numpy

In [33]:

```
import numpy as np
```

In [35]:

```
np.__version__
```

Out[35]:

```
'1.26.4'
```

creating arraya

In [38]:

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

Out[38]:

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

In [40]:

```
type(my_list)
```

Out[40]:

```
list
```

In [42]:

```
arr = np.array(my_list)
```

In [44]:

```
arr
```

Out[44]:

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

In [46]:

```
type(arr)
```

Out[46]:

```
numpy.ndarray
```

In [48]:

```
type(my_list)
```

Out[48]:

```
list
```

In [50]:

```
np.arange(5)
```

Out[50]:

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

In [52]:

```
np.arange(3.0)
```

Out[52]:

```
array([0., 1., 2.])
```

In [54]:

```
np.arange(10)
```

Out[54]:

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

In [56]:

```
np.arange(0,5)
```

Out[56]:

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

In [58]:

```
np.arange(10,20)
```

Out[58]:

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

In [60]:

```
np.arange(20,10)
```

Out[60]:

```
array([], dtype=int32)
```

In [62]:

```
np.arange(-20,10)
```

Out[62]:

```
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 [64]:

```
np.arange(-16,10)
```

Out[64]:

```
array([-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 [66]:

```
np.arange(-20,-10)
```

Out[66]:

```
array([-20, -19, -18, -17, -16, -15, -14, -13, -12, -11])
```

In [68]:

```
np.arange(30,20)
```

Out[68]:

```
array([], dtype=int32)
```

In [70]:

```
b = np.arange(-30,20)
b
```

Out[70]:

```
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 [72]:

```
np.arange(10,10) |
```

```
  Cell In[72], line 1
    np.arange(10,10) |
                     ^
SyntaxError: invalid syntax
```

In [74]:

```
np.arange(-20,20)
```

Out[74]:

```
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,  10,  11,  12,  13,  14,  15,  16,  17,  18,
        19])
```

In [76]:

```
np.arange(10,30,5)
```

Out[76]:

```
array([10, 15, 20, 25])
```

In [78]:

```
np.arange(0,10,3)
```

Out[78]:

```
array([0, 3, 6, 9])
```

In [80]:

```
np.arange(10,30,5,1)
```

```
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
Cell In[80], line 1
----> 1 np.arange(10,30,5,1)

TypeError: Cannot interpret '1' as a data type
```

In [82]:

```
b1 = np.zeros(2)
b1
```

Out[82]:

```
array([0., 0.])
```

In [84]:

```
np.zeros(5,dtype=int)
```

Out[84]:

```
array([0, 0, 0, 0, 0])
```

In [86]:

```
zero = np.zeros((2,2))
zero
```

Out[86]:

```
array([[0., 0.],
       [0., 0.]])
```

In [88]:

```
np.zeros((10,10))
```

Out[88]:

```
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 [90]:

```
np.zeros((2,10))
```

Out[90]:

```
array([[0., 0., 0., 0., 0., 0., 0., 0., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0.]])
```

In [92]:

```
np.zeros((2,2))
```

Out[92]:

```
array([[0., 0.],
       [0., 0.]])
```

In [94]:

```
np.zeros((3,3))
```

Out[94]:

```
array([[0., 0., 0.],
       [0., 0., 0.],
       [0., 0., 0.]])
```

In [96]:

```
np.zeros((10,30))
```

Out[96]:

```
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 [98]:

```
np.zeros((5,10))
```

Out[98]:

```
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.]])
```

In [100]:

```
n = (5,7)
n1 = (6,8)
print(np.zeros(n))
```

```
[[0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 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 [102]:

```
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 [104]:

```
np.ones(4,dtype=int)
```

Out[104]:

```
array([1, 1, 1, 1])
```

In [106]:

```
np.ones(4)
```

Out[106]:

```
array([1., 1., 1., 1.])
```

In [108]:

```
n
```

Out[108]:

```
(5, 7)
```

In [110]:

```
np.ones(n)
```

Out[110]:

```
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.]])
```

In [112]:

