([[71, 56, 50, 83, 25, 93,  9, 50, 54, 64],
       [52, 63, 45, 90, 78, 67, 61, 51, 17, 79],
       [21, 42,  1, 44, 28, 90, 69, 72, 69, 18],
       [ 6,  2, 97, 89, 47, 26, 87, 75, 12, 42],
       [83, 36, 45, 64, 90, 91, 53, 41, 44, 36]])
```

In [168…
```
arr2
```

Out[168…
```
array([[91, 61,  3, 21,  8,  6, 62, 18, 82, 73],
       [83, 36, 45, 64, 90, 91, 53, 41, 44, 36],
       [23, 37, 40, 59, 89, 80, 83, 23, 86, 66],
       [ 6,  2, 97, 89, 47, 26, 87, 75, 12, 42],
       [84, 44, 72, 81, 14, 37, 48, 94, 94, 54],
       [21, 42,  1, 44, 28, 90, 69, 72, 69, 18],
       [14, 40, 85, 45, 79, 37,  6, 35, 90, 25],
       [52, 63, 45, 90, 78, 67, 61, 51, 17, 79],
       [61, 39, 82, 61, 76, 15, 29, 72, 27, 43],
       [71, 56, 50, 83, 25, 93,  9, 50, 54, 64]])
```

In [169…
```
arr2[::-3]
```

Out[169…
```
array([[71, 56, 50, 83, 25, 93,  9, 50, 54, 64],
       [14, 40, 85, 45, 79, 37,  6, 35, 90, 25],
       [ 6,  2, 97, 89, 47, 26, 87, 75, 12, 42],
       [91, 61,  3, 21,  8,  6, 62, 18, 82, 73]])
```

In [170…
```
arr2[:-3]
```

Out[170…
```
array([[91, 61,  3, 21,  8,  6, 62, 18, 82, 73],
       [83, 36, 45, 64, 90, 91, 53, 41, 44, 36],
       [23, 37, 40, 59, 89, 80, 83, 23, 86, 66],
       [ 6,  2, 97, 89, 47, 26, 87, 75, 12, 42],
       [84, 44, 72, 81, 14, 37, 48, 94, 94, 54],
       [21, 42,  1, 44, 28, 90, 69, 72, 69, 18],
       [14, 40, 85, 45, 79, 37,  6, 35, 90, 25]])
```

In [171…
```
arr2
```

Out[171…
```
array([[91, 61,  3, 21,  8,  6, 62, 18, 82, 73],
       [83, 36, 45, 64, 90, 91, 53, 41, 44, 36],
       [23, 37, 40, 59, 89, 80, 83, 23, 86, 66],
       [ 6,  2, 97, 89, 47, 26, 87, 75, 12, 42],
       [84, 44, 72, 81, 14, 37, 48, 94, 94, 54],
       [21, 42,  1, 44, 28, 90, 69, 72, 69, 18],
       [14, 40, 85, 45, 79, 37,  6, 35, 90, 25],
       [52, 63, 45, 90, 78, 67, 61, 51, 17, 79],
       [61, 39, 82, 61, 76, 15, 29, 72, 27, 43],
       [71, 56, 50, 83, 25, 93,  9, 50, 54, 64]])
```

In [172…
```
arr2[:-3]
```

Out[172…
```
array([[91, 61,  3, 21,  8,  6, 62, 18, 82, 73],
       [83, 36, 45, 64, 90, 91, 53, 41, 44, 36],
       [23, 37, 40, 59, 89, 80, 83, 23, 86, 66],
       [ 6,  2, 97, 89, 47, 26, 87, 75, 12, 42],
       [84, 44, 72, 81, 14, 37, 48, 94, 94, 54],
       [21, 42,  1, 44, 28, 90, 69, 72, 69, 18],
       [14, 40, 85, 45, 79, 37,  6, 35, 90, 25]])
```

In [174…
```
arr
```

Out[174…
```
array([0, 1, 2, 3, 4, 5])
```

In [176…
```
arr.max()  # 5
```

Out[176…
```
5
```

In [177…
```
arr.min()
```

Out[177…
```
0
```

In [179…
```
arr
```

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

In [181…
```
arr.mean()  #2.5
```

Out[181…
```
2.5
```

In [182…
```
arr.median()
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[182], line 1
----> 1 arr.median()

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

In [183…
```
from numpy import *
a = array([1,2,3,4,9])
median(a)
```

Out[183…
```
3.0
```

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

In [184…
```
arr
```

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

In [185…
```
arr.reshape(6,1)
```

Out[185…
```
array([[0],
       [1],
       [2],
       [3],
       [4],
       [5]])
```

In [186…
```
arr.reshape(3,2)
```

Out[186…
```
array([[0, 1],
       [2, 3],
       [4, 5]])
```

In [187…
```
arr.reshape(1,6)
```

Out[187…
```
array([[0, 1, 2, 3, 4, 5]])
```

In [188…
```
arr
```

Out[188…
```
array([0, 1, 2, 3, 4, 5])
```

In [190…
```
arr.reshape(2,4)
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[190], line 1
----> 1 arr.reshape(2,4)

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

In [191…
```
arr
```

Out[191…
```
array([0, 1, 2, 3, 4, 5])
```

In [192…
```
arr.reshape(2,4)
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[192], line 1
----> 1 arr.reshape(2,4)

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

In [193…
```
arr.reshape(2,3,order = 'C')
```

Out[193…
```
array([[0, 1, 2],
       [3, 4, 5]])
```

In [194…
```
arr.reshape(2,3,order = 'F')  # print element with fortran
```

Out[194…
```
array([[0, 2, 4],
       [1, 3, 5]])
```

In [195…
```
arr.reshape(2,3,order = 'A')   # A almost give you c type output
```

Out[195…
```
array([[0, 1, 2],
       [3, 4, 5]])
```

In [196…
```
arr
```

Out[196…
```
array([0, 1, 2, 3, 4, 5])
```

In [197…
```
arr.reshape(2,3)
```

Out[197…
```
array([[0, 1, 2],
       [3, 4, 5]])
```

In [198…
```
arr.reshpe(1,4)
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[198], line 1
----> 1 arr.reshpe(1,4)

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

In [199…
```
arr.reshape(1,6)
```

Out[199…
```
array([[0, 1, 2, 3, 4, 5]])
```

In [200…
```
arr.reshape(6,1)
```

Out[200…
```
array([[0],
       [1],
       [2],
       [3],
       [4],
       [5]])
```

In [204…
```
arr.reshape(2,6)
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[204], line 1
----> 1 arr.reshape(2,6)

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

In [205…
```
arr.reshape(3,3)
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[205], line 1
----> 1 arr.reshape(3,3)

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

In [206…
```
arr
```

Out[206…
```
array([0, 1, 2, 3, 4, 5])
```

In [207…
```
arr.reshape(3,2)
```

Out[207…
```
array([[0, 1],
       [2, 3],
       [4, 5]])
```

Indexing

In [208…
```
mat = np.arange(0,100).reshape(10,10)
```

In [209…
```
mat
```

Out[209…
```
array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
       [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
       [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
       [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
       [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
       [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
       [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
       [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
       [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

In [211…
```
row = 4
Col = 5
```

In [213…
```
Col
```

Out[213…
```
5
```

In [214…
```
row
```

Out[214…
```
4
```

In [215…
```
mat
```

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

In [216…
```
mat[row,Col]
```

Out[216…
```
45
```

In [217…
```
mat[4,5]
```

Out[217…
```
45
```

In [218…
```
mat
```

Out[218…
```
array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
       [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
       [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
       [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
       [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
       [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
       [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
       [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
       [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

In [220…
```
mat[:]
```

Out[220…
```
array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
       [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
       [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
       [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
       [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
       [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
       [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
       [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
       [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

