Numpy Crash Course

1.Numpy is a library which handles MDA array(multidimensional array)

2.numpy holds maths+statistic+linearalgebra+datastructures

3.when we work with nuber,images,text,speech-->every data should converted to array before we

import numpy as np

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

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

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

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

```
Out[3]: '3.12.7 | packaged by Anaconda, Inc. | (main, Oct  4 2024, 13:17:27) [MSC v.1929 64
        bit (AMD64)]'
```

Creating Arrays

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

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

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

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

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

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

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

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

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

```python
In [9]: type(my_list)
```

```
Out[9]: list
```

```python
In [10]: np. # we learn important function
```

```
  Cell In[10], line 1
    np. # we learn important function
       ^
SyntaxError: invalid syntax
```

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

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

```python
In [12]: np.random.randint(5,9)
```

```
Out[12]: 5
```

```python
In [13]: np.random.randint(20,30,10)
```

```
Out[13]: array([23, 24, 29, 21, 27, 25, 24, 20, 25, 25])
```

```python
In [14]: np.random.randint(10,40,(10,10))
```

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

```python
In [15]: np.arange(1,13).reshape(3,4)
```

```
Out[15]: array([[ 1,  2,  3,  4],
               [ 5,  6,  7,  8],
               [ 9, 10, 11, 12]])
```

```python
In [16]: np.arange(1,13).reshape(5,4)
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[16], line 1
----> 1 np.arange(1,13).reshape(5,4)

ValueError: cannot reshape array of size 12 into shape (5,4)
```

```python
In [17]: np.arange(1,13).reshape(12,1)
```

```
Out[17]:  array([[ 1],
                  [ 2],
                  [ 3],
                  [ 4],
                  [ 5],
                  [ 6],
                  [ 7],
                  [ 8],
                  [ 9],
                  [10],
                  [11],
                  [12]])
```

```
In [18]:  np.arange(1,13).reshape(6,2)
```

```
Out[18]:  array([[ 1,  2],
                  [ 3,  4],
                  [ 5,  6],
                  [ 7,  8],
                  [ 9, 10],
                  [11, 12]])
```

```
In [19]:  np.arange(1,13).reshape(12,1)
```

```
Out[19]:  array([[ 1],
                  [ 2],
                  [ 3],
                  [ 4],
                  [ 5],
                  [ 6],
                  [ 7],
                  [ 8],
                  [ 9],
                  [10],
                  [11],
                  [12]])
```

```
In [20]:  np.arange(1,13).reshape(1,12)
```

```
Out[20]:  array([[ 1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12]])
```

Slicing in Matrix

```
In [21]:  b=np.random.randint(10,20,(5,4))
```

```
In [22]:  b
```

```
Out[22]:  array([[11, 14, 16, 17],
                  [10, 11, 14, 10],
                  [14, 16, 17, 16],
                  [14, 12, 12, 12],
                  [14, 10, 18, 12]])
```

```
In [23]: type(b)
```

```
Out[23]: numpy.ndarray
```

```
In [24]: b[:]
```

```
Out[24]: array([[11, 14, 16, 17],
                [10, 11, 14, 10],
                [14, 16, 17, 16],
                [14, 12, 12, 12],
                [14, 10, 18, 12]])
```

```
In [25]: b
```

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

```
In [26]: b[1:3]
```

```
Out[26]: array([[10, 11, 14, 10],
                [14, 16, 17, 16]])
```

```
In [27]: b[1:2]
```

```
Out[27]: array([[10, 11, 14, 10]])
```

```
In [28]: b
```

```
Out[28]: array([[11, 14, 16, 17],
                [10, 11, 14, 10],
                [14, 16, 17, 16],
                [14, 12, 12, 12],
                [14, 10, 18, 12]])
```

```
In [29]: b[1,2]
```

```
Out[29]: 14
```

```
In [30]: b[1,3]
```

```
Out[30]: 10
```

```
In [31]: b
```

```
Out[31]: array([[11, 14, 16, 17],
                [10, 11, 14, 10],
                [14, 16, 17, 16],
                [14, 12, 12, 12],
                [14, 10, 18, 12]])
```

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

```
Out[32]:  10
```

```
In [33]:  b[2:3]
```

```
Out[33]:  array([[14, 16, 17, 16]])
```

```
In [34]:  b[0:-2]
```

```
Out[34]:  array([[11, 14, 16, 17],
                 [10, 11, 14, 10],
                 [14, 16, 17, 16]])
```

```
In [35]:  b[0,2]
```

```
Out[35]:  16
```

```
In [36]:  b[-5,-3]
```

```
Out[36]:  14
```

```
In [37]:  b[-4,2]
```

```
Out[37]:  14
```

Operations

```
In [42]:  a = np.random.randint(10,20,10)
          a
```

```
Out[42]:  array([18, 16, 15, 15, 13, 16, 12, 12, 17, 10])
```

```
In [43]:  id(a)
```

```
Out[43]:  3218964380144
```

arrmy_list=[0,1,2,3,4,5]arr=np.array(my_list)

```
In [44]:  arr
```

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

```
In [47]:  arr2 = np.random.randint(0,100,(10,10))
```

```
In [48]:  arr2
```

```
Out[48]: array([[90, 95, 68, 32, 57, 16, 17, 78, 43, 62],
                [45, 23, 74, 60, 58, 86, 76,  2, 11, 53],
                [79, 35, 20, 85, 29,  7, 33,  6,  3, 29],
                [74, 86, 93, 74, 99, 24, 53,  4, 19,  9],
                [73, 87, 53, 30, 65, 29, 34, 97,  1, 25],
                [ 3, 36, 45, 54, 30, 58, 20, 55, 74,  6],
                [51, 53, 41, 31, 21, 60, 58, 40, 35, 72],
                [82, 19, 40, 19, 68, 84, 37, 31, 75, 23],
                [69, 58, 93, 68, 85,  7,  7, 54, 21, 52],
                [59, 81, 88, 55, 14, 15, 50, 85, 20, 35]])
```

In [49]: `arr`

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

In [50]: `arr[:4]`

```
Out[50]: array([0, 1, 2, 3])
```

In [51]: `arr2[:]`

```
Out[51]: array([[90, 95, 68, 32, 57, 16, 17, 78, 43, 62],
                [45, 23, 74, 60, 58, 86, 76,  2, 11, 53],
                [79, 35, 20, 85, 29,  7, 33,  6,  3, 29],
                [74, 86, 93, 74, 99, 24, 53,  4, 19,  9],
                [73, 87, 53, 30, 65, 29, 34, 97,  1, 25],
                [ 3, 36, 45, 54, 30, 58, 20, 55, 74,  6],
                [51, 53, 41, 31, 21, 60, 58, 40, 35, 72],
                [82, 19, 40, 19, 68, 84, 37, 31, 75, 23],
                [69, 58, 93, 68, 85,  7,  7, 54, 21, 52],
                [59, 81, 88, 55, 14, 15, 50, 85, 20, 35]])
```

In [52]: `arr2[0:5]`

```
Out[52]: array([[90, 95, 68, 32, 57, 16, 17, 78, 43, 62],
                [45, 23, 74, 60, 58, 86, 76,  2, 11, 53],
                [79, 35, 20, 85, 29,  7, 33,  6,  3, 29],
                [74, 86, 93, 74, 99, 24, 53,  4, 19,  9],
                [73, 87, 53, 30, 65, 29, 34, 97,  1, 25]])
```

In [53]: `arr2`

```
Out[53]: array([[90, 95, 68, 32, 57, 16, 17, 78, 43, 62],
                [45, 23, 74, 60, 58, 86, 76,  2, 11, 53],
                [79, 35, 20, 85, 29,  7, 33,  6,  3, 29],
                [74, 86, 93, 74, 99, 24, 53,  4, 19,  9],
                [73, 87, 53, 30, 65, 29, 34, 97,  1, 25],
                [ 3, 36, 45, 54, 30, 58, 20, 55, 74,  6],
                [51, 53, 41, 31, 21, 60, 58, 40, 35, 72],
                [82, 19, 40, 19, 68, 84, 37, 31, 75, 23],
                [69, 58, 93, 68, 85,  7,  7, 54, 21, 52],
                [59, 81, 88, 55, 14, 15, 50, 85, 20, 35]])
```

In [54]: `arr2[1,4]`

```
Out[54]:  58

In [55]:  arr2

Out[55]:  array([[90, 95, 68, 32, 57, 16, 17, 78, 43, 62],
                 [45, 23, 74, 60, 58, 86, 76,  2, 11, 53],
                 [79, 35, 20, 85, 29,  7, 33,  6,  3, 29],
                 [74, 86, 93, 74, 99, 24, 53,  4, 19,  9],
                 [73, 87, 53, 30, 65, 29, 34, 97,  1, 25],
                 [ 3, 36, 45, 54, 30, 58, 20, 55, 74,  6],
                 [51, 53, 41, 31, 21, 60, 58, 40, 35, 72],
                 [82, 19, 40, 19, 68, 84, 37, 31, 75, 23],
                 [69, 58, 93, 68, 85,  7,  7, 54, 21, 52],
                 [59, 81, 88, 55, 14, 15, 50, 85, 20, 35]])

In [56]:  arr2[-5,5]

Out[56]:  58

In [57]:  arr2[-5,-5]

Out[57]:  58

In [59]:  arr2[-1,-2]

Out[59]:  20

In [60]:  arr2

Out[60]:  array([[90, 95, 68, 32, 57, 16, 17, 78, 43, 62],
                 [45, 23, 74, 60, 58, 86, 76,  2, 11, 53],
                 [79, 35, 20, 85, 29,  7, 33,  6,  3, 29],
                 [74, 86, 93, 74, 99, 24, 53,  4, 19,  9],
                 [73, 87, 53, 30, 65, 29, 34, 97,  1, 25],
                 [ 3, 36, 45, 54, 30, 58, 20, 55, 74,  6],
                 [51, 53, 41, 31, 21, 60, 58, 40, 35, 72],
                 [82, 19, 40, 19, 68, 84, 37, 31, 75, 23],
                 [69, 58, 93, 68, 85,  7,  7, 54, 21, 52],
                 [59, 81, 88, 55, 14, 15, 50, 85, 20, 35]])

In [61]:  arr2[::-1]

Out[61]:  array([[59, 81, 88, 55, 14, 15, 50, 85, 20, 35],
                 [69, 58, 93, 68, 85,  7,  7, 54, 21, 52],
                 [82, 19, 40, 19, 68, 84, 37, 31, 75, 23],
                 [51, 53, 41, 31, 21, 60, 58, 40, 35, 72],
                 [ 3, 36, 45, 54, 30, 58, 20, 55, 74,  6],
                 [73, 87, 53, 30, 65, 29, 34, 97,  1, 25],
                 [74, 86, 93, 74, 99, 24, 53,  4, 19,  9],
                 [79, 35, 20, 85, 29,  7, 33,  6,  3, 29],
                 [45, 23, 74, 60, 58, 86, 76,  2, 11, 53],
                 [90, 95, 68, 32, 57, 16, 17, 78, 43, 62]])

In [62]:  arr2
```

```
Out[62]:  array([[90, 95, 68, 32, 57, 16, 17, 78, 43, 62],
                 [45, 23, 74, 60, 58, 86, 76,  2, 11, 53],
                 [79, 35, 20, 85, 29,  7, 33,  6,  3, 29],
                 [74, 86, 93, 74, 99, 24, 53,  4, 19,  9],
                 [73, 87, 53, 30, 65, 29, 34, 97,  1, 25],
                 [ 3, 36, 45, 54, 30, 58, 20, 55, 74,  6],
                 [51, 53, 41, 31, 21, 60, 58, 40, 35, 72],
                 [82, 19, 40, 19, 68, 84, 37, 31, 75, 23],
                 [69, 58, 93, 68, 85,  7,  7, 54, 21, 52],
                 [59, 81, 88, 55, 14, 15, 50, 85, 20, 35]])
```

In [63]: `arr2[::-2]`

```
Out[63]:  array([[59, 81, 88, 55, 14, 15, 50, 85, 20, 35],
                 [82, 19, 40, 19, 68, 84, 37, 31, 75, 23],
                 [ 3, 36, 45, 54, 30, 58, 20, 55, 74,  6],
                 [74, 86, 93, 74, 99, 24, 53,  4, 19,  9],
                 [45, 23, 74, 60, 58, 86, 76,  2, 11, 53]])
```

In [64]: `arr2`

```
Out[64]:  array([[90, 95, 68, 32, 57, 16, 17, 78, 43, 62],
                 [45, 23, 74, 60, 58, 86, 76,  2, 11, 53],
                 [79, 35, 20, 85, 29,  7, 33,  6,  3, 29],
                 [74, 86, 93, 74, 99, 24, 53,  4, 19,  9],
                 [73, 87, 53, 30, 65, 29, 34, 97,  1, 25],
                 [ 3, 36, 45, 54, 30, 58, 20, 55, 74,  6],
                 [51, 53, 41, 31, 21, 60, 58, 40, 35, 72],
                 [82, 19, 40, 19, 68, 84, 37, 31, 75, 23],
                 [69, 58, 93, 68, 85,  7,  7, 54, 21, 52],
                 [59, 81, 88, 55, 14, 15, 50, 85, 20, 35]])
```

In [65]: `arr2[::-3]`

```
Out[65]:  array([[59, 81, 88, 55, 14, 15, 50, 85, 20, 35],
                 [51, 53, 41, 31, 21, 60, 58, 40, 35, 72],
                 [74, 86, 93, 74, 99, 24, 53,  4, 19,  9],
                 [90, 95, 68, 32, 57, 16, 17, 78, 43, 62]])
```

In [66]: `arr2`

```
Out[66]:  array([[90, 95, 68, 32, 57, 16, 17, 78, 43, 62],
                 [45, 23, 74, 60, 58, 86, 76,  2, 11, 53],
                 [79, 35, 20, 85, 29,  7, 33,  6,  3, 29],
                 [74, 86, 93, 74, 99, 24, 53,  4, 19,  9],
                 [73, 87, 53, 30, 65, 29, 34, 97,  1, 25],
                 [ 3, 36, 45, 54, 30, 58, 20, 55, 74,  6],
                 [51, 53, 41, 31, 21, 60, 58, 40, 35, 72],
                 [82, 19, 40, 19, 68, 84, 37, 31, 75, 23],
                 [69, 58, 93, 68, 85,  7,  7, 54, 21, 52],
                 [59, 81, 88, 55, 14, 15, 50, 85, 20, 35]])
```

In [67]: `arr2[:-3]`

```
Out[67]: array([[90, 95, 68, 32, 57, 16, 17, 78, 43, 62],
               [45, 23, 74, 60, 58, 86, 76,  2, 11, 53],
               [79, 35, 20, 85, 29,  7, 33,  6,  3, 29],
               [74, 86, 93, 74, 99, 24, 53,  4, 19,  9],
               [73, 87, 53, 30, 65, 29, 34, 97,  1, 25],
               [ 3, 36, 45, 54, 30, 58, 20, 55, 74,  6],
               [51, 53, 41, 31, 21, 60, 58, 40, 35, 72]])
```

```
In [68]: arr
```

```
Out[68]: array([0, 1, 2, 3, 4, 5])
```

```
In [69]: arr.max()
```

```
Out[69]: 5
```

```
In [70]: arr.min()
```

```
Out[70]: 0
```

```
In [71]: arr
```

```
Out[71]: array([0, 1, 2, 3, 4, 5])
```

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

```
Out[72]: 2.5
```

```
In [73]: arr
```

```
Out[73]: array([0, 1, 2, 3, 4, 5])
```

```
In [74]: arr.median()
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[74], line 1
----> 1 arr.median()

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

```
In [75]: from numpy import *
         a = array([1,2,3,4,9])
         median(a)
```

```
Out[75]: 3.0
```

Reshaping: 3 format

1.order-c (Print element using c-type indexing)

2.order-a (Print arbitray)

3.order-f (Print fortan)

```
In [76]: arr
```

```
Out[76]: array([0, 1, 2, 3, 4, 5])
```

```
In [80]: arr.reshape(2,3, order='c')# Print element using c-type indexing
```

```
Out[80]: array([[0, 1, 2],
                [3, 4, 5]])
```

```
In [82]: arr.reshape(3,2, order='c')#Print element with ctype
```

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

```
In [83]: arr.reshape(2,3,order='F')#Print elemnets with fortan
```

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

Indexing

```
In [84]: mat = np.arange(0,100).reshape(10,10)
```

```
In [85]: mat
```

```
Out[85]: 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 [87]: row = 4
         col = 5
```

```
In [88]: col
```

```
Out[88]: 5
```

```
In [89]: row
```

```
Out[89]: 4
```

```
In [90]: mat
```

```
Out[90]: 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 [91]: mat[row,col]
```

```
Out[91]: 45
```

```
In [92]: mat[4,5]
```

```
Out[92]: 45
```

```
In [93]: mat
```

```
Out[93]: 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 [94]: mat[:]
```

```
Out[94]: 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 [95]: col = 6
```

```
In [96]: mat
```

```
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],
                [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 [97]: `mat[6] # befault it represent to rows`

```
Out[97]: array([60, 61, 62, 63, 64, 65, 66, 67, 68, 69])
```

In [98]: `mat`

```
Out[98]: 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 [99]:
```
# With Slices
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[row,:]`

```
Out[101]: array([40, 41, 42, 43, 44, 45, 46, 47, 48, 49])
```

In [102]: `mat`

```
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, 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[:,8]`

Out[104]: `array([ 8, 18, 28, 38, 48, 58, 68, 78, 88, 98])`

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]])
```

mat[:col]

row

In [106]: `mat`

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

```
Out[107]: array([[22, 23],
                  [32, 33],
                  [42, 43],
                  [52, 53]])
```

In [108]: `mat`

```
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],
                  [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 [109]: `mat[1:2,2:4]`

```
Out[109]:  array([[12, 13]])
```

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

```
Out[111]:  array([[22]])
```

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[2:4,3:5]`

```
Out[113]:  array([[23, 24],
                  [33, 34]])
```

In [114]: `mat[3:5,2:4]`

```
Out[114]:  array([[32, 33],
                  [42, 43]])
```

Masking

In [115]: `mat # we also called as filter`

Out[115]:
```
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 [116]: `id(mat)`

Out[116]: 3218965558928

In [117]: `mat`

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],
       [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 [118]: `mat[mat<50]`

Out[118]:
```
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 [119]: `mat[mat<=50]`

Out[119]:
```
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 [124]: `mat > 50`

```
Out[124]: 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 [125]: `mat[mat==50]`

```
Out[125]: array([50])
```

In [126]: `mat`

```
Out[126]: 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 [127]: `mat == 50`

```
Out[127]: 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 [128]: mat
```

```
Out[128]: 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 [129]: a1 = mat[mat<50]
          a1
```

```
Out[129]: 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 [130]: mat
```

```
Out[130]: 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 [131]: a2 = mat[mat>50]
          a2
```

```
Out[131]: 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 [132]:
```python
a3 = mat[mat<=50]
a3
```

```
Out[132]: 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 [123]:
```python
a1 = mat[mat<50]
a1
```

```
Out[123]: 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 [133]:
```python
a4 = mat[mat==50]
a4
```

```
Out[133]: array([50])
```