In [2]:
```
import sys
sys.version
```

Out[2]:
```
'3.12.7 | packaged by Anaconda, Inc. | (main, Oct  4 2024, 13:17:27) [MSC v.1929 6
4 bit (AMD64)]'
```

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

In [3]:
```
np.__version__
```

Out[3]:
```
'1.26.4'
```

Create list

In [25]:
```
my_list=[0,1,2,3,4,5]
my_list
```

Out[25]:
```
[0, 1, 2, 3, 4, 5]
```

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

Out[6]:
```
list
```

In [26]:
```
arr=np.array(my_list)
arr
```

Out[26]:
```
array([0, 1, 2, 3, 4, 5])
```

In [9]:
```
print(type(arr))
print(type(my_list))
```

```
<class 'numpy.ndarray'>
<class 'list'>
```

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

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

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

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

In [15]:
```
np.arange(10,50,5)
```

Out[15]:
```
array([10, 15, 20, 25, 30, 35, 40, 45])
```

In [16]:
```
np.arange(10,30,3)
```

Out[16]:
```
array([10, 13, 16, 19, 22, 25, 28])
```

In [17]:
```
np.arange(10,30,30,3)
```

```
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
Cell In[17], line 1
----> 1 np.arange(10,30,30,3)

TypeError: Cannot interpret '3' as a data type
```

In [19]:
```
np.arange(8,20)
```

Out[19]:
```
array([ 8,  9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19])
```

In [18]:
```
np.arange(20,8)
```

Out[18]:
```
array([], dtype=int32)
```

In [21]:
```
np.arange(-20,8) # 1st arg < 2nd arg
```

Out[21]:
```
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])
```

In [22]:
```
n=np.arange(-20,8)
n
```

Out[22]:
```
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])
```

In [24]:
```
np.zeros(3) # parameter tunning
```

Out[24]:
```
array([0., 0., 0.])
```

In [25]:
```
np.zeros(3,dtype=int)  # hyperparameter tunning
```

Out[25]:
```
array([0, 0, 0])
```

In [26]:
```
z=np.zeros(5)
z
```

Out[26]:
```
array([0., 0., 0., 0., 0.])
```

In [5]:
```
n=(6,7)
n1=(6,8)
print(np.zeros(n1))
```

```
[[0. 0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0.]
 [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 [8]:
```
print(np.ones(n1,dtype=int))
```

```
[[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 [29]:
```
np.zeros((2,2)) #2d array
```

Out[29]:
```
array([[0., 0.],
       [0., 0.]])
```

In [31]:
```
np.zeros((3,3),dtype=int)
```

Out[31]:
```
array([[0, 0, 0],
       [0, 0, 0],
       [0, 0, 0]])
```

In [33]:
```
nd=np.zeros((5,9),dtype=int)
nd
```

Out[33]:
```
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]])
```

In [36]:
```
np.ones(3)
```

Out[36]:
```
array([1., 1., 1.])
```

In [37]:
```
np.ones(3,dtype=int)
```

Out[37]:
```
array([1, 1, 1])
```

In [38]:
```
nd1=np.ones((10,10), dtype=int)
nd1
```

Out[38]:
```
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],
       [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 [39]:
```
np.three(3)
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[39], line 1
----> 1 np.three(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 [40]:
```
nd1
```

Out[40]:
```
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],
       [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 [1]:
```
rand(3,2)
```

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

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

In [2]:
```
random.rand(2)
```

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

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

In [5]:
```
np.random.rand(2)
```

Out[5]:
```
array([0.59519661, 0.4453857 ])
```

In [6]:
```
np.random.rand(3)
```

Out[6]:
```
array([0.63447362, 0.95333614, 0.01270461])
```

In [8]:
```
np.random.rand(2,3)
```

Out[8]:
```
array([[0.64818377, 0.63431022, 0.66698953],
       [0.32876417, 0.82124962, 0.39541957]])
```

In [12]:
```
np.random.randint(3) # less than 3 will get output
```

Out[12]:
```
2
```

In [14]:
```
np.random.randint(2,10) # 10 is exclusive
```

Out[14]:
```
9
```

In [15]:
```
np.random.randint(2,10,3)
```

Out[15]:
```
array([2, 2, 6])
```

In [16]:
```
np.random.randint(2,10,4)
```

Out[16]:
```
array([6, 5, 3, 3])
```

In [15]:
```
np.random.randint(10,20)
```

Out[15]:
```
16
```

In [17]:
```
np.random.randint(2,10,6)
```

Out[17]:
```
array([9, 8, 2, 4, 3, 5])
```

In [20]:
```
np.random.randint(-15,-10,5)
```

Out[20]:
```
array([-15, -13, -12, -11, -14])
```

In [17]:
```
np.random.randint(-30,20,10)
```

Out[17]:
```
array([ 17,  -4,  14, -13, -10,   9,  15,  12,  12,  -6])
```

In [22]:
```
np.random.randint(20,30,10)
```

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

In [20]:
```
np.random.randint(10,40,(10,10))
```

Out[20]:
```
array([[13, 39, 16, 10, 24, 16, 24, 21, 23, 34],
       [26, 36, 36, 20, 35, 12, 24, 20, 32, 39],
       [29, 32, 16, 28, 28, 33, 30, 15, 32, 33],
       [24, 10, 29, 20, 35, 31, 32, 12, 21, 18],
       [24, 36, 36, 18, 38, 21, 20, 33, 34, 10],
       [35, 23, 29, 34, 28, 13, 35, 37, 14, 17],
       [22, 20, 19, 13, 13, 34, 21, 24, 32, 14],
       [30, 22, 35, 11, 30, 13, 12, 21, 13, 13],
       [26, 36, 22, 11, 26, 36, 14, 19, 34, 27],
       [10, 35, 19, 18, 12, 36, 13, 26, 36, 13]])
```

In [21]:
```
m=np.random.randint(10,40,(10,10))
m
```

Out[21]:
```
array([[33, 28, 12, 26, 21, 11, 11, 16, 16, 25],
       [27, 17, 37, 22, 16, 25, 10, 22, 18, 18],
       [29, 36, 18, 32, 11, 11, 25, 33, 16, 26],
       [30, 38, 37, 14, 20, 17, 19, 11, 31, 13],
       [32, 11, 22, 36, 34, 32, 17, 19, 25, 18],
       [36, 34, 27, 28, 34, 24, 12, 14, 34, 12],
       [25, 17, 25, 14, 24, 25, 17, 25, 17, 24],
       [39, 30, 20, 25, 33, 28, 35, 11, 31, 16],
       [35, 22, 15, 32, 29, 28, 37, 22, 26, 31],
       [27, 32, 11, 33, 34, 23, 25, 20, 16, 15]])
```

In [23]:
```
a1=np.random.randint(5,10,(2,3))
a1
```

Out[23]:
```
array([[9, 6, 5],
       [7, 6, 9]])
```

In [24]:
```
type(a1)
```

Out[24]:
```
numpy.ndarray
```

In [27]:
```
arr
```

Out[27]:
```
array([0, 1, 2, 3, 4, 5])
```

In [28]:
```
arr.reshape(1, 6)
```

Out[28]:
```
array([[0, 1, 2, 3, 4, 5]])
```

In [29]:
```
np.arange(10,20).reshape(5,2)
```

Out[29]:
```
array([[10, 11],
       [12, 13],
       [14, 15],
       [16, 17],
       [18, 19]])
```

In [33]:
```
a2=np.arange(20,25).reshape(1,5)
a2
```

Out[33]:
```
array([[20, 21, 22, 23, 24]])
```

slicing in Matrix

In [29]:
```
m
```

Out[29]:
```
array([[33, 28, 12, 26, 21, 11, 11, 16, 16, 25],
       [27, 17, 37, 22, 16, 25, 10, 22, 18, 18],
       [29, 36, 18, 32, 11, 11, 25, 33, 16, 26],
       [30, 38, 37, 14, 20, 17, 19, 11, 31, 13],
       [32, 11, 22, 36, 34, 32, 17, 19, 25, 18],
       [36, 34, 27, 28, 34, 24, 12, 14, 34, 12],
       [25, 17, 25, 14, 24, 25, 17, 25, 17, 24],
       [39, 30, 20, 25, 33, 28, 35, 11, 31, 16],
       [35, 22, 15, 32, 29, 28, 37, 22, 26, 31],
       [27, 32, 11, 33, 34, 23, 25, 20, 16, 15]])
```

In [30]:
```
b=np.random.randint(10,20,(5,4))
b
```

Out[30]:
```
array([[17, 10, 16, 11],
       [17, 19, 15, 11],
       [12, 18, 16, 13],
       [11, 18, 17, 14],
       [13, 15, 15, 19]])
```

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

Out[31]:
```
array([[17, 10, 16, 11],
       [17, 19, 15, 11],
       [12, 18, 16, 13],
       [11, 18, 17, 14],
       [13, 15, 15, 19]])
```

In [32]:
```
b[1:4]
```

Out[32]:
```
array([[17, 19, 15, 11],
       [12, 18, 16, 13],
       [11, 18, 17, 14]])
```

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

Out[33]:
```
array([[17, 10, 16, 11],
       [17, 19, 15, 11],
       [12, 18, 16, 13],
       [11, 18, 17, 14],
       [13, 15, 15, 19]])
```

In [34]:
```
b[-1:]
```

Out[34]:
```
array([[13, 15, 15, 19]])
```

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

Out[35]:
```
array([[17, 10, 16, 11],
       [17, 19, 15, 11],
       [12, 18, 16, 13],
       [11, 18, 17, 14]])
```

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

Out[36]:
```
array([[17, 10, 16, 11],
       [17, 19, 15, 11],
       [12, 18, 16, 13],
       [11, 18, 17, 14],
       [13, 15, 15, 19]])
```

In [35]:
```
b1=np.random.randint(1,16,(4,4))
b1
```

Out[35]:
```
array([[ 5,  1,  8, 13],
       [ 6, 14,  2, 11],
       [13,  4,  6,  4],
       [ 6,  1,  9,  4]])
```

In [39]:
```
b1[-1:]
```

Out[39]:
```
array([[6, 1, 9, 4]])
```

In [40]:
```
b1[:-2]
```

Out[40]:
```
array([[ 5,  1,  8, 13],
       [ 6, 14,  2, 11]])
```

In [41]:
```
b1[-2:-1]
```

Out[41]:
```
array([[13,  4,  6,  4]])
```

In [43]:
```
b1[3,3]
```

Out[43]:
```
4
```

In [44]:
```
b1[-3,2]
```

Out[44]:
```
2
```

In [59]:
```
b2=np.random.randint(10,50,(10,10))
b2
```

Out[59]:
```
array([[29, 15, 10, 36, 19, 37, 22, 18, 35, 28],
       [20, 32, 33, 15, 37, 15, 41, 18, 23, 40],
       [30, 18, 23, 34, 24, 34, 29, 48, 11, 37],
       [38, 40, 31, 17, 43, 18, 47, 17, 24, 13],
       [11, 32, 30, 40, 35, 32, 40, 10, 30, 12],
       [23, 11, 42, 41, 23, 19, 21, 20, 33, 42],
       [15, 19, 41, 13, 27, 33, 22, 18, 41, 45],
       [22, 10, 11, 19, 29, 43, 48, 12, 12, 40],
       [19, 20, 28, 41, 23, 44, 47, 18, 36, 43],
       [49, 19, 17, 15, 39, 43, 15, 33, 23, 35]])
```

In [60]:
```
b2[3:7,3:7]
```

Out[60]:
```
array([[17, 43, 18, 47],
       [40, 35, 32, 40],
       [41, 23, 19, 21],
       [13, 27, 33, 22]])
```

In [63]:
```
b2[2:5,2:5]
```

Out[63]:
```
array([[23, 34, 24],
       [31, 17, 43],
       [30, 40, 35]])
```

In [64]:
```
b2[4:7,4:7]
```

Out[64]:
```
array([[35, 32, 40],
       [23, 19, 21],
       [27, 33, 22]])
```

In [65]:
```
b2
```

Out[65]:
```
array([[29, 15, 10, 36, 19, 37, 22, 18, 35, 28],
       [20, 32, 33, 15, 37, 15, 41, 18, 23, 40],
       [30, 18, 23, 34, 24, 34, 29, 48, 11, 37],
       [38, 40, 31, 17, 43, 18, 47, 17, 24, 13],
       [11, 32, 30, 40, 35, 32, 40, 10, 30, 12],
       [23, 11, 42, 41, 23, 19, 21, 20, 33, 42],
       [15, 19, 41, 13, 27, 33, 22, 18, 41, 45],
       [22, 10, 11, 19, 29, 43, 48, 12, 12, 40],
       [19, 20, 28, 41, 23, 44, 47, 18, 36, 43],
       [49, 19, 17, 15, 39, 43, 15, 33, 23, 35]])
```

In [66]:
```
b2[1:4,1:4]
```

Out[66]:
```
array([[32, 33, 15],
       [18, 23, 34],
       [40, 31, 17]])
```

In [84]:
```
b2[::-1]
```

Out[84]:
```
array([[49, 19, 17, 15, 39, 43, 15, 33, 23, 35],
       [19, 20, 28, 41, 23, 44, 47, 18, 36, 43],
       [22, 10, 11, 19, 29, 43, 48, 12, 12, 40],
       [15, 19, 41, 13, 27, 33, 22, 18, 41, 45],
       [23, 11, 42, 41, 23, 19, 21, 20, 33, 42],
       [11, 32, 30, 40, 35, 32, 40, 10, 30, 12],
       [38, 40, 31, 17, 43, 18, 47, 17, 24, 13],
       [30, 18, 23, 34, 24, 34, 29, 48, 11, 37],
       [20, 32, 33, 15, 37, 15, 41, 18, 23, 40],
       [29, 15, 10, 36, 19, 37, 22, 18, 35, 28]])
```

In [85]:
```
b2[::-2]
```

Out[85]:
```
array([[49, 19, 17, 15, 39, 43, 15, 33, 23, 35],
       [22, 10, 11, 19, 29, 43, 48, 12, 12, 40],
       [23, 11, 42, 41, 23, 19, 21, 20, 33, 42],
       [38, 40, 31, 17, 43, 18, 47, 17, 24, 13],
       [20, 32, 33, 15, 37, 15, 41, 18, 23, 40]])
```

In [86]:
```
b2
```

Out[86]:
```
array([[29, 15, 10, 36, 19, 37, 22, 18, 35, 28],
       [20, 32, 33, 15, 37, 15, 41, 18, 23, 40],
       [30, 18, 23, 34, 24, 34, 29, 48, 11, 37],
       [38, 40, 31, 17, 43, 18, 47, 17, 24, 13],
       [11, 32, 30, 40, 35, 32, 40, 10, 30, 12],
       [23, 11, 42, 41, 23, 19, 21, 20, 33, 42],
       [15, 19, 41, 13, 27, 33, 22, 18, 41, 45],
       [22, 10, 11, 19, 29, 43, 48, 12, 12, 40],
       [19, 20, 28, 41, 23, 44, 47, 18, 36, 43],
       [49, 19, 17, 15, 39, 43, 15, 33, 23, 35]])
```

In [87]:
```
b2[::-4]
```

Out[87]:
```
array([[49, 19, 17, 15, 39, 43, 15, 33, 23, 35],
       [23, 11, 42, 41, 23, 19, 21, 20, 33, 42],
       [20, 32, 33, 15, 37, 15, 41, 18, 23, 40]])
```

In [88]:
```
b2[-4:-2]
```

Out[88]:
```
array([[15, 19, 41, 13, 27, 33, 22, 18, 41, 45],
       [22, 10, 11, 19, 29, 43, 48, 12, 12, 40]])
```

In [89]:
```
b2[:-5]
```

Out[89]:
```
array([[29, 15, 10, 36, 19, 37, 22, 18, 35, 28],
       [20, 32, 33, 15, 37, 15, 41, 18, 23, 40],
       [30, 18, 23, 34, 24, 34, 29, 48, 11, 37],
       [38, 40, 31, 17, 43, 18, 47, 17, 24, 13],
       [11, 32, 30, 40, 35, 32, 40, 10, 30, 12]])
```

numpy operations

In [82]:
```
c=np.random.randint(6,10,5)
c
```

Out[82]:
```
array([7, 7, 7, 9, 6])
```

In [90]:
```
c.min()
```

Out[90]:
```
6
```

In [91]:
```
c.max()
```

Out[91]:
```
9
```

In [92]:
```
c.mean()
```

Out[92]:
```
7.2
```

In [93]:
```
c.median()
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[93], line 1
----> 1 c.median()

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

In [99]:
```
from numpy import*
```

In [96]:
```
median(c)
```

Out[96]: 7.0

In [102…
```
c
```

Out[102… array([7, 7, 7, 9, 6])

In [104…
```
c.reshape(1,5)
```

Out[104… array([[7, 7, 7, 9, 6]])

In [105…
```
c.reshape(5,1)
```

Out[105…
```
array([[7],
       [7],
       [7],
       [9],
       [6]])
```

indexing

In [124…
```
d=np.random.randint(0,50,(5,10))
d
```

Out[124…
```
array([[40, 24, 45, 11, 40, 35, 40, 37, 18, 40],
       [13,  4,  5, 37, 44, 23, 45,  8, 24,  3],
       [10, 44, 22, 46, 44, 46, 23, 18,  6,  8],
       [ 6, 39, 49, 45, 25, 44, 22, 44, 16,  9],
       [ 3, 21, 27,  0, 21,  8,  1, 21, 32, 38]])
```

In [125…
```
row=3
col=5
```

In [126…
```
col
```

Out[126… 5

In [127…
```
row
```

Out[127… 3

In [128…
```
d
```

Out[128…
```
array([[40, 24, 45, 11, 40, 35, 40, 37, 18, 40],
       [13,  4,  5, 37, 44, 23, 45,  8, 24,  3],
       [10, 44, 22, 46, 44, 46, 23, 18,  6,  8],
       [ 6, 39, 49, 45, 25, 44, 22, 44, 16,  9],
       [ 3, 21, 27,  0, 21,  8,  1, 21, 32, 38]])
```

In [129…
```
d[row,col]
```

Out[129…
```
44
```

In [130…
```
d[3]  # prints row value
```

Out[130…
```
array([ 6, 39, 49, 45, 25, 44, 22, 44, 16,  9])
```

slicing

In [131…
```
d[:]
```

Out[131…
```
array([[40, 24, 45, 11, 40, 35, 40, 37, 18, 40],
       [13,  4,  5, 37, 44, 23, 45,  8, 24,  3],
       [10, 44, 22, 46, 44, 46, 23, 18,  6,  8],
       [ 6, 39, 49, 45, 25, 44, 22, 44, 16,  9],
       [ 3, 21, 27,  0, 21,  8,  1, 21, 32, 38]])
```

In [132…
```
d[::-1]
```

Out[132…
```
array([[ 3, 21, 27,  0, 21,  8,  1, 21, 32, 38],
       [ 6, 39, 49, 45, 25, 44, 22, 44, 16,  9],
       [10, 44, 22, 46, 44, 46, 23, 18,  6,  8],
       [13,  4,  5, 37, 44, 23, 45,  8, 24,  3],
       [40, 24, 45, 11, 40, 35, 40, 37, 18, 40]])
```

In [133…
```
d[row:col]
```

Out[133…
```
array([[ 6, 39, 49, 45, 25, 44, 22, 44, 16,  9],
       [ 3, 21, 27,  0, 21,  8,  1, 21, 32, 38]])
```

In [134…
```
d[:,2] # by using comma , prints column
```

Out[134…
```
array([45,  5, 22, 49, 27])
```

In [135…
```
d[:,0]
```

Out[135…
```
array([40, 13, 10,  6,  3])
```

In [136…
```
d[:,4]
```

Out[136…
```
array([40, 44, 44, 25, 21])
```

In [137…
```
d
```

Out[137…
```
array([[40, 24, 45, 11, 40, 35, 40, 37, 18, 40],
       [13,  4,  5, 37, 44, 23, 45,  8, 24,  3],
       [10, 44, 22, 46, 44, 46, 23, 18,  6,  8],
       [ 6, 39, 49, 45, 25, 44, 22, 44, 16,  9],
       [ 3, 21, 27,  0, 21,  8,  1, 21, 32, 38]])
```

In [138…
```
d[:row]
```

Out[138…
```
array([[40, 24, 45, 11, 40, 35, 40, 37, 18, 40],
       [13,  4,  5, 37, 44, 23, 45,  8, 24,  3],
       [10, 44, 22, 46, 44, 46, 23, 18,  6,  8]])
```

In [139…
```
d[row:]
```

Out[139…
```
array([[ 6, 39, 49, 45, 25, 44, 22, 44, 16,  9],
       [ 3, 21, 27,  0, 21,  8,  1, 21, 32, 38]])
```

In [140…
```
d[:,-1]
```

Out[140…
```
array([40,  3,  8,  9, 38])
```

In [145…
```
d[::-2]
```

Out[145…
```
array([[ 3, 21, 27,  0, 21,  8,  1, 21, 32, 38],
       [10, 44, 22, 46, 44, 46, 23, 18,  6,  8],
       [40, 24, 45, 11, 40, 35, 40, 37, 18, 40]])
```

In [147…
```
d
```

Out[147…
```
array([[40, 24, 45, 11, 40, 35, 40, 37, 18, 40],
       [13,  4,  5, 37, 44, 23, 45,  8, 24,  3],
       [10, 44, 22, 46, 44, 46, 23, 18,  6,  8],
       [ 6, 39, 49, 45, 25, 44, 22, 44, 16,  9],
       [ 3, 21, 27,  0, 21,  8,  1, 21, 32, 38]])
```

In [151…
```
d[1:-1]
```

Out[151…
```
array([[13,  4,  5, 37, 44, 23, 45,  8, 24,  3],
       [10, 44, 22, 46, 44, 46, 23, 18,  6,  8],
       [ 6, 39, 49, 45, 25, 44, 22, 44, 16,  9]])
```

In [152…
```
d[0:5:3]
```

Out[152…
```
array([[40, 24, 45, 11, 40, 35, 40, 37, 18, 40],
       [ 6, 39, 49, 45, 25, 44, 22, 44, 16,  9]])
```

In [153…
```
d[1:2:3]
```

Out[153…
```
array([[13,  4,  5, 37, 44, 23, 45,  8, 24,  3]])
```

In [154…
```
d[2:3:2]
```

Out[154…
```
array([[10, 44, 22, 46, 44, 46, 23, 18,  6,  8]])
```

In [155…
```
d[1:3:4]
```

Out[155… array([[13, 4, 5, 37, 44, 23, 45, 8, 24, 3]])

In [157…
```
d1=np.random.randint(0,100,(10,10))
d1
```

Out[157…
```
array([[32, 51, 26, 62, 14, 58, 20, 93, 93, 89],
       [24, 80, 93, 96, 41, 79, 23,  3, 38,  3],
       [59, 39, 32, 44, 37, 50, 75, 37, 70, 12],
       [ 2, 20, 94, 81, 21, 43, 16,  8, 95, 14],
       [64, 33, 57, 65, 33, 65, 67, 71, 74, 26],
       [82, 24, 65, 80, 46, 27,  0, 61, 20, 86],
       [46, 99, 14, 37, 93, 17, 18, 98, 67, 18],
       [82, 79,  5, 78, 31, 21, 99, 21, 98, 85],
       [41, 47, 32, 72, 56,  0, 91, 32, 63, 57],
       [ 3, 67, 80, 26, 17,  5, 51, 75, 92,  9]])
```

In [158…
```
d1[2:6,2:4]
```

Out[158…
```
array([[32, 44],
       [94, 81],
       [57, 65],
       [65, 80]])
```

In [159…
```
d1[1:2,2:4]
```

Out[159… array([[93, 96]])

In [160…
```
d1[2:3,2:3]
```

Out[160… array([[32]])

In [161…
```
d1[3:7,4:6]
```

Out[161…
```
array([[21, 43],
       [33, 65],
       [46, 27],
       [93, 17]])
```

Masking / Filtering

In [162…
```
d1
```

Out[162…
```
array([[32, 51, 26, 62, 14, 58, 20, 93, 93, 89],
       [24, 80, 93, 96, 41, 79, 23,  3, 38,  3],
       [59, 39, 32, 44, 37, 50, 75, 37, 70, 12],
       [ 2, 20, 94, 81, 21, 43, 16,  8, 95, 14],
       [64, 33, 57, 65, 33, 65, 67, 71, 74, 26],
       [82, 24, 65, 80, 46, 27,  0, 61, 20, 86],
       [46, 99, 14, 37, 93, 17, 18, 98, 67, 18],
       [82, 79,  5, 78, 31, 21, 99, 21, 98, 85],
       [41, 47, 32, 72, 56,  0, 91, 32, 63, 57],
       [ 3, 67, 80, 26, 17,  5, 51, 75, 92,  9]])
```

In [163…
```
d1[d1>50]
```

Out[163…
```
array([51, 62, 58, 93, 93, 89, 80, 93, 96, 79, 59, 75, 70, 94, 81, 95, 64,
       57, 65, 65, 67, 71, 74, 82, 65, 80, 61, 86, 99, 93, 98, 67, 82, 79,
       78, 99, 98, 85, 72, 56, 91, 63, 57, 67, 80, 51, 75, 92])
```

In [164…
```
d1[d1<=50]
```

Out[164…
```
array([32, 26, 14, 20, 24, 41, 23,  3, 38,  3, 39, 32, 44, 37, 50, 37, 12,
        2, 20, 21, 43, 16,  8, 14, 33, 33, 26, 24, 46, 27,  0, 20, 46, 14,
       37, 17, 18, 18,  5, 31, 21, 21, 41, 47, 32,  0, 32,  3, 26, 17,  5,
        9])
```

In [165…
```
d1>50
```

Out[165…
```
array([[False,  True, False,  True, False,  True, False,  True,  True,
         True],
       [False,  True,  True,  True, False,  True, False, False, False,
        False],
       [ True, False, False, False, False, False,  True, False,  True,
        False],
       [False, False,  True,  True, False, False, False, False,  True,
        False],
       [ True, False,  True,  True, False,  True,  True,  True,  True,
        False],
       [ True, False,  True,  True, False, False, False,  True, False,
         True],
       [False,  True, False, False,  True, False, False,  True,  True,
        False],
       [ True,  True, False,  True, False, False,  True, False,  True,
         True],
       [False, False, False,  True,  True, False,  True, False,  True,
         True],
       [False,  True,  True, False, False, False,  True,  True,  True,
        False]])
```

In [166…
```
d1[d1==50]
```

Out[166…
```
array([50])
```

In [167…
```
d1==50
```

Out[167…
```
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,  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, 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 [168…
```
d1
```

Out[168…
```
array([[32, 51, 26, 62, 14, 58, 20, 93, 93, 89],
       [24, 80, 93, 96, 41, 79, 23,  3, 38,  3],
       [59, 39, 32, 44, 37, 50, 75, 37, 70, 12],
       [ 2, 20, 94, 81, 21, 43, 16,  8, 95, 14],
       [64, 33, 57, 65, 33, 65, 67, 71, 74, 26],
       [82, 24, 65, 80, 46, 27,  0, 61, 20, 86],
       [46, 99, 14, 37, 93, 17, 18, 98, 67, 18],
       [82, 79,  5, 78, 31, 21, 99, 21, 98, 85],
       [41, 47, 32, 72, 56,  0, 91, 32, 63, 57],
       [ 3, 67, 80, 26, 17,  5, 51, 75, 92,  9]])
```

In [170…
```
d2=d1[d1>40]
d2
```

Out[170…
```
array([51, 62, 58, 93, 93, 89, 80, 93, 96, 41, 79, 59, 44, 50, 75, 70, 94,
       81, 43, 95, 64, 57, 65, 65, 67, 71, 74, 82, 65, 80, 46, 61, 86, 46,
       99, 93, 98, 67, 82, 79, 78, 99, 98, 85, 41, 47, 72, 56, 91, 63, 57,
       67, 80, 51, 75, 92])
```

In [171…
```
d3=d1[d1<40]
d3
```

Out[171…
```
array([32, 26, 14, 20, 24, 23,  3, 38,  3, 39, 32, 37, 37, 12,  2, 20, 21,
       16,  8, 14, 33, 33, 26, 24, 27,  0, 20, 14, 37, 17, 18, 18,  5, 31,
       21, 21, 32,  0, 32,  3, 26, 17,  5,  9])
```

In [173…
```
d4=d1[d1!=40]
d4
```

Out[173…
```
array([32, 51, 26, 62, 14, 58, 20, 93, 93, 89, 24, 80, 93, 96, 41, 79, 23,
        3, 38,  3, 59, 39, 32, 44, 37, 50, 75, 37, 70, 12,  2, 20, 94, 81,
       21, 43, 16,  8, 95, 14, 64, 33, 57, 65, 33, 65, 67, 71, 74, 26, 82,
       24, 65, 80, 46, 27,  0, 61, 20, 86, 46, 99, 14, 37, 93, 17, 18, 98,
       67, 18, 82, 79,  5, 78, 31, 21, 99, 21, 98, 85, 41, 47, 32, 72, 56,
        0, 91, 32, 63, 57,  3, 67, 80, 26, 17,  5, 51, 75, 92,  9])
```

In [174…
```
d1
```

Out[174…
```
array([[32, 51, 26, 62, 14, 58, 20, 93, 93, 89],
       [24, 80, 93, 96, 41, 79, 23,  3, 38,  3],
       [59, 39, 32, 44, 37, 50, 75, 37, 70, 12],
       [ 2, 20, 94, 81, 21, 43, 16,  8, 95, 14],
       [64, 33, 57, 65, 33, 65, 67, 71, 74, 26],
       [82, 24, 65, 80, 46, 27,  0, 61, 20, 86],
       [46, 99, 14, 37, 93, 17, 18, 98, 67, 18],
       [82, 79,  5, 78, 31, 21, 99, 21, 98, 85],
       [41, 47, 32, 72, 56,  0, 91, 32, 63, 57],
       [ 3, 67, 80, 26, 17,  5, 51, 75, 92,  9]])
```

In [175…
```
d2
```

Out[175…
```
array([51, 62, 58, 93, 93, 89, 80, 93, 96, 41, 79, 59, 44, 50, 75, 70, 94,
       81, 43, 95, 64, 57, 65, 65, 67, 71, 74, 82, 65, 80, 46, 61, 86, 46,
       99, 93, 98, 67, 82, 79, 78, 99, 98, 85, 41, 47, 72, 56, 91, 63, 57,
       67, 80, 51, 75, 92])
```

In [176…
```
d3
```

Out[176…
```
array([32, 26, 14, 20, 24, 23,  3, 38,  3, 39, 32, 37, 37, 12,  2, 20, 21,
       16,  8, 14, 33, 33, 26, 24, 27,  0, 20, 14, 37, 17, 18, 18,  5, 31,
       21, 21, 32,  0, 32,  3, 26, 17,  5,  9])
```

In [177…
```
d4
```

Out[177…
```
array([32, 51, 26, 62, 14, 58, 20, 93, 93, 89, 24, 80, 93, 96, 41, 79, 23,
        3, 38,  3, 59, 39, 32, 44, 37, 50, 75, 37, 70, 12,  2, 20, 94, 81,
       21, 43, 16,  8, 95, 14, 64, 33, 57, 65, 33, 65, 67, 71, 74, 26, 82,
       24, 65, 80, 46, 27,  0, 61, 20, 86, 46, 99, 14, 37, 93, 17, 18, 98,
       67, 18, 82, 79,  5, 78, 31, 21, 99, 21, 98, 85, 41, 47, 32, 72, 56,
        0, 91, 32, 63, 57,  3, 67, 80, 26, 17,  5, 51, 75, 92,  9])
```

In [ ]: