Numpy

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

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

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

In [6]:
```
import sys
sys.version
```

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

Creating Arrays

In [11]:
```
my_list=[0,1,2,3,4,5]
my_list
```

Out[11]:
```
[0, 1, 2, 3, 4, 5]
```

In [13]:
```
type(my_list)
```

Out[13]:
```
list
```

below code we are converting list to array

In [18]:
```
arr=np.array(my_list)
arr
```

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

In [20]:
```
type(arr)
```

Out[20]:
```
numpy.ndarray
```

In [ ]:
```
np. # we learn import function
```

In [26]:
```
np.arange(15) # integer datatype
```

Out[26]:
```
array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14])
```

In [32]:
```
np.arange(3.0) # float datatype
```

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

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

Out[34]:
```
array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])
```

In [36]:
```
np.arange(0,5) # passing 2 arguments
```

Out[36]:
```
array([0, 1, 2, 3, 4])
```

In [38]:
```
np.arange(10,20)
```

Out[38]:
```
array([10, 11, 12, 13, 14, 15, 16, 17, 18, 19])
```

In [40]:
```
np.arange(20,10) # 1st arg< 2nd arg
```

Out[40]:
```
array([], dtype=int32)
```

In [42]:
```
np.arange(-20,10)
```

Out[42]:
```
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 [44]:
```
np.arange(-16,10)
```

Out[44]:
```
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 [46]:
```
np.arange(-20,-10)
```

Out[46]:
```
array([-20, -19, -18, -17, -16, -15, -14, -13, -12, -11])
```

In [48]:
```
np.arange(30,20) # 1st arg always be < then 2nd arg
```

Out[48]:
```
array([], dtype=int32)
```

In [50]:
```
ar=np.arange(-30,20)
ar
```

Out[50]:
```
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 [52]:
```
np.arange(10,10)
```

Out[52]:
```
array([], dtype=int32)
```

In [54]:
```
np.arange()
```

```
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
Cell In[54], line 1
----> 1 np.arange()

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

In [56]:
```
np.arange(10,30,5) # 10 starting from 30 end point 5 - stepcount n-1
```

Out[56]:
```
array([10, 15, 20, 25])
```

In [58]:
```
np.arange(0,10,3)
```

Out[58]:
```
array([0, 3, 6, 9])
```

In [60]:
```
np.arange(10,30,5,8)
```

```
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
Cell In[60], line 1
----> 1 np.arange(10,30,5,8)

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

In [66]:
```
np.zeros(3) # PARAMETER TUNING 1D ARRAY
```

Out[66]:
```
array([0., 0., 0.])
```

In [64]:
```
np.zeros(3,dtype=int) # HYPERPARAMETER TUNNING
```

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

In [68]:
```
np.zeros((2,2),dtype=int)
```

Out[68]:
```
array([[0, 0],
       [0, 0]])
```

In [70]:
```
np.zeros((2,10)) #float
```

Out[70]:
```
array([[0., 0., 0., 0., 0., 0., 0., 0., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0.]])
```

In [72]:
```
np.zeros((3,3))
```

Out[72]:
```
array([[0., 0., 0.],
       [0., 0., 0.],
       [0., 0., 0.]])
```

In [74]:
```
np.zeros((10,30))
```

Out[74]:
```
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 [76]:
```
np.zeros((5,10)) # bydefault large -- will give row & 2nd arg columns
```

Out[76]:
```
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 [78]:
```
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 [80]:
```
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 [82]:
```
np.ones(3) #by default it is float the output
```

Out[82]:
```
array([1., 1., 1.])
```

In [84]:
```
np.ones(4,dtype=int)
```

Out[84]:
```
array([1, 1, 1, 1])
```

In [86]:
```
np.ones(4)
```

Out[86]:
```
array([1., 1., 1., 1.])
```

In [88]:
```
n
```

Out[88]:
```
(6, 7)
```

In [90]:
```
np.twos((2,3)) # function is not there
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[90], 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 [92]:
```
np.three(2,3)
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[92], 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 [94]:
```
rand(3,2)
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
Cell In[94], line 1
----> 1 rand(3,2)

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

In [96]:
```
random.rand(3,2)
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
Cell In[96], line 1
----> 1 random.rand(3,2)

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

In [98]:
```
np.random.rand(5) #np=package, random=module, rand=function
```

Out[98]:
```
array([0.4023223 , 0.40752356, 0.64519741, 0.81136221, 0.45474743])
```

In [100…
```
np.rand(4)
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[100], line 1
----> 1 np.rand(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 'rand'
```

In [102…
```
np.random.rand(2,4)
```

Out[102…
```
array([[0.49473963, 0.92362488, 0.02436216, 0.12489074],
       [0.21331562, 0.92926193, 0.14031944, 0.8384056 ]])
```

In [104…
```
np.random.randint(2,4)
```

Out[104…
```
2
```

In [106…
```
np.random.randint(2,20) # 2nd argument is exclusive
```

Out[106…
```
18
```

In [108…
```
np.random.randint(0,1)
```

Out[108…
```
0
```

In [110…
```
np.random.randint(10,25,5)
```

Out[110…
```
array([22, 17, 19, 17, 18])
```

In [112…
```
np.random.randint(1,6,4)
```

Out[112…
```
array([3, 4, 5, 3])
```

In [114…
```
np.random.rand(3)
```

Out[114…
```
array([0.75106551, 0.21295616, 0.96685937])
```

In [116…
```
np.random.randint(1)
```

Out[116…
```
0
```

In [118…
```
np.random.randint(-30,20,10)
```

Out[118…
```
array([-24, -18, -20,  10,  -1, -23, -22,  14,  -5, -26])
```

In [120…
```
np.random.randint(20,30,10)
```

Out[120…
```
array([27, 24, 28, 27, 27, 22, 22, 22, 26, 27])
```

In [124…
```
np.random.randint(5,9)
```

Out[124…
```
7
```

In [126…
```
np.random.randint(10,40,(10,10)) # generate the element 10-30 2ith 4*4 matrix
```

Out[126…
```
array([[19, 12, 11, 19, 26, 39, 32, 39, 15, 17],
       [37, 38, 14, 23, 25, 24, 20, 14, 30, 16],
       [30, 33, 37, 34, 28, 34, 18, 30, 17, 10],
       [14, 39, 32, 13, 13, 18, 16, 15, 13, 34],
       [15, 14, 29, 35, 36, 25, 13, 22, 29, 32],
       [29, 39, 39, 17, 13, 38, 13, 15, 26, 35],
       [29, 35, 21, 39, 26, 21, 11, 23, 33, 22],
       [14, 11, 26, 11, 34, 39, 24, 19, 22, 18],
       [26, 10, 19, 11, 14, 26, 39, 11, 34, 25],
       [39, 18, 36, 23, 29, 28, 13, 24, 25, 14]])
```

In [128…
```
np.random.randint(1,100,(12,12))
```

Out[128…
```
array([[59, 76,  9, 77, 61, 99, 57, 45, 48, 40, 19, 58],
       [31, 72, 63,  9, 35, 48, 30,  3, 58, 93, 27, 76],
       [88, 94, 48, 70, 86, 15, 47, 50,  2, 74, 12, 21],
       [38, 19, 24, 29,  3,  9, 81, 38, 93, 47, 33, 61],
       [50, 74, 99, 84, 89, 44, 71,  3, 30, 41, 26, 10],
       [25, 69, 65, 11, 81, 94, 63, 16, 16, 44, 98, 40],
       [ 3, 19, 64, 64, 63,  8, 74, 62, 26,  1, 52, 18],
       [88, 52, 59, 99, 38,  7, 55, 24, 30, 43, 99, 39],
       [14, 15, 64, 15,  3, 23, 92, 21, 19,  1, 60,  1],
       [89, 96, 83, 22, 66, 73, 61, 94, 39, 88, 48, 28],
       [14, 34, 66, 34, 85,  9, 68, 31, 36, 47,  5, 58],
       [44, 82, 99, 84, 91, 52, 22, 72, 53, 20, 68, 81]])
```

In [130…
```
np.arange(1,13).reshape(3,4)
```

Out[130…
```
array([[ 1,  2,  3,  4],
       [ 5,  6,  7,  8],
       [ 9, 10, 11, 12]])
```

In [132…
```
np.arange(1,13).reshape(12,1)
```

Out[132…
```
array([[ 1],
       [ 2],
       [ 3],
       [ 4],
       [ 5],
       [ 6],
       [ 7],
       [ 8],
       [ 9],
       [10],
       [11],
       [12]])
```

In [134…
```
np.arange(1,13).reshape(6,2)
```

Out[134…
```
array([[ 1,  2],
       [ 3,  4],
       [ 5,  6],
       [ 7,  8],
       [ 9, 10],
       [11, 12]])
```

Slicing in MATRIX

In [139…
```
b=np.random.randint(10,20,(5,4))
b
```

Out[139…
```
array([[19, 19, 10, 19],
       [10, 13, 12, 18],
       [12, 15, 17, 17],
       [17, 13, 11, 10],
       [16, 19, 13, 10]])
```

In [141…
```
type(b)
```

Out[141…
```
numpy.ndarray
```

In [145…
```
b
```

Out[145…
```
array([[19, 19, 10, 19],
       [10, 13, 12, 18],
       [12, 15, 17, 17],
       [17, 13, 11, 10],
       [16, 19, 13, 10]])
```

In [147…
```
b[:] # empty slice
```

Out[147…
```
array([[19, 19, 10, 19],
       [10, 13, 12, 18],
       [12, 15, 17, 17],
       [17, 13, 11, 10],
       [16, 19, 13, 10]])
```

In [149…
```
b[1:3]
```

Out[149…
```
array([[10, 13, 12, 18],
       [12, 15, 17, 17]])
```

In [151…
```
b
```

Out[151…
```
array([[19, 19, 10, 19],
       [10, 13, 12, 18],
       [12, 15, 17, 17],
       [17, 13, 11, 10],
       [16, 19, 13, 10]])
```

In [153…
```
b[1,2]
```

Out[153…
```
12
```

In [155…
```
b
```

Out[155…
```
array([[19, 19, 10, 19],
       [10, 13, 12, 18],
       [12, 15, 17, 17],
       [17, 13, 11, 10],
       [16, 19, 13, 10]])
```

In [157…
```
b[1,3]
```

Out[157…
```
18
```

In [159…
```
b[1,-1]
```

Out[159…
```
18
```

In [161…
```
b
```

Out[161…
```
array([[19, 19, 10, 19],
       [10, 13, 12, 18],
       [12, 15, 17, 17],
       [17, 13, 11, 10],
       [16, 19, 13, 10]])
```

In [163…
```
b[2:3]
```

Out[163…
```
array([[12, 15, 17, 17]])
```

In [165…
```
b
```

Out[165…
```
array([[19, 19, 10, 19],
       [10, 13, 12, 18],
       [12, 15, 17, 17],
       [17, 13, 11, 10],
       [16, 19, 13, 10]])