In [221…
```
Col = 6
```

In [222…
```
Col
```

Out[222…
```
6
```

In [223…
```
mat
```

Out[223…
```
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 [224…
```
mat[6]      # befault it represent to rows
```

Out[224…
```
array([60, 61, 62, 63, 64, 65, 66, 67, 68, 69])
```

In [225…
```
mat
```

Out[225…
```
array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
       [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
       [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
       [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
       [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
       [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
       [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
       [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
       [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

In [226…
```
mat
```

Out[226…
```
array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
       [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
       [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
       [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
       [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
       [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
       [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
       [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
       [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

with slices

In [228…
```
mat[:,col]
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
Cell In[228], line 1
----> 1 mat[:,col]

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

In [229…
```
mat[:,Col]
```

Out[229…
```
array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])
```

In [230…
```
mat
```

Out[230…
```
array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
       [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
       [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
       [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
       [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 [231…
```
mat[row,:]
```

Out[231…
```
array([40, 41, 42, 43, 44, 45, 46, 47, 48, 49])
```

In [232…
```
mat
```

Out[232…
```
array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
       [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
       [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
       [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
       [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 [233…
```
mat[:,8]
```

Out[233…
```
array([ 8, 18, 28, 38, 48, 58, 68, 78, 88, 98])
```

In [234…
```
mat
```

Out[234…
```
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 [235…
```
mat[:Col]
```

Out[235…
```
array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
       [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
       [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
       [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
       [50, 51, 52, 53, 54, 55, 56, 57, 58, 59]])
```

In [236…
```
mat[:6]
```

Out[236…
```
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 [237…
```
row
```

Out[237… 4

In [238…
```
mat
```

Out[238…
```
array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
       [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
       [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
       [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
       [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 [239…
```
mat[:row]
```

Out[239…
```
array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
       [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
       [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
       [30, 31, 32, 33, 34, 35, 36, 37, 38, 39]])
```

In [240…
```
mat
```

Out[240…
```
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 [241…
```
mat[:]
```

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

mat[:,8]

In [242…
```
mat[:,8]
```

Out[242…
```
array([ 8, 18, 28, 38, 48, 58, 68, 78, 88, 98])
```

In [243…
```
mat
```

Out[243…
```
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 [244…
```
mat[:,-1]
```

Out[244…
```
array([ 9, 19, 29, 39, 49, 59, 69, 79, 89, 99])
```

In [245…
```
mat
```

Out[245…
```
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 [246…
```
row
```

Out[246…
```
4
```

In [247…
```
Col
```

Out[247…
```
6
```

In [249…
```
mat[:,Col]
```

Out[249…
```
array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])
```

In [250…
```
mat
```

Out[250…
```
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 [251…
```
mat[1:4]
```

Out[251…
```
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 [252…
```
mat
```

Out[252…
```
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 [253…
```
mat[1,4]
```

Out[253…
```
14
```

In [254…
```
mat
```

Out[254…
```
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 [255…
```
mat[3:-3]
```

Out[255…
```
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 [256…
```
mat
```

Out[256…
```
array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
       [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
       [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
       [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
       [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
       [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
       [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
       [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
       [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

In [257…
```
mat[0]
```

Out[257…
```
array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])
```

In [259…
```
mat[6]
```

Out[259…
```
array([60, 61, 62, 63, 64, 65, 66, 67, 68, 69])
```

In [260…
```
mat
```

Out[260…
```
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 [261…
```
mat[6:]
```

Out[261…
```
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 [262…
```
mat[:6]
```

Out[262…
```
array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
       [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
       [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
       [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
       [50, 51, 52, 53, 54, 55, 56, 57, 58, 59]])
```

In [263…
```
mat
```

Out[263…
```
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 [264…
```
mat[5:7]
```

Out[264…
```
array([[50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
       [60, 61, 62, 63, 64, 65, 66, 67, 68, 69]])
```

In [265…
```
mat
```

Out[265…
```
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 [266…
```
mat
```

Out[266…
```
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 [267…
```
mat[0:10]
```

Out[267…
```
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 [268…
```
mat[0:10:3]
```

Out[268…
```
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 [269…
```
mat[0:10]
```

Out[269…
```
array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
       [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
       [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
       [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
       [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
       [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 [270…
```
mat
```

Out[270…
```
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 [271…
```
mat[:4]
```

Out[271…
```
array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
       [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
       [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
       [30, 31, 32, 33, 34, 35, 36, 37, 38, 39]])
```

In [272…
```
mat
```

Out[272…
```
array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
       [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
       [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
       [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [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 [273…
```
mat[::-1]
```

Out[273…
```
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 [274…
```
mat
```

Out[274…
```
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 [275…
```
mat[::-3]
```

Out[275…
```
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 [276…
```
mat[::-5]
```

Out[276…
```
array([[90, 91, 92, 93, 94, 95, 96, 97, 98, 99],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49]])
```

In [277…
```
mat
```

Out[277…
```
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 [278…
```
mat[2:6]
```

Out[278…
```
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 [279…
```
mat[2:6,2:4] # 1:5 --> only row part /// 1:3 -- it indicates only column parts
```

Out[279…
```
array([[22, 23],
       [32, 33],
       [42, 43],
       [52, 53]])
```

In [280…
```
mat
```

Out[280…
```
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 [281…
```
mat[0,1]
```

Out[281…
```
1
```

In [282…
```
mat[1,6]
```

Out[282…
```
16
```

In [283…
```
mat[1:]
```

Out[283…
```
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 [284…
```
mat
```

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

In [285…
```
mat[:6]
```

Out[285…
```
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 [286…
```
mat[0:1]
```

Out[286…
```
array([[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]])
```

In [287…
```
mat
```

Out[287…
```
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 [288…
```
mat[3:5]
```

Out[288…
```
array([[30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49]])
```

In [289…
```
mat[1:2,2:4]
```

Out[289…
```
array([[12, 13]])
```

In [290…
```
mat
```

Out[290…
```
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 [291…
```
mat[2:3,2:3]
```

Out[291…
```
array([[22]])
```

In [292…
```
mat[2:4,3:5]
```

Out[292…
```
array([[23, 24],
       [33, 34]])
```

In [293…
```
mat[3:5,2:4]
```

Out[293…
```
array([[32, 33],
       [42, 43]])
```

In [294…
```
mat
```

Out[294…
```
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 [295…
```
mat[2:3,4:5]
```

Out[295…
```
array([[24]])
```

Masking

In [296…
```
mat   # we also called as filter
```

Out[296…
```
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 [297…
```
id(mat)
```

Out[297…
```
1858838965840
```

In [298…
```
mat[mat<50]
```

Out[298…
```
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 [299…
```
mat[mat<=50]
```

Out[299…
```
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 [300…
```
mat[mat == 50]
```

Out[300…
```
array([50])
```

In [301…
```
mat
```

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

In [302…
```
mat == 50
```

Out[302…
```
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 [303…
```
mat
```

Out[303…
```
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 [306…
```
a1 = mat[mat<50]
a1
```

Out[306…
```
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 [ ]:

In [307…
```
mat
```

Out[307…
```
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 [309…
```
a2 = mat[mat>50]
a2
```

Out[309…
```
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 [310…
```
a3 = mat[mat<=50]
a3
```

Out[310…
```
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 [312…
```
a4 = mat[mat==50]
a4
```

Out[312…
```
array([50])
```

Python program to generate OTP

In [315…
```
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: 2033
```

In [316…
```
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 [317…
```
def wish():
    print('good even')
wish()

wish()

wish()
```

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

In [318…
```
list1=['a','b','g',1,5]
print(list1.pop)
```

```
<built-in method pop of list object at 0x000001B0CB60EA00>
```

In [319…
```
x = [1, 2, 3]
y = x.copy()
x.append(4)
print(x)
```

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

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]: