```
In [ ]:   # numpy indexing
```

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

```
In [2]:   mat=np.arange(0,100).reshape(10,10)
```

```
In [3]:   mat
```

```
Out[3]:   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 [4]:   mat[0:-2]
```

```
Out[4]:   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]])
```

```
In [5]:   mat[::2]
```

```
Out[5]:   array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
                 [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
                 [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
                 [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
                 [80, 81, 82, 83, 84, 85, 86, 87, 88, 89]])
```

```
In [6]:   mat[0:-2]
```

```
Out[6]:   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]])
```

```
In [7]:   mat1=np.arange(0,100,5)
```

In [8]:
```python
mat1
```

Out[8]:
```
array([ 0,  5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 8
0,
        85, 90, 95])
```

In [9]:
```python
mat1=np.arange(0,100,5).reshape(4,5)
```

In [10]:
```python
mat1
```

Out[10]:
```
array([[ 0,  5, 10, 15, 20],
       [25, 30, 35, 40, 45],
       [50, 55, 60, 65, 70],
       [75, 80, 85, 90, 95]])
```

In [11]:
```python
np.arange(6)
```

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

In [12]:
```python
a=np.random.randint(3,10,10)
a
```

Out[12]:
```
array([5, 7, 5, 7, 3, 3, 4, 7, 4, 9])
```

In [13]:
```python
a2=np.random.randint(10,40,(10,10))
a2
```

Out[13]:
```
array([[22, 12, 24, 28, 18, 38, 36, 37, 29, 14],
       [24, 18, 35, 17, 25, 28, 29, 26, 23, 13],
       [36, 28, 20, 18, 34, 26, 28, 23, 24, 36],
       [25, 30, 30, 16, 27, 11, 22, 20, 39, 22],
       [23, 32, 39, 17, 22, 33, 20, 20, 33, 15],
       [27, 27, 36, 29, 32, 10, 29, 29, 36, 26],
       [18, 32, 20, 25, 32, 17, 28, 27, 11, 28],
       [21, 22, 33, 11, 32, 34, 37, 17, 35, 10],
       [27, 25, 15, 26, 18, 14, 30, 13, 10, 26],
       [37, 16, 16, 24, 10, 23, 23, 14, 14, 14]])
```

In [14]:
```python
a2[0,-2]
```

Out[14]:
```
np.int64(29)
```

In [15]:
```python
a2[0:-2]
```

Out[15]:
```
array([[22, 12, 24, 28, 18, 38, 36, 37, 29, 14],
       [24, 18, 35, 17, 25, 28, 29, 26, 23, 13],
       [36, 28, 20, 18, 34, 26, 28, 23, 24, 36],
       [25, 30, 30, 16, 27, 11, 22, 20, 39, 22],
       [23, 32, 39, 17, 22, 33, 20, 20, 33, 15],
       [27, 27, 36, 29, 32, 10, 29, 29, 36, 26],
       [18, 32, 20, 25, 32, 17, 28, 27, 11, 28],
       [21, 22, 33, 11, 32, 34, 37, 17, 35, 10]])
```

In [16]: `a2[::-1]`

Out[16]:
```
array([[37, 16, 16, 24, 10, 23, 23, 14, 14, 14],
       [27, 25, 15, 26, 18, 14, 30, 13, 10, 26],
       [21, 22, 33, 11, 32, 34, 37, 17, 35, 10],
       [18, 32, 20, 25, 32, 17, 28, 27, 11, 28],
       [27, 27, 36, 29, 32, 10, 29, 29, 36, 26],
       [23, 32, 39, 17, 22, 33, 20, 20, 33, 15],
       [25, 30, 30, 16, 27, 11, 22, 20, 39, 22],
       [36, 28, 20, 18, 34, 26, 28, 23, 24, 36],
       [24, 18, 35, 17, 25, 28, 29, 26, 23, 13],
       [22, 12, 24, 28, 18, 38, 36, 37, 29, 14]])
```

In [17]:
```python
print(a2[:])
print(a2[2:6,2:4])
```

```
[[22 12 24 28 18 38 36 37 29 14]
 [24 18 35 17 25 28 29 26 23 13]
 [36 28 20 18 34 26 28 23 24 36]
 [25 30 30 16 27 11 22 20 39 22]
 [23 32 39 17 22 33 20 20 33 15]
 [27 27 36 29 32 10 29 29 36 26]
 [18 32 20 25 32 17 28 27 11 28]
 [21 22 33 11 32 34 37 17 35 10]
 [27 25 15 26 18 14 30 13 10 26]
 [37 16 16 24 10 23 23 14 14 14]]
[[20 18]
 [30 16]
 [39 17]
 [36 29]]
```

In [18]: `a2>20`

Out[18]:
```
array([[ True, False,  True,  True, False,  True,  True,  True,  True,
        False],
       [ True, False,  True, False,  True,  True,  True,  True,  True,
        False],
       [ True,  True, False, False,  True,  True,  True,  True,  True,
         True],
       [ True,  True,  True, False,  True, False,  True, False,  True,
         True],
       [ True,  True,  True, False,  True,  True, False, False,  True,
        False],
       [ True,  True,  True,  True,  True, False,  True,  True,  True,
         True],
       [False,  True, False,  True,  True, False,  True,  True, False,
         True],
       [ True,  True,  True, False,  True,  True,  True, False,  True,
        False],
       [ True,  True, False,  True, False, False,  True, False, False,
         True],
       [ True, False, False,  True, False,  True,  True, False, False,
        False]])
```

In [19]:
```python
a2[a2>20]
```

Out[19]:
```
array([22, 24, 28, 38, 36, 37, 29, 24, 35, 25, 28, 29, 26, 23, 36, 28, 3
4,
       26, 28, 23, 24, 36, 25, 30, 30, 27, 22, 39, 22, 23, 32, 39, 22, 3
3,
       33, 27, 27, 36, 29, 32, 29, 29, 36, 26, 32, 25, 32, 28, 27, 28, 2
1,
       22, 33, 32, 34, 37, 35, 27, 25, 26, 30, 26, 37, 24, 23, 23])
```

In [20]:
```python
# identical matrix
```

In [21]:
```python
np.eye(4)
```

Out[21]:
```
array([[1., 0., 0., 0.],
       [0., 1., 0., 0.],
       [0., 0., 1., 0.],
       [0., 0., 0., 1.]])
```

In [22]:
```python
np.eye(4,dtype=int)    # identity matrix
```

Out[22]:
```
array([[1, 0, 0, 0],
       [0, 1, 0, 0],
       [0, 0, 1, 0],
       [0, 0, 0, 1]])
```

In [23]:
```python
a2[:,-1]
```

Out[23]:
```
array([14, 13, 36, 22, 15, 26, 28, 10, 26, 14])
```

In [24]:
```python
a2[:]
```

Out[24]:
```
array([[22, 12, 24, 28, 18, 38, 36, 37, 29, 14],
       [24, 18, 35, 17, 25, 28, 29, 26, 23, 13],
       [36, 28, 20, 18, 34, 26, 28, 23, 24, 36],
       [25, 30, 30, 16, 27, 11, 22, 20, 39, 22],
       [23, 32, 39, 17, 22, 33, 20, 20, 33, 15],
       [27, 27, 36, 29, 32, 10, 29, 29, 36, 26],
       [18, 32, 20, 25, 32, 17, 28, 27, 11, 28],
       [21, 22, 33, 11, 32, 34, 37, 17, 35, 10],
       [27, 25, 15, 26, 18, 14, 30, 13, 10, 26],
       [37, 16, 16, 24, 10, 23, 23, 14, 14, 14]])
```

In [25]:
```python
a2[:8]
```

Out[25]:
```
array([[22, 12, 24, 28, 18, 38, 36, 37, 29, 14],
       [24, 18, 35, 17, 25, 28, 29, 26, 23, 13],
       [36, 28, 20, 18, 34, 26, 28, 23, 24, 36],
       [25, 30, 30, 16, 27, 11, 22, 20, 39, 22],
       [23, 32, 39, 17, 22, 33, 20, 20, 33, 15],
       [27, 27, 36, 29, 32, 10, 29, 29, 36, 26],
       [18, 32, 20, 25, 32, 17, 28, 27, 11, 28],
       [21, 22, 33, 11, 32, 34, 37, 17, 35, 10]])
```

```python
In [26]: a2[:,8]
```

```
Out[26]: array([29, 23, 24, 39, 33, 36, 11, 35, 10, 14])
```

```python
In [27]: a2[2,:]
```

```
Out[27]: array([36, 28, 20, 18, 34, 26, 28, 23, 24, 36])
```

```python
In [28]: a2[1:2,2:4]
```

```
Out[28]: array([[35, 17]])
```

```python
In [29]: row=4
         col=5
```

```python
In [30]: a2[row,col]
```

```
Out[30]: np.int64(33)
```

```python
In [31]: a2[0:10]
```

```
Out[31]: array([[22, 12, 24, 28, 18, 38, 36, 37, 29, 14],
               [24, 18, 35, 17, 25, 28, 29, 26, 23, 13],
               [36, 28, 20, 18, 34, 26, 28, 23, 24, 36],
               [25, 30, 30, 16, 27, 11, 22, 20, 39, 22],
               [23, 32, 39, 17, 22, 33, 20, 20, 33, 15],
               [27, 27, 36, 29, 32, 10, 29, 29, 36, 26],
               [18, 32, 20, 25, 32, 17, 28, 27, 11, 28],
               [21, 22, 33, 11, 32, 34, 37, 17, 35, 10],
               [27, 25, 15, 26, 18, 14, 30, 13, 10, 26],
               [37, 16, 16, 24, 10, 23, 23, 14, 14, 14]])
```

```python
In [35]: a2[::-2]
```

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

```python
In [37]: b=np.arange(27).reshape(3,3,3)
         b
```

```
Out[37]: 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]]])
```

In [38]: `b[0]`

```
Out[38]: array([[0, 1, 2],
                [3, 4, 5],
                [6, 7, 8]])
```

In [39]: `b[1]`

```
Out[39]: array([[ 9, 10, 11],
                [12, 13, 14],
                [15, 16, 17]])
```

In [40]: `b[2]`

```
Out[40]: array([[18, 19, 20],
                [21, 22, 23],
                [24, 25, 26]])
```

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

```
Out[41]: array([[[ 0,  1,  2],
                  [ 3,  4,  5],
                  [ 6,  7,  8]],

                 [[18, 19, 20],
                  [21, 22, 23],
                  [24, 25, 26]]])
```

In [42]: `b[0,1]`

```
Out[42]: array([3, 4, 5])
```

In [43]: `b[::2]`

```
Out[43]: array([[[ 0,  1,  2],
                  [ 3,  4,  5],
                  [ 6,  7,  8]],

                 [[18, 19, 20],
                  [21, 22, 23],
                  [24, 25, 26]]])
```

In [44]: `#numy masking`

NumPy Masking

In [45]:
```
mat=np.arange(0,100)
mat
```

Out[45]:
```
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 [46]: `mat>50`

Out[46]:
```
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 [47]: `mat[mat>50]`

Out[47]:
```
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 [49]: `mat[mat==50]`

Out[49]: `array([50])`

In [50]: `mat>=0`

```
Out[50]: 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,   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 [51]: # numpy operators

NumPy Operators

In [62]:
```python
import numpy as np
arr1=np.array([1,2,3,4,5])
arr1
```

Out[62]: array([1, 2, 3, 4, 5])

In [63]:
```python
arr2=np.ones(5,dtype=int)
```

In [64]:
```python
arr2
```

Out[64]: array([1, 1, 1, 1, 1])

In [65]:
```python
arr1+arr2
```

Out[65]: array([2, 3, 4, 5, 6])

In [66]:
```python
arr1-arr2
```

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

In [67]:
```python
arr1*arr2
```

Out[67]: array([1, 2, 3, 4, 5])

In [68]:
```python
arr1/ arr2
```

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

In [69]:
```python
arr1//arr2
```

Out[69]: array([1, 2, 3, 4, 5])

In [70]:
```python
arr1%arr2
```

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

```
In [71]:   arr1 ** arr2
```

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

```
In [72]:   #sum of numbers
```

```
In [76]:   arr1.sum()
```

```
Out[76]:   np.int64(15)
```

```
In [77]:   arr1.max()
```

```
Out[77]:   np.int64(5)
```

```
In [78]:   arr2.min()
```

```
Out[78]:   np.int64(1)
```

```
In [80]:   arr1.median()
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[80], line 1
----> 1 arr1.median()

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

```
In [81]:   from numpy import *
```

```
In [84]:   median(arr1)
```

```
Out[84]:   np.float64(3.0)
```

```
In [85]:   std(arr1) # standard deviation
```

```
Out[85]:   np.float64(1.4142135623730951)
```

Adding removing sorting elements

```
In [86]:   # adding removing sorting elements
```

```
In [90]:   arr=np.array([1,5,2,8,3,4])
```

```
In [92]:   np.sort(arr)      #---- sort
```

```
Out[92]:  array([1, 2, 3, 4, 5, 8])
```

```
In [93]:  a=np.array([1,2,6,3,5])
```

```
In [94]:  b=np.array([1,5,2,3])
```

```
In [99]:  np.concatenate((a,b))    # -----concatenate
```

```
Out[99]:  array([1, 2, 6, 3, 5, 1, 5, 2, 3])
```

```
In [106…  x=np.array([[1,2],[3,4]])
          y=np.array([[5,6]])
```

```
In [107…  np.concatenate((x,y),axis=0)
```

```
Out[107…  array([[1, 2],
                 [3, 4],
                 [5, 6]])
```

shape and size of an array

```
In [108…  #shape and size of an array
```

```
In [110…  x.ndim    # no. of dimenstion of array
```

```
Out[110…  2
```

```
In [112…  x.size # total no. of elements
```

```
Out[112…  4
```

```
In [113…  x.shape    # shape
```

```
Out[113…  (2, 2)
```

```
In [ ]:
```