```

In [167…
```
b[0:-2]
```

Out[167…
```
array([[19, 19, 10, 19],
       [10, 13, 12, 18],
       [12, 15, 17, 17]])
```

In [169…
```
b
```

Out[169…
```
array([[19, 19, 10, 19],
       [10, 13, 12, 18],
       [12, 15, 17, 17],
       [17, 13, 11, 10],
       [16, 19, 13, 10]])
```

In [171…
```
b[0,2]
```

Out[171…
```
10
```

In [173…
```
b
```

Out[173…
```
array([[19, 19, 10, 19],
       [10, 13, 12, 18],
       [12, 15, 17, 17],
       [17, 13, 11, 10],
       [16, 19, 13, 10]])
```

In [175…
```
b[-5,-3]
```

Out[175…
```
19
```

In [177…
```
b
```

Out[177…
```
array([[19, 19, 10, 19],
       [10, 13, 12, 18],
       [12, 15, 17, 17],
       [17, 13, 11, 10],
       [16, 19, 13, 10]])
```

In [179…
```
b[-4,2]
```

Out[179…
```
12
```

Operations

In [182…
```
a=np.random.randint(10,20,10)
a
```

Out[182…
```
array([10, 16, 15, 14, 17, 11, 17, 16, 19, 14])
```

In [184…
```
id(a)
```

Out[184…
```
2675220674864
```

In [186…
```
arr
```

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

In [188…
```
arr2=np.random.randint(0,100,(10,10))
```

In [190…
```
arr2
```

Out[190…
```
array([[83, 44, 97, 86, 83,  1, 85, 83, 81, 92],
       [29, 29, 23, 53, 87,  8, 18, 16, 83, 94],
       [83, 62, 46,  9, 37, 85, 27, 83, 31,  4],
       [31, 29, 41, 59, 66, 23, 53, 39,  8, 21],
       [77, 71, 37, 33, 24, 73, 30, 83, 43, 47],
       [ 1, 91, 55, 44, 96, 42, 12,  2, 47, 39],
       [53, 52, 17, 96, 98, 94, 15, 69, 14, 25],
       [78, 64, 25, 97, 18,  5,  2,  6, 87, 46],
       [25, 59, 41, 54, 92, 91, 87, 35, 28, 98],
       [ 7, 75, 49, 52, 85, 14, 52, 19,  2, 48]])
```

In [192…
```
arr
```

Out[192…
```
array([0, 1, 2, 3, 4, 5])
```

In [194…
```
arr[:4]
```

Out[194…
```
array([0, 1, 2, 3])
```

In [196…
```
arr2[:]
```

Out[196…
```
array([[83, 44, 97, 86, 83,  1, 85, 83, 81, 92],
       [29, 29, 23, 53, 87,  8, 18, 16, 83, 94],
       [83, 62, 46,  9, 37, 85, 27, 83, 31,  4],
       [31, 29, 41, 59, 66, 23, 53, 39,  8, 21],
       [77, 71, 37, 33, 24, 73, 30, 83, 43, 47],
       [ 1, 91, 55, 44, 96, 42, 12,  2, 47, 39],
       [53, 52, 17, 96, 98, 94, 15, 69, 14, 25],
       [78, 64, 25, 97, 18,  5,  2,  6, 87, 46],
       [25, 59, 41, 54, 92, 91, 87, 35, 28, 98],
       [ 7, 75, 49, 52, 85, 14, 52, 19,  2, 48]])
```

In [198…
```
arr2[0:5]
```

Out[198…
```
array([[83, 44, 97, 86, 83,  1, 85, 83, 81, 92],
       [29, 29, 23, 53, 87,  8, 18, 16, 83, 94],
       [83, 62, 46,  9, 37, 85, 27, 83, 31,  4],
       [31, 29, 41, 59, 66, 23, 53, 39,  8, 21],
       [77, 71, 37, 33, 24, 73, 30, 83, 43, 47]])
```

In [200…
```
arr2
```

Out[200…
```
array([[83, 44, 97, 86, 83,  1, 85, 83, 81, 92],
       [29, 29, 23, 53, 87,  8, 18, 16, 83, 94],
       [83, 62, 46,  9, 37, 85, 27, 83, 31,  4],
       [31, 29, 41, 59, 66, 23, 53, 39,  8, 21],
       [77, 71, 37, 33, 24, 73, 30, 83, 43, 47],
       [ 1, 91, 55, 44, 96, 42, 12,  2, 47, 39],
       [53, 52, 17, 96, 98, 94, 15, 69, 14, 25],
       [78, 64, 25, 97, 18,  5,  2,  6, 87, 46],
       [25, 59, 41, 54, 92, 91, 87, 35, 28, 98],
       [ 7, 75, 49, 52, 85, 14, 52, 19,  2, 48]])
```

In [202…
```
arr2[::-1] # reverse matrix
```

Out[202…
```
array([[ 7, 75, 49, 52, 85, 14, 52, 19,  2, 48],
       [25, 59, 41, 54, 92, 91, 87, 35, 28, 98],
       [78, 64, 25, 97, 18,  5,  2,  6, 87, 46],
       [53, 52, 17, 96, 98, 94, 15, 69, 14, 25],
       [ 1, 91, 55, 44, 96, 42, 12,  2, 47, 39],
       [77, 71, 37, 33, 24, 73, 30, 83, 43, 47],
       [31, 29, 41, 59, 66, 23, 53, 39,  8, 21],
       [83, 62, 46,  9, 37, 85, 27, 83, 31,  4],
       [29, 29, 23, 53, 87,  8, 18, 16, 83, 94],
       [83, 44, 97, 86, 83,  1, 85, 83, 81, 92]])
```

In [204…
```
arr2
```

Out[204…
```
array([[83, 44, 97, 86, 83,  1, 85, 83, 81, 92],
       [29, 29, 23, 53, 87,  8, 18, 16, 83, 94],
       [83, 62, 46,  9, 37, 85, 27, 83, 31,  4],
       [31, 29, 41, 59, 66, 23, 53, 39,  8, 21],
       [77, 71, 37, 33, 24, 73, 30, 83, 43, 47],
       [ 1, 91, 55, 44, 96, 42, 12,  2, 47, 39],
       [53, 52, 17, 96, 98, 94, 15, 69, 14, 25],
       [78, 64, 25, 97, 18,  5,  2,  6, 87, 46],
       [25, 59, 41, 54, 92, 91, 87, 35, 28, 98],
       [ 7, 75, 49, 52, 85, 14, 52, 19,  2, 48]])
```

In [206…
```
arr2[::-2]
```

Out[206…
```
array([[ 7, 75, 49, 52, 85, 14, 52, 19,  2, 48],
       [78, 64, 25, 97, 18,  5,  2,  6, 87, 46],
       [ 1, 91, 55, 44, 96, 42, 12,  2, 47, 39],
       [31, 29, 41, 59, 66, 23, 53, 39,  8, 21],
       [29, 29, 23, 53, 87,  8, 18, 16, 83, 94]])
```

In [208…
```
arr2
```

Out[208…
```
array([[83, 44, 97, 86, 83,  1, 85, 83, 81, 92],
       [29, 29, 23, 53, 87,  8, 18, 16, 83, 94],
       [83, 62, 46,  9, 37, 85, 27, 83, 31,  4],
       [31, 29, 41, 59, 66, 23, 53, 39,  8, 21],
       [77, 71, 37, 33, 24, 73, 30, 83, 43, 47],
       [ 1, 91, 55, 44, 96, 42, 12,  2, 47, 39],
       [53, 52, 17, 96, 98, 94, 15, 69, 14, 25],
       [78, 64, 25, 97, 18,  5,  2,  6, 87, 46],
       [25, 59, 41, 54, 92, 91, 87, 35, 28, 98],
       [ 7, 75, 49, 52, 85, 14, 52, 19,  2, 48]])
```

In [210…
```
arr2[::-3]
```

Out[210…
```
array([[ 7, 75, 49, 52, 85, 14, 52, 19,  2, 48],
       [53, 52, 17, 96, 98, 94, 15, 69, 14, 25],
       [31, 29, 41, 59, 66, 23, 53, 39,  8, 21],
       [83, 44, 97, 86, 83,  1, 85, 83, 81, 92]])
```

In [212…
```
arr2
```

Out[212…
```
array([[83, 44, 97, 86, 83,  1, 85, 83, 81, 92],
       [29, 29, 23, 53, 87,  8, 18, 16, 83, 94],
       [83, 62, 46,  9, 37, 85, 27, 83, 31,  4],
       [31, 29, 41, 59, 66, 23, 53, 39,  8, 21],
       [77, 71, 37, 33, 24, 73, 30, 83, 43, 47],
       [ 1, 91, 55, 44, 96, 42, 12,  2, 47, 39],
       [53, 52, 17, 96, 98, 94, 15, 69, 14, 25],
       [78, 64, 25, 97, 18,  5,  2,  6, 87, 46],
       [25, 59, 41, 54, 92, 91, 87, 35, 28, 98],
       [ 7, 75, 49, 52, 85, 14, 52, 19,  2, 48]])
```

In [214…
```
arr2[:-3]
```

Out[214…
```
array([[83, 44, 97, 86, 83,  1, 85, 83, 81, 92],
       [29, 29, 23, 53, 87,  8, 18, 16, 83, 94],
       [83, 62, 46,  9, 37, 85, 27, 83, 31,  4],
       [31, 29, 41, 59, 66, 23, 53, 39,  8, 21],
       [77, 71, 37, 33, 24, 73, 30, 83, 43, 47],
       [ 1, 91, 55, 44, 96, 42, 12,  2, 47, 39],
       [53, 52, 17, 96, 98, 94, 15, 69, 14, 25]])
```

In [216…
```
arr2
```

Out[216…
```
array([[83, 44, 97, 86, 83,  1, 85, 83, 81, 92],
       [29, 29, 23, 53, 87,  8, 18, 16, 83, 94],
       [83, 62, 46,  9, 37, 85, 27, 83, 31,  4],
       [31, 29, 41, 59, 66, 23, 53, 39,  8, 21],
       [77, 71, 37, 33, 24, 73, 30, 83, 43, 47],
       [ 1, 91, 55, 44, 96, 42, 12,  2, 47, 39],
       [53, 52, 17, 96, 98, 94, 15, 69, 14, 25],
       [78, 64, 25, 97, 18,  5,  2,  6, 87, 46],
       [25, 59, 41, 54, 92, 91, 87, 35, 28, 98],
       [ 7, 75, 49, 52, 85, 14, 52, 19,  2, 48]])
```

In [218…
```
arr2[3:]
```

Out[218…
```
array([[31, 29, 41, 59, 66, 23, 53, 39,  8, 21],
       [77, 71, 37, 33, 24, 73, 30, 83, 43, 47],
       [ 1, 91, 55, 44, 96, 42, 12,  2, 47, 39],
       [53, 52, 17, 96, 98, 94, 15, 69, 14, 25],
       [78, 64, 25, 97, 18,  5,  2,  6, 87, 46],
       [25, 59, 41, 54, 92, 91, 87, 35, 28, 98],
       [ 7, 75, 49, 52, 85, 14, 52, 19,  2, 48]])
```

In [220…
```
arr
```

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

In [222…
```
arr.max()
```

Out[222…
```
5
```

In [224…
```
arr.min()
```

Out[224…
```
0
```

In [226…
```
arr
```

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

In [228…
```
arr.mean()
```

Out[228…
```
2.5
```

In [230…
```
arr
```

Out[230…
```
array([0, 1, 2, 3, 4, 5])
```

In [232…
```
arr.median()
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[232], line 1
----> 1 arr.median()

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

In [234…
```
from numpy import *
a=array([1,2,3,4,9])
median(a)
```

Out[234…
```
3.0
```

In [236…
```
arr
```

Out[236…
```
array([0, 1, 2, 3, 4, 5])
```

In [238…
```
arr.reshape(3,2)
```

Out[238…
```
array([[0, 1],
       [2, 3],
       [4, 5]])
```

In [240…
```
arr
```

Out[240…
```
array([0, 1, 2, 3, 4, 5])
```

In [242…
```
arr.reshape(2,3,order='C')
```

Out[242…
```
array([[0, 1, 2],
       [3, 4, 5]])
```

In [246…
```
arr.reshape(3,2,order='C')
```

Out[246…
```
array([[0, 1],
       [2, 3],
       [4, 5]])
```

In [248…
```
arr.reshape(2,3,order='F') # print element with fortran
#rows will become coulmns
```

Out[248…
```
array([[0, 2, 4],
       [1, 3, 5]])
```

In [250…
```
arr.reshape(2,3,order='A') # A almost give you c type output
```

Out[250…
```
array([[0, 1, 2],
       [3, 4, 5]])
```

Indexing

In [276…
```
mat = np.arange(0,100).reshape(10,10)
```

In [278…
```
mat
```

Out[278…
```
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 [280…
```
row=4
col=5
```

In [282…
```
col
```

Out[282… 5

In [284…
```
row
```

Out[284… 4

In [286…
```
mat
```

Out[286…
```
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[row,col]
```

Out[288… 45

In [290…
```
mat[4,5]
```

Out[290… 45

In [292…
```
mat
```

Out[292…
```
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 [294…
```
mat[6] #default it represent to rows
```

Out[294… array([60, 61, 62, 63, 64, 65, 66, 67, 68, 69])

In [296…
```
mat
```

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 [298…
```
mat[:,col] #with slices
```

Out[298…
```
array([ 5, 15, 25, 35, 45, 55, 65, 75, 85, 95])
```

In [300…
```
mat[:,5]
```

Out[300…
```
array([ 5, 15, 25, 35, 45, 55, 65, 75, 85, 95])
```

In [302…
```
mat
```

Out[302…
```
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 [304…
```
mat[row,:]
```

Out[304…
```
array([40, 41, 42, 43, 44, 45, 46, 47, 48, 49])
```

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

Out[309…
```
array([[22, 23],
       [32, 33],
       [42, 43],
       [52, 53]])
```

In [311…
```
mat
```

Out[311…
```
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 [313…
```
mat[1:2,2:4]
```

Out[313…
```
array([[12, 13]])
```

In [315…
```
mat
```

Out[315…
```
array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
       [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
       [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
       [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
       [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
       [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
       [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
       [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
       [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

In [317…
```
mat[2:3,2:3]
```

Out[317…
```
array([[22]])
```

Masking

In [320…
```
mat # we also called as filter
```

Out[320…
```
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 [322…
```
id(mat)
```

Out[322…
```
2675221110320
```

In [324…
```
mat
```

Out[324…
```
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 [326…
```
mat<50
```

Out[326…
```
array([[ 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,
         True],
       [False, False, False, False, False, False, False, False, False,
        False],
       [False, False, False, False, False, False, False, False, False,
        False],
       [False, False, False, False, False, False, False, False, False,
        False],
       [False, False, False, False, False, False, False, False, False,
        False],
       [False, False, False, False, False, False, False, False, False,
        False]])
```

In [328…
```
mat[mat<50]
```

Out[328…
```
array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14, 15, 16,
       17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33,
       34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49])
```

In [330…
```
mat[mat<=50]
```

Out[330…
```
array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14, 15, 16,
       17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33,
       34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50])
```

In [334…
```
mat[mat>=50]
```

Out[334…
```
array([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 [336…
```
mat[mat!=50]
```

Out[336…
```
array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14, 15, 16,
       17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33,
       34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 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 [338…
```
mat>50
```

Out[338…
```
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 [340…
```
mat[mat==50]
```

Out[340…
```
array([50])
```

In [342…
```
mat
```

Out[342…
```
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 [344…
```
mat ==50
```

Out[344…

```
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]])
```

PYTHON PROGRAM TO GENERATE OTP

In [367…

```python
import random

def generate_otp(length=4):
    """Generate a numeric OTP of a specified length."""
    digits = '0123456789'
    otp = ''.join(random.choice(digits) for _ in range(length))
    return otp

otp_length = 4
otp = generate_otp(otp_length)
print(f"Your OTP is: {otp}")
```

```
Your OTP is: 1114
```

In [ ]: