NUMPY

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

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

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

In [3]:
```
#CREATING NUMPY ARRAY
```

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

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

In [5]:
```
type(my_list)
```

Out[5]:
```
list
```

In [6]:
```
arr = np.array(my_list)
```

In [7]:
```
arr
```

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

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

Out[8]:
```
numpy.ndarray
```

In [9]:
```
#nd means: n dimension
```

In [12]:
```
#ARANGE
```

In [11]:
```
np.arange(15)
```

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

In [13]:
```
np.arange(0,10)
```

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

In [15]:
```
np.arange(0,20,4) #Start,Stop,Step (End element will be n-1)
```

Out[15]:
```
array([ 0,  4,  8, 12, 16])
```

In [16]:
```
np.arange(30,20)
```

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

In [17]:
```
np.zeros(5)
```

Out[17]:
```
array([0., 0., 0., 0., 0.])
```

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

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

In [19]:
```
np.zeros((2,10,5), dtype = int)
```

Out[19]:
```
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]]])
```

In [20]:
```
a = (5,10)
b= (2,5)
print(np.zeros(a))
```

```
[[0. 0. 0. 0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 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 [21]:
```
print(np.zeros(b))
```

```
[[0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0.]]
```

In [22]:
```
np.ones(4, dtype=int)
```

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

In [23]:
```
np.ones(a)
```

Out[23]:
```
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.]])
```

In [24]:
```
np.twos((2,3))
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[24], 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 [25]:
```
#RANGE
```

In [26]:
```
r = range(5)
r
```

Out[26]:
```
range(0, 5)
```

In [27]:
```
for i in r:
    print(i)
```

```
0
1
2
3
4
```

In [28]:
```
list(range(0,10))
```

Out[28]:
```
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
```

In [29]:
```
np.arange(12)
```

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

In [30]:
```
 # “arange” is NumPy function whereas “range” is python function
```

In [31]:
```
#RAND
```

In [32]:
```
rand(3,2)
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
Cell In[32], line 1
----> 1 rand(3,2)

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

In [33]:
```
random.rand(3,2)
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
Cell In[33], line 1
----> 1 random.rand(3,2)

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

In [34]:
```
# np--package, random--module, rand--function
```

In [35]:
```
np.random.rand(4,6)
```

Out[35]:
```
array([[0.94829508, 0.33367999, 0.4404546 , 0.36261342, 0.18233346,
        0.50415811],
       [0.64089538, 0.06550836, 0.93243725, 0.74268458, 0.63826321,
        0.23050685],
       [0.72388159, 0.40652825, 0.64545719, 0.81867367, 0.46341651,
        0.50073544],
       [0.07994158, 0.86741467, 0.66727014, 0.80262646, 0.40843476,
        0.4544627 ]])
```

In [36]:
```
np.random.randint(3,6)
```

Out[36]:
```
5
```

In [37]:
```
np.random.rand(2,4)
```

Out[37]:
```
array([[0.97419655, 0.11986032, 0.93159869, 0.26987074],
       [0.40161361, 0.06965923, 0.96678266, 0.33501445]])
```

In [38]:
```
np.random.randint(2,4)
```

Out[38]:
```
2
```

In [41]:
```
np.random.randint(10,20,3)
```

Out[41]:
```
array([10, 10, 12])
```

In [42]:
```
a = np.random.randint(10,40,(5,3,8))
a
```

Out[42]:
```
array([[[22, 10, 26, 16, 30, 26, 36, 19],
        [12, 29, 14, 30, 35, 29, 23, 32],
        [25, 32, 26, 37, 16, 36, 11, 21]],

       [[26, 24, 23, 12, 26, 14, 25, 38],
        [24, 29, 10, 21, 24, 19, 25, 25],
        [25, 18, 13, 32, 35, 21, 33, 26]],

       [[30, 34, 28, 38, 27, 25, 26, 39],
        [11, 19, 35, 22, 21, 37, 36, 29],
        [20, 33, 17, 37, 14, 27, 38, 23]],

       [[39, 26, 24, 21, 30, 20, 15, 20],
        [18, 25, 14, 12, 23, 19, 36, 16],
        [31, 32, 20, 10, 14, 13, 23, 12]],

       [[38, 15, 24, 24, 32, 24, 11, 36],
        [32, 31, 14, 14, 23, 12, 11, 22],
        [37, 12, 25, 18, 32, 30, 28, 24]]])
```

In [44]:
```
b = np.random.randint(0,10,(15,11))
b
```

Out[44]:
```
array([[4, 4, 5, 2, 6, 2, 4, 6, 9, 2, 0],
       [7, 2, 2, 5, 5, 9, 4, 4, 2, 9, 3],
       [6, 3, 4, 1, 5, 7, 5, 2, 0, 7, 9],
       [5, 0, 3, 2, 5, 6, 1, 0, 8, 2, 4],
       [2, 9, 0, 8, 8, 3, 8, 8, 7, 0, 1],
       [3, 9, 3, 7, 7, 8, 9, 6, 6, 5, 6],
       [5, 9, 4, 7, 6, 6, 4, 0, 2, 0, 7],
       [9, 7, 3, 2, 0, 5, 5, 1, 3, 6, 1],
       [5, 2, 9, 2, 9, 7, 8, 2, 8, 9, 6],
       [5, 5, 0, 9, 7, 9, 7, 9, 1, 3, 0],
       [6, 3, 7, 1, 1, 8, 5, 0, 7, 1, 4],
       [2, 8, 8, 5, 0, 1, 8, 0, 8, 7, 7],
       [7, 8, 3, 5, 5, 0, 6, 5, 9, 0, 7],
       [1, 4, 5, 2, 8, 8, 5, 7, 6, 5, 4],
       [0, 0, 3, 7, 5, 4, 3, 6, 0, 4, 2]])
```

In [45]:
```
b[1:5]
```

Out[45]:
```
array([[7, 2, 2, 5, 5, 9, 4, 4, 2, 9, 3],
       [6, 3, 4, 1, 5, 7, 5, 2, 0, 7, 9],
       [5, 0, 3, 2, 5, 6, 1, 0, 8, 2, 4],
       [2, 9, 0, 8, 8, 3, 8, 8, 7, 0, 1]])
```

In [46]:
```
b[1,5]
```

Out[46]:
```
9
```

In [47]:
```
b[-1]
```

Out[47]:
```
array([0, 0, 3, 7, 5, 4, 3, 6, 0, 4, 2])
```

In [48]:
```
b[-1,-4]
```

Out[48]:
```
6
```

In [49]:
```
b[::-1]
```

Out[49]:
```
array([[0, 0, 3, 7, 5, 4, 3, 6, 0, 4, 2],
       [1, 4, 5, 2, 8, 8, 5, 7, 6, 5, 4],
       [7, 8, 3, 5, 5, 0, 6, 5, 9, 0, 7],
       [2, 8, 8, 5, 0, 1, 8, 0, 8, 7, 7],
       [6, 3, 7, 1, 1, 8, 5, 0, 7, 1, 4],
       [5, 5, 0, 9, 7, 9, 7, 9, 1, 3, 0],
       [5, 2, 9, 2, 9, 7, 8, 2, 8, 9, 6],
       [9, 7, 3, 2, 0, 5, 5, 1, 3, 6, 1],
       [5, 9, 4, 7, 6, 6, 4, 0, 2, 0, 7],
       [3, 9, 3, 7, 7, 8, 9, 6, 6, 5, 6],
       [2, 9, 0, 8, 8, 3, 8, 8, 7, 0, 1],
       [5, 0, 3, 2, 5, 6, 1, 0, 8, 2, 4],
       [6, 3, 4, 1, 5, 7, 5, 2, 0, 7, 9],
       [7, 2, 2, 5, 5, 9, 4, 4, 2, 9, 3],
       [4, 4, 5, 2, 6, 2, 4, 6, 9, 2, 0]])
```

In [51]:
```
b
```

Out[51]:
```
array([[4, 4, 5, 2, 6, 2, 4, 6, 9, 2, 0],
       [7, 2, 2, 5, 5, 9, 4, 4, 2, 9, 3],
       [6, 3, 4, 1, 5, 7, 5, 2, 0, 7, 9],
       [5, 0, 3, 2, 5, 6, 1, 0, 8, 2, 4],
       [2, 9, 0, 8, 8, 3, 8, 8, 7, 0, 1],
       [3, 9, 3, 7, 7, 8, 9, 6, 6, 5, 6],
       [5, 9, 4, 7, 6, 6, 4, 0, 2, 0, 7],
       [9, 7, 3, 2, 0, 5, 5, 1, 3, 6, 1],
       [5, 2, 9, 2, 9, 7, 8, 2, 8, 9, 6],
       [5, 5, 0, 9, 7, 9, 7, 9, 1, 3, 0],
       [6, 3, 7, 1, 1, 8, 5, 0, 7, 1, 4],
       [2, 8, 8, 5, 0, 1, 8, 0, 8, 7, 7],
       [7, 8, 3, 5, 5, 0, 6, 5, 9, 0, 7],
       [1, 4, 5, 2, 8, 8, 5, 7, 6, 5, 4],
       [0, 0, 3, 7, 5, 4, 3, 6, 0, 4, 2]])
```

In [50]:
```
b[::-2]
```

Out[50]:
```
array([[0, 0, 3, 7, 5, 4, 3, 6, 0, 4, 2],
       [7, 8, 3, 5, 5, 0, 6, 5, 9, 0, 7],
       [6, 3, 7, 1, 1, 8, 5, 0, 7, 1, 4],
       [5, 2, 9, 2, 9, 7, 8, 2, 8, 9, 6],
       [5, 9, 4, 7, 6, 6, 4, 0, 2, 0, 7],
       [2, 9, 0, 8, 8, 3, 8, 8, 7, 0, 1],
       [6, 3, 4, 1, 5, 7, 5, 2, 0, 7, 9],
       [4, 4, 5, 2, 6, 2, 4, 6, 9, 2, 0]])
```

In [52]:
```
b.max()
```

Out[52]: 9

In [53]:
```
b.min()
```

Out[53]: 0

In [54]:
```
b.mean()
```

Out[54]: 4.6

In [55]:
```
from numpy import *
a = array([1,2,3,4,5,6,7,8,9])
median(a)
```

Out[55]: 5.0

In [56]:
```
arr
```

Out[56]:
```
array([0, 1, 2, 3, 4, 5])
```

In [57]:
```
#RESHAPE
```

In [58]:
```
arr
```

Out[58]:
```
array([0, 1, 2, 3, 4, 5])
```

In [59]:
```
arr.reshape(2,3)
```

Out[59]:
```
array([[0, 1, 2],
       [3, 4, 5]])
```

In [60]:
```
arr.reshape(6,1)
```

Out[60]:
```
array([[0],
       [1],
       [2],
       [3],
       [4],
       [5]])
```

In [64]:
```
arr.reshape(3,2,order='F') #F-Fortran order
```

Out[64]:
```
array([[0, 3],
       [1, 4],
       [2, 5]])
```

In [65]:
```
arr.reshape(3,2,order='C') #C-Contiguous order
```

Out[65]:
```
array([[0, 1],
       [2, 3],
       [4, 5]])
```

In [66]:
```
arr.reshape(3,2,order='A') #A-Any order
```

Out[66]:
```
array([[0, 1],
       [2, 3],
       [4, 5]])
```

In [67]:
```
#INDEXING
```

In [68]:
```
mat = np.arange(0,100).reshape(10,10)
mat
```

Out[68]:
```
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 [69]:
```
mat[:6]
```

Out[69]:
```
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 [70]:
```
mat[6:]
```

Out[70]:
```
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 [71]:
```
mat[3:-3]
```

Out[71]:
```
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 [72]:
```
mat[5,9]
```

Out[72]:
```
59
```

In [73]:
```
mat[5]
```

Out[73]:
```
array([50, 51, 52, 53, 54, 55, 56, 57, 58, 59])
```

In [74]:
```
row = 2
col = 5
```

In [75]:
```
mat[row,col]
```

Out[75]:
```
25
```

In [78]:
```
 mat[:,9] #matrix [:, column ] -> column
```

Out[78]:
```
array([ 9, 19, 29, 39, 49, 59, 69, 79, 89, 99])
```

In [79]:
```
mat[:,9].reshape(10,1) #9th column, 10 no.s in a single(1) colum
```

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

In [80]:
```
mat[row,:] #matrix [row, :] -> row
```

Out[80]:
```
array([20, 21, 22, 23, 24, 25, 26, 27, 28, 29])
```

In [81]:
```
mat[:, col]
```

Out[81]:
```
array([ 5, 15, 25, 35, 45, 55, 65, 75, 85, 95])
```

In [82]:
```
mat[-1]
```

Out[82]:
```
array([90, 91, 92, 93, 94, 95, 96, 97, 98, 99])
```

In [83]:
```
mat[0:10]
```

Out[83]:
```
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 [84]:
```
mat[0:10:3] #Start-0,Stop-10,Step-3
```

Out[84]:
```
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 [85]:
```
mat[2:6,2:4]
```

Out[85]:
```
array([[22, 23],
       [32, 33],
       [42, 43],
       [52, 53]])
```

In [86]:
```
mat[2:3,2:3]
```

Out[86]:
```
array([[22]])
```

In [87]:
```
#MASKING
```

In [88]:
```
mat
```

Out[88]:
```
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 [89]:
```
id(mat)
```

Out[89]:
```
2633738790608
```

In [90]:
```
mat<50
```

Out[90]:
```
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 [94]:
```
mat>50
```

Out[94]:
```
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 [99]:
```
mat==50
```

Out[99]:
```
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 [91]:
```
mat[mat<50]
```

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])
```

In [92]:
```
mat[mat==50]
```

Out[92]:
```
array([50])
```

In [93]:
```
mat[mat>50]
```

Out[93]:
```
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 [95]:
```
mat[mat<=50]
```

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])
```

In [96]:
```
mat[mat!=50]
```

Out[96]:
```
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 [100…
```
a = mat[mat<20]
b = mat[mat>80]
c = np.concatenate((a, b))
print(c)
```

```
[ 0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 81 82 83 84
 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99]
```

In [101…
```
a1 = mat[mat==50]
a1
```

Out[101…
```
array([50])
```

In [102…
```
a2 = mat[mat<=50]
a2
```

Out[102…
```
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 [103…
```
a3 = mat[mat>=50]
a3
```

Out[103…
```
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 [106…
```
a4 = mat[mat<50]
a4
```

Out[106…
```
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 [107…
```
a5 = mat[mat>50]
a5
```

Out[107…
```
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 [108…
```
a6 = mat[mat!=50]
a6
```

Out[108…
```
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 [ ]:
```

```