```
np.ones((5,4),dtype=int)
```

Out[112]:

```
array([[1, 1, 1, 1],
       [1, 1, 1, 1],
       [1, 1, 1, 1],
       [1, 1, 1, 1],
       [1, 1, 1, 1]])
```

In [114]:

```
np.twos((2,3))
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[114], 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 [116]:

```
np.ones((2,4))
```

Out[116]:

```
array([[1., 1., 1., 1.],
       [1., 1., 1., 1.]])
```

In [118]:

```
np.ones((6,10),dtype = int)
```

Out[118]:

```
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]])
```

In [120]:

```
np.twos((2,4))
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[120], line 1
----> 1 np.twos((2,4))

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 [122]:

```
np.three((2,4))
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[122], line 1
----> 1 np.three((2,4))

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 [124]:

```
np.arange(3)
```

Out[124]:

```
array([0, 1, 2])
```

In [130]:

```
zeros(5)
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
Cell In[130], line 1
----> 1 zeros(5)

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

In [132]:

```
from numpy import
arange(3)
```

```
  Cell In[132], line 1
    from numpy import
                     ^
SyntaxError: invalid syntax
```

In [135]:

```
np.threes((3,2))
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[135], line 1
----> 1 np.threes((3,2))

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 'threes'
```

In [137]:

```
rand(3,2)
random.rand(3,2)
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
Cell In[137], line 1
----> 1 rand(3,2)
      2 random.rand(3,2)

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

In [139]:

```
np.random.rand(4)
```

Out[139]:

```
array([0.08873839, 0.70929077, 0.90663158, 0.19733766])
```

In [141]:

```
np.rand(4)
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[141], line 1
----> 1 np.rand(4)

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 'rand'
```

In [143]:

```
np.random.rand(2,4)
```

Out[143]:

```
array([[0.97429657, 0.21316113, 0.50441772, 0.98515827],
       [0.12385676, 0.33311414, 0.26146227, 0.63522639]])
```

In [145]:

```
np.random.randint(2,20)
```

Out[145]:

```
12
```

In [147]:

```
np.random.randint(0,2)
```

Out[147]:

```
1
```

In [149]:

```
np.random.randint(1,10,4)
```

Out[149]:

```
array([8, 2, 3, 4])
```

In [151]:

```
np.random.randint(1,3,5)
```

Out[151]:

```
array([1, 2, 2, 2, 1])
```

In [153]:

```
np.random.randint(30,20,10)
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[153], line 1
----> 1 np.random.randint(30,20,10)

File numpy\\random\\mtrand.pyx:780, in numpy.random.mtrand.RandomState.randint()

File numpy\\random\\_bounded_integers.pyx:1425, in numpy.random._bounded_integers._rand_int32()

ValueError: low >= high
```

In [155]:

```
np.random.randint(1)
```

Out[155]:

```
0
```

In [157]:

```
np.random.randint(5,9)
```

Out[157]:

```
8
```

In [159]:

```
np.random.randint(10,21,3)
```

Out[159]:

```
array([14, 15, 12])
```

In [161]:

```
np.random.randint(1,12,10)
```

Out[161]:

```
array([ 1,  3,  8,  1,  2,  2, 10, 11,  8, 11])
```

In [163]:

```
np.random.randint(10,40,(10,10))
```

Out[163]:

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

In [165]:

```
b = np.random.randint(10,20,(5,4))
b
```

Out[165]:

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

In [167]:

```
b[:]
```

Out[167]:

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

In [169]:

```
b[0:2]
```

Out[169]:

```
array([[14, 13, 16, 15],
       [18, 11, 18, 11]])
```

In [171]:

```
b
```

Out[171]:

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

In [173]:

```
b[0:-1]
```

Out[173]:

```
array([[14, 13, 16, 15],
       [18, 11, 18, 11],
       [18, 11, 15, 16],
       [15, 15, 16, 13]])
```

In [175]:

```
b
```

Out[175]:

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

In [177]:

```
b[0,2]
```

Out[177]:

```
16
```

In [179]:

```
np.random.randint(10,20,(4,4))
```

Out[179]:

```
array([[19, 15, 19, 17],
       [12, 15, 19, 13],
       [15, 10, 13, 19],
       [16, 16, 15, 12]])
```

OPERATIONS

In [182]:

```
a = np.random.randint(10,20,5)
a
```

Out[182]:

```
array([16, 16, 12, 10, 13])
```

In [184]:

```
arr
```

Out[184]:

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

In [186]:

```
arr2 = np.random.randint(0,100,(10,10))
```

In [188]:

```
arr2
```

Out[188]:

```
array([[37, 27, 91, 31, 87, 34, 36, 91, 39, 81],
       [ 6,  8, 32,  9, 93, 54, 88, 89, 18, 20],
       [88, 34, 57, 17, 89, 27, 60, 24, 27, 19],
       [22, 65, 23, 53, 63, 79, 64, 96, 35, 88],
       [81,  3, 36, 70, 45, 55, 75,  6, 57, 35],
       [49, 45, 25, 70,  5, 91, 91, 17, 49, 41],
       [31, 45,  3, 65, 47, 69,  4, 83, 78, 77],
       [99, 77, 92,  1, 53, 95, 98,  5, 91, 11],
       [93, 79, 51, 37,  0, 52, 13, 57, 84, 75],
       [65, 20, 95,  0, 72, 46, 14, 48, 50, 22]])
```

In [190]:

```
arr
```

Out[190]:

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

In [192]:

```
arr[:]
```

Out[192]:

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

In [194]:

```
arr[:4]
```

Out[194]:

```
array([0, 1, 2, 3])
```

In [196]:

```
arr2[:]
```

Out[196]:

```
array([[37, 27, 91, 31, 87, 34, 36, 91, 39, 81],
       [ 6,  8, 32,  9, 93, 54, 88, 89, 18, 20],
       [88, 34, 57, 17, 89, 27, 60, 24, 27, 19],
       [22, 65, 23, 53, 63, 79, 64, 96, 35, 88],
       [81,  3, 36, 70, 45, 55, 75,  6, 57, 35],
       [49, 45, 25, 70,  5, 91, 91, 17, 49, 41],
       [31, 45,  3, 65, 47, 69,  4, 83, 78, 77],
       [99, 77, 92,  1, 53, 95, 98,  5, 91, 11],
       [93, 79, 51, 37,  0, 52, 13, 57, 84, 75],
       [65, 20, 95,  0, 72, 46, 14, 48, 50, 22]])
```

In [198]:

```
arr2[0:5]
```

Out[198]:

```
array([[37, 27, 91, 31, 87, 34, 36, 91, 39, 81],
       [ 6,  8, 32,  9, 93, 54, 88, 89, 18, 20],
       [88, 34, 57, 17, 89, 27, 60, 24, 27, 19],
       [22, 65, 23, 53, 63, 79, 64, 96, 35, 88],
       [81,  3, 36, 70, 45, 55, 75,  6, 57, 35]])
```

In [200]:

```
arr2
```

Out[200]:

```
array([[37, 27, 91, 31, 87, 34, 36, 91, 39, 81],
       [ 6,  8, 32,  9, 93, 54, 88, 89, 18, 20],
       [88, 34, 57, 17, 89, 27, 60, 24, 27, 19],
       [22, 65, 23, 53, 63, 79, 64, 96, 35, 88],
       [81,  3, 36, 70, 45, 55, 75,  6, 57, 35],
       [49, 45, 25, 70,  5, 91, 91, 17, 49, 41],
       [31, 45,  3, 65, 47, 69,  4, 83, 78, 77],
       [99, 77, 92,  1, 53, 95, 98,  5, 91, 11],
       [93, 79, 51, 37,  0, 52, 13, 57, 84, 75],
       [65, 20, 95,  0, 72, 46, 14, 48, 50, 22]])
```

In [202]:

```
arr2[1,5]
```

Out[202]:

```
54
```

In [204]:

```
arr2
```

Out[204]:

```
array([[37, 27, 91, 31, 87, 34, 36, 91, 39, 81],
       [ 6,  8, 32,  9, 93, 54, 88, 89, 18, 20],
       [88, 34, 57, 17, 89, 27, 60, 24, 27, 19],
       [22, 65, 23, 53, 63, 79, 64, 96, 35, 88],
       [81,  3, 36, 70, 45, 55, 75,  6, 57, 35],
       [49, 45, 25, 70,  5, 91, 91, 17, 49, 41],
       [31, 45,  3, 65, 47, 69,  4, 83, 78, 77],
       [99, 77, 92,  1, 53, 95, 98,  5, 91, 11],
       [93, 79, 51, 37,  0, 52, 13, 57, 84, 75],
       [65, 20, 95,  0, 72, 46, 14, 48, 50, 22]])
```

In [206]:

```
arr2[-5,5]
```

Out[206]:

```
91
```

In [208]:

```
arr2[-5,-5]
```

Out[208]:

```
91
```

arr2

In [210]:

```
arr2[-5,-5]
```

Out[210]:

```
91
```

In [212]:

```
arr2
```

Out[212]:

```
array([[37, 27, 91, 31, 87, 34, 36, 91, 39, 81],
       [ 6,  8, 32,  9, 93, 54, 88, 89, 18, 20],
       [88, 34, 57, 17, 89, 27, 60, 24, 27, 19],
       [22, 65, 23, 53, 63, 79, 64, 96, 35, 88],
       [81,  3, 36, 70, 45, 55, 75,  6, 57, 35],
       [49, 45, 25, 70,  5, 91, 91, 17, 49, 41],
       [31, 45,  3, 65, 47, 69,  4, 83, 78, 77],
       [99, 77, 92,  1, 53, 95, 98,  5, 91, 11],
       [93, 79, 51, 37,  0, 52, 13, 57, 84, 75],
       [65, 20, 95,  0, 72, 46, 14, 48, 50, 22]])
```

In [214]:

```
arr2[-1,-2]
```

Out[214]:

```
50
```

In [216]:

```
arr2
```

Out[216]:

```
array([[37, 27, 91, 31, 87, 34, 36, 91, 39, 81],
       [ 6,  8, 32,  9, 93, 54, 88, 89, 18, 20],
       [88, 34, 57, 17, 89, 27, 60, 24, 27, 19],
       [22, 65, 23, 53, 63, 79, 64, 96, 35, 88],
       [81,  3, 36, 70, 45, 55, 75,  6, 57, 35],
       [49, 45, 25, 70,  5, 91, 91, 17, 49, 41],
       [31, 45,  3, 65, 47, 69,  4, 83, 78, 77],
       [99, 77, 92,  1, 53, 95, 98,  5, 91, 11],
       [93, 79, 51, 37,  0, 52, 13, 57, 84, 75],
       [65, 20, 95,  0, 72, 46, 14, 48, 50, 22]])
```

In [218]:

```
arr2[::-1]
```

Out[218]:

```
array([[65, 20, 95,  0, 72, 46, 14, 48, 50, 22],
       [93, 79, 51, 37,  0, 52, 13, 57, 84, 75],
       [99, 77, 92,  1, 53, 95, 98,  5, 91, 11],
       [31, 45,  3, 65, 47, 69,  4, 83, 78, 77],
       [49, 45, 25, 70,  5, 91, 91, 17, 49, 41],
       [81,  3, 36, 70, 45, 55, 75,  6, 57, 35],
       [22, 65, 23, 53, 63, 79, 64, 96, 35, 88],
       [88, 34, 57, 17, 89, 27, 60, 24, 27, 19],
       [ 6,  8, 32,  9, 93, 54, 88, 89, 18, 20],
       [37, 27, 91, 31, 87, 34, 36, 91, 39, 81]])
```

In [220]:

```
arr2
```

Out[220]:

```
array([[37, 27, 91, 31, 87, 34, 36, 91, 39, 81],
       [ 6,  8, 32,  9, 93, 54, 88, 89, 18, 20],
       [88, 34, 57, 17, 89, 27, 60, 24, 27, 19],
       [22, 65, 23, 53, 63, 79, 64, 96, 35, 88],
       [81,  3, 36, 70, 45, 55, 75,  6, 57, 35],
       [49, 45, 25, 70,  5, 91, 91, 17, 49, 41],
       [31, 45,  3, 65, 47, 69,  4, 83, 78, 77],
       [99, 77, 92,  1, 53, 95, 98,  5, 91, 11],
       [93, 79, 51, 37,  0, 52, 13, 57, 84, 75],
       [65, 20, 95,  0, 72, 46, 14, 48, 50, 22]])
```

In [222]:

```
arr2[::-2]
```

Out[222]:

```
array([[65, 20, 95,  0, 72, 46, 14, 48, 50, 22],
       [99, 77, 92,  1, 53, 95, 98,  5, 91, 11],
       [49, 45, 25, 70,  5, 91, 91, 17, 49, 41],
       [22, 65, 23, 53, 63, 79, 64, 96, 35, 88],
       [ 6,  8, 32,  9, 93, 54, 88, 89, 18, 20]])
```

In [224]:

```
arr2
```

Out[224]:

```
array([[37, 27, 91, 31, 87, 34, 36, 91, 39, 81],
       [ 6,  8, 32,  9, 93, 54, 88, 89, 18, 20],
       [88, 34, 57, 17, 89, 27, 60, 24, 27, 19],
       [22, 65, 23, 53, 63, 79, 64, 96, 35, 88],
       [81,  3, 36, 70, 45, 55, 75,  6, 57, 35],
       [49, 45, 25, 70,  5, 91, 91, 17, 49, 41],
       [31, 45,  3, 65, 47, 69,  4, 83, 78, 77],
       [99, 77, 92,  1, 53, 95, 98,  5, 91, 11],
       [93, 79, 51, 37,  0, 52, 13, 57, 84, 75],
       [65, 20, 95,  0, 72, 46, 14, 48, 50, 22]])
```

In [226]:

```
arr2[::-3]
```

Out[226]:

```
array([[65, 20, 95,  0, 72, 46, 14, 48, 50, 22],
       [31, 45,  3, 65, 47, 69,  4, 83, 78, 77],
       [22, 65, 23, 53, 63, 79, 64, 96, 35, 88],
       [37, 27, 91, 31, 87, 34, 36, 91, 39, 81]])
```

In [228]:

```
arr2
```

Out[228]:

```
array([[37, 27, 91, 31, 87, 34, 36, 91, 39, 81],
       [ 6,  8, 32,  9, 93, 54, 88, 89, 18, 20],
       [88, 34, 57, 17, 89, 27, 60, 24, 27, 19],
       [22, 65, 23, 53, 63, 79, 64, 96, 35, 88],
       [81,  3, 36, 70, 45, 55, 75,  6, 57, 35],
       [49, 45, 25, 70,  5, 91, 91, 17, 49, 41],
       [31, 45,  3, 65, 47, 69,  4, 83, 78, 77],
       [99, 77, 92,  1, 53, 95, 98,  5, 91, 11],
       [93, 79, 51, 37,  0, 52, 13, 57, 84, 75],
       [65, 20, 95,  0, 72, 46, 14, 48, 50, 22]])
```

In [230]:

```
arr.max()
```

Out[230]:

```
5
```

In [232]:

```
arr.min()
```

Out[232]:

```
0
```

In [234]:

```
arr
```

Out[234]:

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

In [236]:

```
arr.mean()
```

Out[236]:

```
2.5
```

In [238]:

```
arr.mean()
```

Out[238]:

```
2.5
```

In [240]:

```
arr.mean()
```

Out[240]:

```
2.5
```

In [242]:

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

```
  Cell In[242], line 1
    from numpy import
                     ^
SyntaxError: invalid syntax
```

In [244]:

```
arr
```

Out[244]:

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

In [246]:

```
arr.reshape(2,3)
```

Out[246]:

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

In [248]:

```
arr.reshape(6,1)
```

Out[248]:

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

In [250]:

```
arr.reshape(1,6)
```

Out[250]:

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

In [252]:

```
arr.reshape(1,6)
```

Out[252]:

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

In [254]:

```
arr
```

Out[254]:

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

In [256]:

```
arr.reshape(1,5)
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[256], line 1
----> 1 arr.reshape(1,5)

ValueError: cannot reshape array of size 6 into shape (1,5)
```

In [258]:

```
arr.reshape(3,2,order='C')
```

Out[258]:

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

In [260]:

```
arr.reshape(3,2,order='F')
```

Out[260]:

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

In [266]:

```
arr.reshape(3,2,order='A')
```

Out[266]:

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

In [268]:

```
arr.reshape(3,2,order='K')
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[268], line 1
----> 1 arr.reshape(3,2,order='K')

ValueError: order 'K' is not permitted for reshaping
```

In [270]:

```
arr
```

Out[270]:

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

In [272]:

```
arr.reshape(2,3)
```

Out[272]:

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

In [276]:

```
arr.reshape(1,4)
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[276], line 1
----> 1 arr.reshape(1,4)

ValueError: cannot reshape array of size 6 into shape (1,4)
```

In [278]:

```
arr.reshape(1,6)
```

Out[278]:

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

In [280]:

```
arr.reshape(6,1)
```

Out[280]:

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

In [284]:

```
arr.reshape(2,6)
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[284], line 1
----> 1 arr.reshape(2,6)

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

In [286]:

```
arr.reshape(3,3)
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[286], line 1
----> 1 arr.reshape(3,3)

ValueError: cannot reshape array of size 6 into shape (3,3)
```

In [288]:

```
arr
```

Out[288]:

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

In [290]:

```
arr.reshape(3,2)
```

Out[290]:

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

Indexing

In [293]:

```
mat = np.arange(0,100).reshape(10,10)
```

In [295]:

```
mat
```

Out[295]:

```
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 [301]:

```
row = 4
col = 5
```

In [303]:

```
col
```

Out[303]:

```
5
```

In [305]:

```
row
```

Out[305]:

```
4
```

In [307]:

```
mat
```

Out[307]:

```
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 [309]:

```
mat[row,col]
```

Out[309]:

```
45
```

In [311]:

```
mat[4,5]
```

Out[311]:

```
45
```

In [313]:

```
mat
```

Out[313]:

```
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 [315]:

```
mat[:]
```

Out[315]:

```
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 [317]:

```
col = 6
```

In [319]:

```
mat
```

Out[319]:

```
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 [321]:

```
mat[:,col]
```

Out[321]:

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

In [323]:

```
mat
```

Out[323]:

```
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 [325]:

```
mat[row,:]
```

Out[325]:

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

In [327]:

```
mat
```

Out[327]:

```
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 [329]:

```
mat[:,col]
```

Out[329]:

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

In [331]:

```
mat[:col]
```

Out[331]:

```
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 [333]:

```
row
```

Out[333]:

```
4
```

In [335]:

```
mat
```

Out[335]:

```
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 [337]:

```
mat[row:]
```

Out[337]:

```
array([[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 [339]:

```
mat[:]
```

Out[339]:

```
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 [341]:

```
mat[:,8]
```

Out[341]:

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

In [343]:

```
mat
```

Out[343]:

```
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 [345]:

```
row
```

Out[345]:

```
4
```

In [347]:

```
col
```

Out[347]:

```
6
```

In [349]:

```
mat[:,col]
```

Out[349]:

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

In [351]:

```
mat
```

Out[351]:

```
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 [353]:

```
mat[1,4]
```

Out[353]:

```
14
```

In [355]:

```
mat[1:4]
```

Out[355]:

```
array([[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]])
```

In [357]:

```
mat
```

Out[357]:

```
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 [359]:

```
mat[3:-3]
```

Out[359]:

```
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 [361]:

```
mat[0]
```

Out[361]:

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

In [363]:

```
mat[6]
```

Out[363]:

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

In [365]:

```
mat
```

Out[365]:

```
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 [367]:

```
mat[:6]
```

Out[367]:

```
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 [369]:

```
mat[6:]
```

Out[369]:

```
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 [371]:

```
mat
```

Out[371]:

```
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 [373]:

```
mat[5:7]
```

Out[373]:

```
array([[50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
       [60, 61, 62, 63, 64, 65, 66, 67, 68, 69]])
```

In [375]:

```
mat[0:10]
```

Out[375]:

```
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 [377]:

```
mat[0:10:3]
```

Out[377]:

```
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 [381]:

```
mat[0:10]
```

Out[381]:

```
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 [383]:

```
mat[0:10:3]
```

Out[383]:

```
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 [385]:

```
mat
```

Out[385]:

```
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 [387]:

```
mat[4:]
```

Out[387]:

```
array([[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 [389]:

```
mat[:4]
```

Out[389]:

```
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]])
```

In [391]:

```
mat[::-1]
```

Out[391]:

```
array([[90, 91, 92, 93, 94, 95, 96, 97, 98, 99],
       [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
       [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
       [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
       [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
       [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
       [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
       [ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9]])
```

In [393]:

```
mat[::-2]
```

Out[393]:

```
array([[90, 91, 92, 93, 94, 95, 96, 97, 98, 99],
       [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
       [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
       [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [10, 11, 12, 13, 14, 15, 16, 17, 18, 19]])
```

In [395]:

```
mat[::-3]
```

Out[395]:

```
array([[90, 91, 92, 93, 94, 95, 96, 97, 98, 99],
       [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
       [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9]])
```

In [399]:

```
mat[::-5]
```

Out[399]:

```
array([[90, 91, 92, 93, 94, 95, 96, 97, 98, 99],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49]])
```

In [401]:

```
mat
```

Out[401]:

```
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 [403]:

```
mat[2:6]
```

Out[403]:

```
array([[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 [405]:

```
mat[2:6,2:4]
```

Out[405]:

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

In [409]:

```
mat[0,1]
```

Out[409]:

```
1
```

In [411]:

```
mat[1,6]
```

Out[411]:

```
16
```

In [413]:

```
mat[1:6]
```

Out[413]:

```
array([[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 [415]:

```
mat[1:]
```

Out[415]:

```
array([[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 [417]:

```
mat[:6]
```

Out[417]:

```
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 [419]:

```
mat[3,5]
```

Out[419]:

```
35
```

In [421]:

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

Out[421]:

```
array([[12, 13]])
```

In [423]:

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

Out[423]:

```
array([[22]])
```

In [425]:

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

Out[425]:

```
array([[32, 33],
       [42, 43]])
```

In [427]:

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

Out[427]:

```
array([[24]])
```

Masking

In [430]:

```
mat
```

Out[430]:

```
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 [432]:

```
id(mat)
```

Out[432]:

```
2921050831728
```

In [434]:

```
mat
```

Out[434]:

```
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 [436]:

```
mat < 50
```

Out[436]:

```
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 [438]:

```
mat > 50
```

Out[438]:

```
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 [440]:

```
mat == 50
```

Out[440]:

```
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 [442]:

```
mat[mat==50]
```

Out[442]:

```
array([50])
```

In [444]:

```
a1 = mat[mat<50]
a1
```

Out[444]:

```
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 [446]:

```
mat
```

Out[446]:

```
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 [448]:

```
a2 = mat[mat>50]
a2
```

Out[448]:

```
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 [452]:

```
a3 = mat[mat>=50]
a3
```

Out[452]:

```
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 [454]:

```
a4 = mat[mat==50]
a4
```

Out[454]:

```
array([50])
```

In [456]:

```
mat>50
```

Out[456]:

```
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 [458]:

```
a1
```

Out[458]:

```
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 [460]:

```
a2
```

Out[460]:

```
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 [ ]: