Numpy Introduction

In [1]:
```
import numpy as np
```

In [2]:
```
np.__version__
```

Out[2]:
```
'1.26.4'
```

Creating Arrays

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

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

In [4]:
```
type(my_list)
```

Out[4]:
```
list
```

In [5]:
```
arr = np.array(my_list)
```

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

Out[6]:
```
numpy.ndarray
```

In [7]:
```
type(my_list)
```

Out[7]:
```
list
```

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

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

In [9]:
```
np.arange(3.0)
```

Out[9]:
```
array([0., 1., 2.])
```

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

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

In [11]:
```
np.arange(0,5)
```

Out[11]:
```
array([0, 1, 2, 3, 4])
```

In [12]:
```
np.arange(10,20)
```

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

In [13]:
```
np.arange(20,10)
```

Out[13]:
```
array([], dtype=int32)
```

In [14]:
```
np.arange(-20,10)
```

Out[14]:
```
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 [15]:
```
np.arange(-30,20)
```

Out[15]:
```
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 [16]:
```
np.arange(10,30,5)  # 10- starting from 30- end point 5 - step count
```

Out[16]:
```
array([10, 15, 20, 25])
```

In [17]:
```
np.arange(0,10,3)
```

Out[17]:
```
array([0, 3, 6, 9])
```

In [18]:
```
np.zeros(5,dtype=int) #hyperparameter tunning
```

Out[18]:
```
array([0, 0, 0, 0, 0])
```

In [19]:
```
np.zeros(10,dtype=int) #hyperparameter tunning
```

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

In [20]:
```
zero = np.zeros((2,2))
zero
```

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

In [21]:
```
np.zeros((10,30))
```

Out[21]:
```
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 [22]:
```
np.ones(3)
```

Out[22]:
```
array([1., 1., 1.])
```

In [23]:
```
np.random.rand(5)
```

Out[23]:
```
array([0.48310714, 0.01290402, 0.65568633, 0.92699672, 0.69452634])
```

In [24]:
```
np.random.rand(6,4)
```

Out[24]:
```
array([[0.62133637, 0.025463  , 0.80918225, 0.53697643],
       [0.33090177, 0.58112081, 0.64826207, 0.03478519],
       [0.27044158, 0.06937698, 0.15290396, 0.16745038],
       [0.77029426, 0.50473699, 0.43780001, 0.00193142],
       [0.70397127, 0.3384177 , 0.54670851, 0.28368647],
       [0.08073081, 0.50189044, 0.66872672, 0.22310775]])
```

In [25]:
```
b = np.random.randint(10,20,(5,4))
b
```

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

Slicing In Matrix

In [27]:
```
b=np.random.randint(10,20,(5,4))
b
```

Out[27]:
```
array([[12, 11, 10, 11],
       [15, 12, 17, 18],
       [13, 11, 11, 10],
       [18, 17, 18, 15],
       [17, 17, 10, 14]])
```

In [28]:
```
type(b)
```

Out[28]:
```
numpy.ndarray
```

In [29]:
```
b[:]
```

Out[29]:
```
array([[12, 11, 10, 11],
       [15, 12, 17, 18],
       [13, 11, 11, 10],
       [18, 17, 18, 15],
       [17, 17, 10, 14]])
```

In [31]:
```
b[1:3]
```

Out[31]:
```
array([[15, 12, 17, 18],
       [13, 11, 11, 10]])
```

In [32]:
```
b[1,2]
```

Out[32]:
```
17
```

In [33]:
```
b
```

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

In [34]:
```
b[1,3]
```

Out[34]:
```
18
```

In [35]:
```
b[1,-1]
```

Out[35]:
```
18
```

In [36]:
```
b
```

Out[36]:
```
array([[12, 11, 10, 11],
       [15, 12, 17, 18],
       [13, 11, 11, 10],
       [18, 17, 18, 15],
       [17, 17, 10, 14]])
```

In [37]:
```
b[2:3]
```

Out[37]:
```
array([[13, 11, 11, 10]])
```

In [38]:
```
b
```

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

In [39]:
```
b[0:-2]
```

Out[39]:
```
array([[12, 11, 10, 11],
       [15, 12, 17, 18],
       [13, 11, 11, 10]])
```

In [40]:
```
b
```

Out[40]:
```
array([[12, 11, 10, 11],
       [15, 12, 17, 18],
       [13, 11, 11, 10],
       [18, 17, 18, 15],
       [17, 17, 10, 14]])
```

In [41]:
```
b[0,2]
```

Out[41]:
```
10
```

In [43]:
```
b[-5,-3]
```

Out[43]:
```
11
```

In [44]:
```
b
```

Out[44]:
```
array([[12, 11, 10, 11],
       [15, 12, 17, 18],
       [13, 11, 11, 10],
       [18, 17, 18, 15],
       [17, 17, 10, 14]])
```

In [45]:
```
b[-4,2]
```

Out[45]:
```
17
```

Operation In Numpy

In [46]:
```
a=np.random.randint(10,20,30)
a
```

Out[46]:
```
array([19, 15, 19, 17, 13, 12, 18, 10, 18, 14, 10, 12, 14, 19, 16, 19, 17,
       16, 11, 17, 19, 14, 14, 13, 12, 17, 18, 15, 10, 10])
```

In [47]:
```
id(a)
```

Out[47]:
```
1605595654320
```

In [49]:
```
__name__
```

Out[49]:
```
'__main__'
```

In [50]:
```
a
```

Out[50]:
```
array([19, 15, 19, 17, 13, 12, 18, 10, 18, 14, 10, 12, 14, 19, 16, 19, 17,
       16, 11, 17, 19, 14, 14, 13, 12, 17, 18, 15, 10, 10])
```

In [51]:
```
arr
```

Out[51]:
```
array([0, 1, 2, 3, 4, 5])
```

In [53]:
```
arr2=np.random.randint(0,100,(10,10))
arr2
```

Out[53]:
```
array([[49, 85, 74, 36, 97, 49, 88, 63, 39, 94],
       [85, 61, 11,  2, 55, 78, 49, 53, 70, 98],
       [85,  3,  2, 34, 91, 63, 62, 75, 75, 41],
       [79, 17, 48, 60, 84, 19, 38, 13, 26, 83],
       [70, 52, 59, 12, 22, 64, 59, 46, 26, 62],
       [27, 52, 96, 18, 56, 56,  0, 43, 29, 22],
       [57, 79, 67, 37, 68, 53, 57, 11, 72, 36],
       [93, 69, 44, 43, 37, 37, 48, 55, 42, 55],
       [57, 77, 27, 19, 64,  8, 38, 81, 78, 57],
       [ 3, 77, 98, 80, 12, 91, 17, 18,  3, 44]])
```

In [54]:
```
arr[:]
```

Out[54]:
```
array([0, 1, 2, 3, 4, 5])
```

In [55]:
```
arr[:4]
```

Out[55]:
```
array([0, 1, 2, 3])
```

In [56]:
```
arr2[:]
```

Out[56]:
```
array([[49, 85, 74, 36, 97, 49, 88, 63, 39, 94],
       [85, 61, 11,  2, 55, 78, 49, 53, 70, 98],
       [85,  3,  2, 34, 91, 63, 62, 75, 75, 41],
       [79, 17, 48, 60, 84, 19, 38, 13, 26, 83],
       [70, 52, 59, 12, 22, 64, 59, 46, 26, 62],
       [27, 52, 96, 18, 56, 56,  0, 43, 29, 22],
       [57, 79, 67, 37, 68, 53, 57, 11, 72, 36],
       [93, 69, 44, 43, 37, 37, 48, 55, 42, 55],
       [57, 77, 27, 19, 64,  8, 38, 81, 78, 57],
       [ 3, 77, 98, 80, 12, 91, 17, 18,  3, 44]])
```

In [57]:
```
arr2[0:5]
```

Out[57]:
```
array([[49, 85, 74, 36, 97, 49, 88, 63, 39, 94],
       [85, 61, 11,  2, 55, 78, 49, 53, 70, 98],
       [85,  3,  2, 34, 91, 63, 62, 75, 75, 41],
       [79, 17, 48, 60, 84, 19, 38, 13, 26, 83],
       [70, 52, 59, 12, 22, 64, 59, 46, 26, 62]])
```

In [58]:
```
arr2[1,4]
```

Out[58]:
```
55
```

In [59]:
```
arr2
```

Out[59]:
```
array([[49, 85, 74, 36, 97, 49, 88, 63, 39, 94],
       [85, 61, 11,  2, 55, 78, 49, 53, 70, 98],
       [85,  3,  2, 34, 91, 63, 62, 75, 75, 41],
       [79, 17, 48, 60, 84, 19, 38, 13, 26, 83],
       [70, 52, 59, 12, 22, 64, 59, 46, 26, 62],
       [27, 52, 96, 18, 56, 56,  0, 43, 29, 22],
       [57, 79, 67, 37, 68, 53, 57, 11, 72, 36],
       [93, 69, 44, 43, 37, 37, 48, 55, 42, 55],
       [57, 77, 27, 19, 64,  8, 38, 81, 78, 57],
       [ 3, 77, 98, 80, 12, 91, 17, 18,  3, 44]])
```

In [60]:
```
arr2[::-1]
```

Out[60]:
```
array([[ 3, 77, 98, 80, 12, 91, 17, 18,  3, 44],
       [57, 77, 27, 19, 64,  8, 38, 81, 78, 57],
       [93, 69, 44, 43, 37, 37, 48, 55, 42, 55],
       [57, 79, 67, 37, 68, 53, 57, 11, 72, 36],
       [27, 52, 96, 18, 56, 56,  0, 43, 29, 22],
       [70, 52, 59, 12, 22, 64, 59, 46, 26, 62],
       [79, 17, 48, 60, 84, 19, 38, 13, 26, 83],
       [85,  3,  2, 34, 91, 63, 62, 75, 75, 41],
       [85, 61, 11,  2, 55, 78, 49, 53, 70, 98],
       [49, 85, 74, 36, 97, 49, 88, 63, 39, 94]])
```

In [61]:
```
arr2[::-2]
```

Out[61]:
```
array([[ 3, 77, 98, 80, 12, 91, 17, 18,  3, 44],
       [93, 69, 44, 43, 37, 37, 48, 55, 42, 55],
       [27, 52, 96, 18, 56, 56,  0, 43, 29, 22],
       [79, 17, 48, 60, 84, 19, 38, 13, 26, 83],
       [85, 61, 11,  2, 55, 78, 49, 53, 70, 98]])
```

In [62]:
```
arr2[::-3]
```

Out[62]:
```
array([[ 3, 77, 98, 80, 12, 91, 17, 18,  3, 44],
       [57, 79, 67, 37, 68, 53, 57, 11, 72, 36],
       [79, 17, 48, 60, 84, 19, 38, 13, 26, 83],
       [49, 85, 74, 36, 97, 49, 88, 63, 39, 94]])
```

In [63]:
```
arr2
```

Out[63]:
```
array([[49, 85, 74, 36, 97, 49, 88, 63, 39, 94],
       [85, 61, 11,  2, 55, 78, 49, 53, 70, 98],
       [85,  3,  2, 34, 91, 63, 62, 75, 75, 41],
       [79, 17, 48, 60, 84, 19, 38, 13, 26, 83],
       [70, 52, 59, 12, 22, 64, 59, 46, 26, 62],
       [27, 52, 96, 18, 56, 56,  0, 43, 29, 22],
       [57, 79, 67, 37, 68, 53, 57, 11, 72, 36],
       [93, 69, 44, 43, 37, 37, 48, 55, 42, 55],
       [57, 77, 27, 19, 64,  8, 38, 81, 78, 57],
       [ 3, 77, 98, 80, 12, 91, 17, 18,  3, 44]])
```

In [64]:
```
arr2[:-3]
```

Out[64]:
```
array([[49, 85, 74, 36, 97, 49, 88, 63, 39, 94],
       [85, 61, 11,  2, 55, 78, 49, 53, 70, 98],
       [85,  3,  2, 34, 91, 63, 62, 75, 75, 41],
       [79, 17, 48, 60, 84, 19, 38, 13, 26, 83],
       [70, 52, 59, 12, 22, 64, 59, 46, 26, 62],
       [27, 52, 96, 18, 56, 56,  0, 43, 29, 22],
       [57, 79, 67, 37, 68, 53, 57, 11, 72, 36]])
```

In [65]:
```
arr2
```

Out[65]:
```
array([[49, 85, 74, 36, 97, 49, 88, 63, 39, 94],
       [85, 61, 11,  2, 55, 78, 49, 53, 70, 98],
       [85,  3,  2, 34, 91, 63, 62, 75, 75, 41],
       [79, 17, 48, 60, 84, 19, 38, 13, 26, 83],
       [70, 52, 59, 12, 22, 64, 59, 46, 26, 62],
       [27, 52, 96, 18, 56, 56,  0, 43, 29, 22],
       [57, 79, 67, 37, 68, 53, 57, 11, 72, 36],
       [93, 69, 44, 43, 37, 37, 48, 55, 42, 55],
       [57, 77, 27, 19, 64,  8, 38, 81, 78, 57],
       [ 3, 77, 98, 80, 12, 91, 17, 18,  3, 44]])
```

In [66]:
```
arr2[1:]
```

Out[66]:
```
array([[85, 61, 11,  2, 55, 78, 49, 53, 70, 98],
       [85,  3,  2, 34, 91, 63, 62, 75, 75, 41],
       [79, 17, 48, 60, 84, 19, 38, 13, 26, 83],
       [70, 52, 59, 12, 22, 64, 59, 46, 26, 62],
       [27, 52, 96, 18, 56, 56,  0, 43, 29, 22],
       [57, 79, 67, 37, 68, 53, 57, 11, 72, 36],
       [93, 69, 44, 43, 37, 37, 48, 55, 42, 55],
       [57, 77, 27, 19, 64,  8, 38, 81, 78, 57],
       [ 3, 77, 98, 80, 12, 91, 17, 18,  3, 44]])
```

In [67]:
```
arr2[2:]
```

Out[67]:
```
array([[85,  3,  2, 34, 91, 63, 62, 75, 75, 41],
       [79, 17, 48, 60, 84, 19, 38, 13, 26, 83],
       [70, 52, 59, 12, 22, 64, 59, 46, 26, 62],
       [27, 52, 96, 18, 56, 56,  0, 43, 29, 22],
       [57, 79, 67, 37, 68, 53, 57, 11, 72, 36],
       [93, 69, 44, 43, 37, 37, 48, 55, 42, 55],
       [57, 77, 27, 19, 64,  8, 38, 81, 78, 57],
       [ 3, 77, 98, 80, 12, 91, 17, 18,  3, 44]])
```

In [68]:
```
arr2[0:10:3]
```

Out[68]:
```
array([[49, 85, 74, 36, 97, 49, 88, 63, 39, 94],
       [79, 17, 48, 60, 84, 19, 38, 13, 26, 83],
       [57, 79, 67, 37, 68, 53, 57, 11, 72, 36],
       [ 3, 77, 98, 80, 12, 91, 17, 18,  3, 44]])
```

In [69]:
```
arr2
```

Out[69]:
```
array([[49, 85, 74, 36, 97, 49, 88, 63, 39, 94],
       [85, 61, 11,  2, 55, 78, 49, 53, 70, 98],
       [85,  3,  2, 34, 91, 63, 62, 75, 75, 41],
       [79, 17, 48, 60, 84, 19, 38, 13, 26, 83],
       [70, 52, 59, 12, 22, 64, 59, 46, 26, 62],
       [27, 52, 96, 18, 56, 56,  0, 43, 29, 22],
       [57, 79, 67, 37, 68, 53, 57, 11, 72, 36],
       [93, 69, 44, 43, 37, 37, 48, 55, 42, 55],
       [57, 77, 27, 19, 64,  8, 38, 81, 78, 57],
       [ 3, 77, 98, 80, 12, 91, 17, 18,  3, 44]])
```

In [70]:
```
arr
```

Out[70]:
```
array([0, 1, 2, 3, 4, 5])
```

In [71]:
```
arr.max()
```

Out[71]:
```
5
```

In [72]:
```
arr.min()
```

Out[72]:
```
0
```

In [73]:
```
arr.mean()
```

Out[73]:
```
2.5
```

In [78]:
```
from numpy import*
a=array([1, 2, 3, 4, 9])
median(a)
```

Out[78]:
```
3.0
```

Filter In Numpy

In [79]:
```
arr
```

Out[79]:
```
array([0, 1, 2, 3, 4, 5])
```

In [81]:
```
arr.reshape(3,2)
```

Out[81]:
```
array([[0, 1],
       [2, 3],
       [4, 5]])
```

In [82]:
```
arr.reshape(6,1)
```

Out[82]:
```
array([[0],
       [1],
       [2],
       [3],
       [4],
       [5]])
```

In [83]:
```
arr.reshape(1,6)
```

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

In [84]:
```
arr.reshape(2,4)
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[84], line 1
----> 1 arr.reshape(2,4)

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

In [85]:
```
arr.reshape(3,2,order='C')
```

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

In [86]:
```
arr.reshape(2,3,order='C')
```

Out[86]:
```
array([[0, 1, 2],
       [3, 4, 5]])
```

In [87]:
```
arr.reshape(2,3,order='F')
```

Out[87]:
```
array([[0, 2, 4],
       [1, 3, 5]])
```

In [88]:
```
arr.reshape(2,3,order='A')
```

Out[88]:
```
array([[0, 1, 2],
       [3, 4, 5]])
```

Indexing

In [90]:
```
mat=np.arange(0,100).reshape(10,10)
```

In [91]:
```
mat
```

Out[91]:
```
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 [92]:
```
row=4
col=5
```

In [93]:
```
row
```

Out[93]:
```
4
```

In [94]:
```
col
```

Out[94]:
```
5
```

In [95]:
```
mat
```

Out[95]:
```
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 [96]:
```
mat[row,col]
```

Out[96]:
```
45
```

In [97]:
```
col=6
```

In [98]:
```
mat[6]
```

Out[98]:
```
array([60, 61, 62, 63, 64, 65, 66, 67, 68, 69])
```

In [99]:
```
mat[:,col]
```

Out[99]:
```
array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])
```

In [100…
```
mat
```

Out[100…
```
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 [101…
```
mat[:,5]
```

Out[101…
```
array([ 5, 15, 25, 35, 45, 55, 65, 75, 85, 95])
```

In [102…
```
mat[:,-1]
```

Out[102…
```
array([ 9, 19, 29, 39, 49, 59, 69, 79, 89, 99])
```

In [103…
```
mat
```

Out[103…
```
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 [104…
```
mat[2:6,2:4]
```

Out[104…
```
array([[22, 23],
       [32, 33],
       [42, 43],
       [52, 53]])
```

In [105…
```
mat
```

Out[105…
```
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 [106…
```
mat[1:2,2:4]
```

Out[106…
```
array([[12, 13]])
```

In [107…
```
mat[2:4,3:5]
```

Out[107…
```
array([[23, 24],
       [33, 34]])
```

In [109…
```
# Masking
```

In [110…
```
mat
```

Out[110…
```
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 [111…
```
id(mat)
```

Out[111…
```
1605597563184
```

In [112…
```
mat
```

Out[112…
```
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 [113…
```
mat[mat>50]
```

Out[113…
```
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 [114…
```
mat>50
```

Out[114…
```
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 [115…
```
mat>=50
```

Out[115…
```
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,  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 [116…
```
mat[mat>=50]
```

Out[116…
```
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 [117…
```
mat[mat<50]
```

Out[117…
```
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 [118…
```
mat[mat==50]
```

Out[118…
```
array([50])
```

In [120…
```
mat[mat!=50]
```

Out[120…
```
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 [121…
```
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: 4151
```

In [ ]:

In [ ]: