Numpy crash course

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

```
In [2]:  np.__version__
```
```
Out[2]:  '1.21.5'
```

```
In [3]:  import sys
         sys.version
```
```
Out[3]:  '3.9.12 (main, Apr  4 2022, 05:22:27) [MSC v.1916 64 bit (AMD64)]'
```

creating Arrays

```
In [12]:  my_list = [0,1,2,3,4,5]
          my_list
```
```
Out[12]:  [0, 1, 2, 3, 4, 5]
```

```
In [13]:  type(my_list)
```
```
Out[13]:  list
```

```
In [14]:  arr = np.array(my_list)
```

```
In [15]:  arr
```
```
Out[15]:  array([0, 1, 2, 3, 4, 5])
```

```
In [16]:  type(arr)
```
```
Out[16]:  numpy.ndarray
```

```
In [17]:  type(my_list)
```
```
Out[17]:  list
```

```
In [19]:  np.arange(15)
```
```
Out[19]:  array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14])
```

```
In [20]:  np.arange(3.0)
```
```
Out[20]:  array([0., 1., 2.])
```

```
In [21]:  np.arange(10)
```

Out[21]: `array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])`

In [22]: `np.arange(0,5)`

Out[22]: `array([0, 1, 2, 3, 4])`

In [23]: `np.arange(10,20)`

Out[23]: `array([10, 11, 12, 13, 14, 15, 16, 17, 18, 19])`

In [24]: `np.arange(20,10)`

Out[24]: `array([], dtype=int32)`

In [25]: `np.arange(-20,10)`

Out[25]:
```
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 [26]: `np.arange(-16,10)`

Out[26]:
```
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 [27]: `np.arange(-20,-10)`

Out[27]: `array([-20, -19, -18, -17, -16, -15, -14, -13, -12, -11])`

In [28]: `np.arange(30,20)`

Out[28]: `array([], dtype=int32)`

In [30]:
```
ar = np.arange(-30,20)
ar
```

Out[30]:
```
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 [32]: `np.arange(10,10)`

Out[32]: `array([], dtype=int32)`

In [34]: `np.arange(10,30,5) # 10- starting from 30 -end point 5 - step count`

Out[34]: `array([10, 15, 20, 25])`

In [35]: `np.arange(0,10,3)`

Out[35]: `array([0, 3, 6, 9])`

In [36]: `np.zeros(3) # parameter tunning`

Out[36]:
```
array([0., 0., 0.])
```

In [37]:
```python
np.zeros(5, dtype=int) # hyperparameter tunning
```

Out[37]:
```
array([0, 0, 0, 0, 0])
```

In [38]:
```python
np.zeros((2,2), dtype=int)
```

Out[38]:
```
array([[0, 0],
       [0, 0]])
```

In [41]:
```python
zero = np.zeros([2,2])
print(zero)
print(type(zero))
```

```
[[0. 0.]
 [0. 0.]]
<class 'numpy.ndarray'>
```

In [44]:
```python
zero = np.zeros([2,2])
print(zero)


print('####')
print(type(zero))
```

```
[[0. 0.]
 [0. 0.]]
####
<class 'numpy.ndarray'>
```

In [46]:
```python
np.zeros((2,10))
```

Out[46]:
```
array([[0., 0., 0., 0., 0., 0., 0., 0., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0.]])
```

In [47]:
```python
np.zeros((2,2))
```

Out[47]:
```
array([[0., 0.],
       [0., 0.]])
```

In [48]:
```python
np.zeros((3,3))
```

Out[48]:
```
array([[0., 0., 0.],
       [0., 0., 0.],
       [0., 0., 0.]])
```

In [49]:
```python
np.zeros((10,30))
```

Out[49]:
```
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.]])
```

In [50]:
```python
np.zeros((5,10)) # bydefault large -- will give row & 2nd arg  - columns
```

Out[50]:
```
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 [51]:
```python
n = (6,7)
n1 = (6,8)
print(np.zeros(n1)) # parameter tunning
```

```
[[0. 0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0.]
 [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 [52]:
```python
print(np.zeros(n, dtype=int)) # hyperparameter tunning
```

```
[[0 0 0 0 0 0 0]
 [0 0 0 0 0 0 0]
 [0 0 0 0 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 [53]:
```python
n
```

Out[53]:
```
(6, 7)
```

In [54]:
```python
n1
```

Out[54]:
```
(6, 8)
```

In [55]:
```python
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 [56]: `np.ones(3)`

Out[56]: `array([1., 1., 1.])`

In [58]: `np.ones(4,dtype=int)`

Out[58]: `array([1, 1, 1, 1])`

In [59]: `np.ones(4)`

Out[59]: `array([1., 1., 1., 1.])`

In [60]: `n`

Out[60]: `(6, 7)`

In [62]: `np.ones(n)`

Out[62]:
```
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.]])
```

In [63]: `np.ones((5,4),dtype=int) # by default 5 - rows & 4 - columns`

Out[63]:
```
array([[1, 1, 1, 1],
       [1, 1, 1, 1],
       [1, 1, 1, 1],
       [1, 1, 1, 1],
       [1, 1, 1, 1]])
```

In [64]: `np.ones(2)`

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

In [65]: `np.ones((2,4))`

Out[65]:
```
array([[1., 1., 1., 1.],
       [1., 1., 1., 1.]])
```

In [66]: `np.ones((6,10), dtype=int)`

Out[66]:
```
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 [67]:
```python
range(5)
```

Out[67]:
```
range(0, 5)
```

In [70]:
```python
r = range(0,5)
r
```

Out[70]:
```
range(0, 5)
```

In [71]:
```python
for i in r:
    print(i)
```

```
0
1
2
3
4
```

In [73]:
```python
list(range(10))
```

Out[73]:
```
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
```

In [74]:
```python
range(1,10)
```

Out[74]:
```
range(1, 10)
```

In [75]:
```python
list(range(1,10))
```

Out[75]:
```
[1, 2, 3, 4, 5, 6, 7, 8, 9]
```

In [76]:
```python
list(range(1,10,3))
```

Out[76]:
```
[1, 4, 7]
```

In [78]:
```python
y = list(range(12))
y
```

Out[78]:
```
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11]
```

In [79]:
```python
np.random.rand(5)
```

Out[79]:
```
array([0.53694449, 0.26988473, 0.10944729, 0.02183082, 0.37436927])
```

In [80]:
```python
np.random.rand(2,4)
```

Out[80]:
```
array([[0.48705189, 0.19033577, 0.89333251, 0.6717383 ],
       [0.88031285, 0.45240572, 0.88442482, 0.19871893]])
```

In [81]:
```python
np.random.rand(2,20)
```

```
Out[81]:  array([[0.63608128, 0.26492787, 0.69273716, 0.06956443, 0.06771391,
                 0.79561151, 0.39465145, 0.57935519, 0.15166779, 0.54571124,
                 0.82162576, 0.26102598, 0.76854787, 0.21940598, 0.39777358,
                 0.56870297, 0.09360092, 0.81513342, 0.76641807, 0.41591523],
                [0.05122403, 0.61551148, 0.39247998, 0.02829814, 0.87588667,
                 0.25493754, 0.95433985, 0.44686716, 0.76959019, 0.64124825,
                 0.47730191, 0.71271582, 0.55643688, 0.90281798, 0.22765437,
                 0.97162307, 0.66240442, 0.06438823, 0.49566797, 0.75097928]])
```

```
In [82]:  np.random.randint(2,4)
```

```
Out[82]:  3
```

```
In [83]:  np.random.randint(2,20)
```

```
Out[83]:  9
```

```
In [84]:  np.random.randint(0,1)
```

```
Out[84]:  0
```

```
In [85]:  np.random.randint(10,20,5)
```

```
Out[85]:  array([16, 15, 18, 13, 19])
```

```
In [86]:  np.random.randint(1,6,4)
```

```
Out[86]:  array([2, 4, 4, 3])
```

```
In [91]:  np.random.rand(3)
```

```
Out[91]:  array([0.85290001, 0.57802279, 0.22694922])
```

```
In [92]:  np.random.randint(1)
```

```
Out[92]:  0
```

```
In [93]:  np.random.randint(-30,20,10)
```

```
Out[93]:  array([ 15,  -2, -16,   9,  10,  13,  -9,   5, -30,  10])
```

```
In [94]:  np.random.randint(20,30,10)
```

```
Out[94]:  array([24, 25, 26, 27, 20, 24, 29, 28, 28, 22])
```

```
In [95]:  np.random.randint(5,9)
```

```
Out[95]:  8
```

```
In [96]:  np.random.randint(10,21,3)
```

```
Out[96]:  array([15, 14, 20])
```

```
In [97]:  np.random.randint(1,12,10)
```

```
Out[97]:  array([ 4,  8,  7,  9, 11, 10,  1,  2,  5,  8])
```

```
In [98]:  np.random.randint(10,40,(10,10))
```

```
Out[98]:  array([[38, 14, 39, 20, 35, 29, 30, 35, 32, 16],
                 [31, 24, 21, 25, 36, 13, 24, 28, 28, 12],
                 [27, 20, 24, 28, 18, 39, 23, 30, 33, 24],
                 [25, 35, 17, 27, 11, 18, 13, 30, 26, 20],
                 [11, 26, 18, 33, 39, 18, 39, 36, 23, 24],
                 [19, 37, 33, 26, 20, 27, 35, 39, 23, 30],
                 [29, 39, 16, 25, 25, 27, 23, 15, 13, 21],
                 [39, 30, 22, 11, 24, 15, 30, 31, 15, 10],
                 [34, 37, 23, 36, 37, 23, 29, 39, 32, 30],
                 [34, 23, 17, 16, 25, 38, 18, 16, 39, 10]])
```

```
In [100…  np.random.randint(10,100,(12,12))
```

```
Out[100]:  array([[44, 94, 64, 54, 23, 27, 18, 92, 89, 28, 95, 60],
                  [99, 11, 62, 27, 79, 25, 94, 91, 76, 54, 37, 69],
                  [72, 83, 50, 69, 89, 20, 86, 69, 36, 83, 49, 19],
                  [34, 70, 40, 50, 89, 77, 36, 96, 26, 93, 84, 58],
                  [67, 65, 58, 24, 92, 77, 44, 36, 13, 12, 18, 27],
                  [12, 25, 22, 73, 56, 74, 71, 65, 16, 83, 99, 52],
                  [71, 14, 16, 38, 33, 56, 45, 26, 70, 40, 67, 42],
                  [18, 66, 39, 91, 71, 77, 12, 45, 74, 67, 10, 58],
                  [37, 20, 90, 19, 27, 29, 49, 17, 27, 88, 57, 43],
                  [87, 81, 85, 93, 63, 48, 75, 27, 24, 10, 52, 87],
                  [30, 55, 97, 31, 29, 76, 50, 96, 55, 87, 25, 95],
                  [19, 31, 97, 45, 12, 72, 93, 68, 29, 46, 35, 89]])
```

```
In [101…  np.arange(1,13).reshape(3,4)
```

```
Out[101]:  array([[ 1,  2,  3,  4],
                  [ 5,  6,  7,  8],
                  [ 9, 10, 11, 12]])
```

```
In [102…  np.arange(1,13).reshape(12,1)
```

```
Out[102]:  array([[ 1],
                  [ 2],
                  [ 3],
                  [ 4],
                  [ 5],
                  [ 6],
                  [ 7],
                  [ 8],
                  [ 9],
                  [10],
                  [11],
                  [12]])
```

```
In [104…  b = np.random.randint(10,20,(5,4))
          b
```

```
Out[104]:  array([[13, 13, 17, 18],
                  [10, 11, 17, 14],
                  [10, 11, 11, 18],
                  [18, 15, 18, 14],
                  [18, 13, 15, 18]])
```

In [105…   `type(b)`

Out[105]: `numpy.ndarray`

In [106…   `b`

Out[106]:
```
array([[13, 13, 17, 18],
       [10, 11, 17, 14],
       [10, 11, 11, 18],
       [18, 15, 18, 14],
       [18, 13, 15, 18]])
```

In [107…   `b[:]`

Out[107]:
```
array([[13, 13, 17, 18],
       [10, 11, 17, 14],
       [10, 11, 11, 18],
       [18, 15, 18, 14],
       [18, 13, 15, 18]])
```

In [108…   `b[1:3]`

Out[108]:
```
array([[10, 11, 17, 14],
       [10, 11, 11, 18]])
```

In [109…   `b`

Out[109]:
```
array([[13, 13, 17, 18],
       [10, 11, 17, 14],
       [10, 11, 11, 18],
       [18, 15, 18, 14],
       [18, 13, 15, 18]])
```

In [110…   `b[1,2]`

Out[110]: `17`

In [111…   `b`

Out[111]:
```
array([[13, 13, 17, 18],
       [10, 11, 17, 14],
       [10, 11, 11, 18],
       [18, 15, 18, 14],
       [18, 13, 15, 18]])
```

In [112…   `b[1,3]`

Out[112]: `14`

In [113…   `b[1,-1]`

Out[113]: `14`

In [114…   `b`

Out[114]:
```
array([[13, 13, 17, 18],
       [10, 11, 17, 14],
       [10, 11, 11, 18],
       [18, 15, 18, 14],
       [18, 13, 15, 18]])
```

In [115…
```
b[2:3]
```

Out[115]:
```
array([[10, 11, 11, 18]])
```

In [116…
```
b
```

Out[116]:
```
array([[13, 13, 17, 18],
       [10, 11, 17, 14],
       [10, 11, 11, 18],
       [18, 15, 18, 14],
       [18, 13, 15, 18]])
```

In [117…
```
b[0:-2]
```

Out[117]:
```
array([[13, 13, 17, 18],
       [10, 11, 17, 14],
       [10, 11, 11, 18]])
```

In [118…
```
b
```

Out[118]:
```
array([[13, 13, 17, 18],
       [10, 11, 17, 14],
       [10, 11, 11, 18],
       [18, 15, 18, 14],
       [18, 13, 15, 18]])
```

In [119…
```
b[0,2]
```

Out[119]: 17

In [120…
```
b
```

Out[120]:
```
array([[13, 13, 17, 18],
       [10, 11, 17, 14],
       [10, 11, 11, 18],
       [18, 15, 18, 14],
       [18, 13, 15, 18]])
```

In [121…
```
b[-4,2]
```

Out[121]: 17

In [123…
```
np.random.randint(10,20,(4,4))
```

Out[123]:
```
array([[17, 16, 18, 12],
       [18, 19, 16, 16],
       [16, 10, 12, 17],
       [15, 16, 18, 15]])
```

In [124…
```
b
```

Out[124]:
```
array([[13, 13, 17, 18],
       [10, 11, 17, 14],
       [10, 11, 11, 18],
       [18, 15, 18, 14],
       [18, 13, 15, 18]])
```

In [125…
```python
b[-4,-2]
```

Out[125]: 17

In [126…
```python
b
```

Out[126]:
```
array([[13, 13, 17, 18],
       [10, 11, 17, 14],
       [10, 11, 11, 18],
       [18, 15, 18, 14],
       [18, 13, 15, 18]])
```

In [127…
```python
b[-4:2]
```

Out[127]:
```
array([[10, 11, 17, 14]])
```

In [128…
```python
b[:]
```

Out[128]:
```
array([[13, 13, 17, 18],
       [10, 11, 17, 14],
       [10, 11, 11, 18],
       [18, 15, 18, 14],
       [18, 13, 15, 18]])
```

operations

In [130…
```python
a =np.random.randint(10,20,10)
a
```

Out[130]: `array([14, 10, 18, 19, 15, 15, 17, 10, 11, 17])`

In [131…
```python
id(a)
```

Out[131]: 1627525947632

In [132…
```python
arr
```

Out[132]: `array([0, 1, 2, 3, 4, 5])`

In [134…
```python
arr2 = np.random.randint(0,100,(10,10))
```

In [135…
```python
arr2
```

```
Out[135]:   array([[74, 36, 50, 65, 72, 52, 15, 16, 34, 70],
                   [ 0, 79, 24, 82, 47, 81, 93, 44, 44, 73],
                   [68, 26, 69, 74,  5,  1, 63, 78, 57, 54],
                   [21, 13, 92, 16,  2, 86, 12, 79, 22, 98],
                   [23,  9, 11, 36, 82, 25, 78, 38, 59, 68],
                   [81, 55, 19, 55, 77, 85, 14, 45, 38, 93],
                   [90, 46,  1, 62, 11, 48, 94, 77, 36, 17],
                   [16, 59, 21, 33, 88, 48,  9, 21, 96, 16],
                   [83, 20, 64, 15, 55, 20, 10,  4, 43, 92],
                   [40, 41, 29, 15, 66, 48, 22, 30, 88, 94]])
```

In [136…   `arr`

Out[136]:   `array([0, 1, 2, 3, 4, 5])`

In [137…   `arr[:]`

Out[137]:   `array([0, 1, 2, 3, 4, 5])`

In [138…   `arr`

Out[138]:   `array([0, 1, 2, 3, 4, 5])`

In [139…   `arr[:4]`

Out[139]:   `array([0, 1, 2, 3])`

In [141…   `arr2[:]`

```
Out[141]:   array([[74, 36, 50, 65, 72, 52, 15, 16, 34, 70],
                   [ 0, 79, 24, 82, 47, 81, 93, 44, 44, 73],
                   [68, 26, 69, 74,  5,  1, 63, 78, 57, 54],
                   [21, 13, 92, 16,  2, 86, 12, 79, 22, 98],
                   [23,  9, 11, 36, 82, 25, 78, 38, 59, 68],
                   [81, 55, 19, 55, 77, 85, 14, 45, 38, 93],
                   [90, 46,  1, 62, 11, 48, 94, 77, 36, 17],
                   [16, 59, 21, 33, 88, 48,  9, 21, 96, 16],
                   [83, 20, 64, 15, 55, 20, 10,  4, 43, 92],
                   [40, 41, 29, 15, 66, 48, 22, 30, 88, 94]])
```

In [143…   `arr2[0:5]`

```
Out[143]:   array([[74, 36, 50, 65, 72, 52, 15, 16, 34, 70],
                   [ 0, 79, 24, 82, 47, 81, 93, 44, 44, 73],
                   [68, 26, 69, 74,  5,  1, 63, 78, 57, 54],
                   [21, 13, 92, 16,  2, 86, 12, 79, 22, 98],
                   [23,  9, 11, 36, 82, 25, 78, 38, 59, 68]])
```

In [144…   `arr2[1,4]`

Out[144]:   47

In [145…   `arr2`

```
Out[145]:  array([[74, 36, 50, 65, 72, 52, 15, 16, 34, 70],
                  [ 0, 79, 24, 82, 47, 81, 93, 44, 44, 73],
                  [68, 26, 69, 74,  5,  1, 63, 78, 57, 54],
                  [21, 13, 92, 16,  2, 86, 12, 79, 22, 98],
                  [23,  9, 11, 36, 82, 25, 78, 38, 59, 68],
                  [81, 55, 19, 55, 77, 85, 14, 45, 38, 93],
                  [90, 46,  1, 62, 11, 48, 94, 77, 36, 17],
                  [16, 59, 21, 33, 88, 48,  9, 21, 96, 16],
                  [83, 20, 64, 15, 55, 20, 10,  4, 43, 92],
                  [40, 41, 29, 15, 66, 48, 22, 30, 88, 94]])
```

In [146… `arr2[-5,5]`

Out[146]: 85

In [147… `arr2[-5,-5]`

Out[147]: 85

In [148… `arr2`

```
Out[148]:  array([[74, 36, 50, 65, 72, 52, 15, 16, 34, 70],
                  [ 0, 79, 24, 82, 47, 81, 93, 44, 44, 73],
                  [68, 26, 69, 74,  5,  1, 63, 78, 57, 54],
                  [21, 13, 92, 16,  2, 86, 12, 79, 22, 98],
                  [23,  9, 11, 36, 82, 25, 78, 38, 59, 68],
                  [81, 55, 19, 55, 77, 85, 14, 45, 38, 93],
                  [90, 46,  1, 62, 11, 48, 94, 77, 36, 17],
                  [16, 59, 21, 33, 88, 48,  9, 21, 96, 16],
                  [83, 20, 64, 15, 55, 20, 10,  4, 43, 92],
                  [40, 41, 29, 15, 66, 48, 22, 30, 88, 94]])
```

In [149… `arr2[-1,-2]`

Out[149]: 88

In [150… `arr2`

```
Out[150]:  array([[74, 36, 50, 65, 72, 52, 15, 16, 34, 70],
                  [ 0, 79, 24, 82, 47, 81, 93, 44, 44, 73],
                  [68, 26, 69, 74,  5,  1, 63, 78, 57, 54],
                  [21, 13, 92, 16,  2, 86, 12, 79, 22, 98],
                  [23,  9, 11, 36, 82, 25, 78, 38, 59, 68],
                  [81, 55, 19, 55, 77, 85, 14, 45, 38, 93],
                  [90, 46,  1, 62, 11, 48, 94, 77, 36, 17],
                  [16, 59, 21, 33, 88, 48,  9, 21, 96, 16],
                  [83, 20, 64, 15, 55, 20, 10,  4, 43, 92],
                  [40, 41, 29, 15, 66, 48, 22, 30, 88, 94]])
```

In [152… `arr2[::-1]`

```
Out[152]:  array([[40, 41, 29, 15, 66, 48, 22, 30, 88, 94],
                  [83, 20, 64, 15, 55, 20, 10,  4, 43, 92],
                  [16, 59, 21, 33, 88, 48,  9, 21, 96, 16],
                  [90, 46,  1, 62, 11, 48, 94, 77, 36, 17],
                  [81, 55, 19, 55, 77, 85, 14, 45, 38, 93],
                  [23,  9, 11, 36, 82, 25, 78, 38, 59, 68],
                  [21, 13, 92, 16,  2, 86, 12, 79, 22, 98],
                  [68, 26, 69, 74,  5,  1, 63, 78, 57, 54],
                  [ 0, 79, 24, 82, 47, 81, 93, 44, 44, 73],
                  [74, 36, 50, 65, 72, 52, 15, 16, 34, 70]])
```

In [153… `arr2`

```
Out[153]:  array([[74, 36, 50, 65, 72, 52, 15, 16, 34, 70],
                  [ 0, 79, 24, 82, 47, 81, 93, 44, 44, 73],
                  [68, 26, 69, 74,  5,  1, 63, 78, 57, 54],
                  [21, 13, 92, 16,  2, 86, 12, 79, 22, 98],
                  [23,  9, 11, 36, 82, 25, 78, 38, 59, 68],
                  [81, 55, 19, 55, 77, 85, 14, 45, 38, 93],
                  [90, 46,  1, 62, 11, 48, 94, 77, 36, 17],
                  [16, 59, 21, 33, 88, 48,  9, 21, 96, 16],
                  [83, 20, 64, 15, 55, 20, 10,  4, 43, 92],
                  [40, 41, 29, 15, 66, 48, 22, 30, 88, 94]])
```

In [155… `arr2[::-2]`

```
Out[155]:  array([[40, 41, 29, 15, 66, 48, 22, 30, 88, 94],
                  [16, 59, 21, 33, 88, 48,  9, 21, 96, 16],
                  [81, 55, 19, 55, 77, 85, 14, 45, 38, 93],
                  [21, 13, 92, 16,  2, 86, 12, 79, 22, 98],
                  [ 0, 79, 24, 82, 47, 81, 93, 44, 44, 73]])
```

In [156… `arr2`

```
Out[156]:  array([[74, 36, 50, 65, 72, 52, 15, 16, 34, 70],
                  [ 0, 79, 24, 82, 47, 81, 93, 44, 44, 73],
                  [68, 26, 69, 74,  5,  1, 63, 78, 57, 54],
                  [21, 13, 92, 16,  2, 86, 12, 79, 22, 98],
                  [23,  9, 11, 36, 82, 25, 78, 38, 59, 68],
                  [81, 55, 19, 55, 77, 85, 14, 45, 38, 93],
                  [90, 46,  1, 62, 11, 48, 94, 77, 36, 17],
                  [16, 59, 21, 33, 88, 48,  9, 21, 96, 16],
                  [83, 20, 64, 15, 55, 20, 10,  4, 43, 92],
                  [40, 41, 29, 15, 66, 48, 22, 30, 88, 94]])
```

In [159… `arr2[::-3]`

```
Out[159]:  array([[40, 41, 29, 15, 66, 48, 22, 30, 88, 94],
                  [90, 46,  1, 62, 11, 48, 94, 77, 36, 17],
                  [21, 13, 92, 16,  2, 86, 12, 79, 22, 98],
                  [74, 36, 50, 65, 72, 52, 15, 16, 34, 70]])
```

In [161… `arr2`

```
Out[161]:  array([[74, 36, 50, 65, 72, 52, 15, 16, 34, 70],
                  [ 0, 79, 24, 82, 47, 81, 93, 44, 44, 73],
                  [68, 26, 69, 74,  5,  1, 63, 78, 57, 54],
                  [21, 13, 92, 16,  2, 86, 12, 79, 22, 98],
                  [23,  9, 11, 36, 82, 25, 78, 38, 59, 68],
                  [81, 55, 19, 55, 77, 85, 14, 45, 38, 93],
                  [90, 46,  1, 62, 11, 48, 94, 77, 36, 17],
                  [16, 59, 21, 33, 88, 48,  9, 21, 96, 16],
                  [83, 20, 64, 15, 55, 20, 10,  4, 43, 92],
                  [40, 41, 29, 15, 66, 48, 22, 30, 88, 94]])
```

In [163… `arr2[:-3]`

```
Out[163]:  array([[74, 36, 50, 65, 72, 52, 15, 16, 34, 70],
                  [ 0, 79, 24, 82, 47, 81, 93, 44, 44, 73],
                  [68, 26, 69, 74,  5,  1, 63, 78, 57, 54],
                  [21, 13, 92, 16,  2, 86, 12, 79, 22, 98],
                  [23,  9, 11, 36, 82, 25, 78, 38, 59, 68],
                  [81, 55, 19, 55, 77, 85, 14, 45, 38, 93],
                  [90, 46,  1, 62, 11, 48, 94, 77, 36, 17]])
```

In [164… `arr`

Out[164]: `array([0, 1, 2, 3, 4, 5])`

In [165… `arr.max()`

Out[165]: 5

In [166… `arr.min()`

Out[166]: 0

In [167… `arr`

Out[167]: `array([0, 1, 2, 3, 4, 5])`

In [168… `arr.mean()`

Out[168]: 2.5

In [169… `arr`

Out[169]: `array([0, 1, 2, 3, 4, 5])`

In [170…
```
from numpy import *
a = array([1,2,3,4,5])
median(a)
```

Out[170]: 3.0

without work on import* can you please find the median and mode

In [172…   ```python
                arr
                ```

Out[172]:      ```python
               array([0, 1, 2, 3, 4, 5])
               ```

In [173…   ```python
                arr.reshape(3,2)
                ```

Out[173]:      ```python
               array([[0, 1],
                      [2, 3],
                      [4, 5]])
               ```

In [174…   ```python
                arr.reshape(6,1)
                ```

Out[174]:      ```python
               array([[0],
                      [1],
                      [2],
                      [3],
                      [4],
                      [5]])
               ```

In [175…   ```python
                arr.reshape(1,6)
                ```

Out[175]:      ```python
               array([[0, 1, 2, 3, 4, 5]])
               ```

In [176…   ```python
                arr
                ```

Out[176]:      ```python
               array([0, 1, 2, 3, 4, 5])
               ```

In [179…   ```python
                arr
                ```

Out[179]:      ```python
               array([0, 1, 2, 3, 4, 5])
               ```

In [180…   ```python
                arr.reshape(2,3,order='c')
                ```

Out[180]:      ```python
               array([[0, 1, 2],
                      [3, 4, 5]])
               ```

In [181…   ```python
                arr.reshape(2,3,order='F') # print element with fortran
                ```

Out[181]:      ```python
               array([[0, 2, 4],
                      [1, 3, 5]])
               ```

In [183…   ```python
                arr.reshape(2,3,order='A') # A ALMOST GIVE YOU C OUT PUT
                ```

Out[183]:      ```python
               array([[0, 1, 2],
                      [3, 4, 5]])
               ```

In [184…   ```python
                arr
                ```

Out[184]:      ```python
               array([0, 1, 2, 3, 4, 5])
               ```

In [185…   ```python
                arr.reshape(2,3)
                ```

Out[185]:      ```python
               array([[0, 1, 2],
                      [3, 4, 5]])
               ```

In [187…   ```python
                arr.reshape(1,6)
                ```

Out[187]:      ```python
               array([[0, 1, 2, 3, 4, 5]])
               ```

In [188…   `arr.reshape(6,1)`

Out[188]:   ```
            array([[0],
                   [1],
                   [2],
                   [3],
                   [4],
                   [5]])
            ```

In [189…    `arr.reshape(2,6)`

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Input In [189], in <cell line: 1>()
----> 1 arr.reshape(2,6)

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

In [190…   `arr.reshape(3,3)`

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Input In [190], in <cell line: 1>()
----> 1 arr.reshape(3,3)

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

In [191…   `arr`

Out[191]:   `array([0, 1, 2, 3, 4, 5])`

In [192…   `arr.reshape(3,2)`

Out[192]:   ```
            array([[0, 1],
                   [2, 3],
                   [4, 5]])
            ```

indexing

In [193…   `mat = np.arange(0,100).reshape(10,10)`

In [194…   `mat`

Out[194]:   ```
            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 [195…    ```
            row = 4
            col = 5
            ```

In [196…   `col`

Out[196]:   5

In [197…   `row`

Out[197]:   4

In [198…   `mat`

Out[198]:   ```
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 [199…    `mat[row,col]`

Out[199]:   45

In [200…    `mat[:]`

Out[200]:   ```
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 [201…   `col = 6`

In [202…   `mat`

Out[202]:   ```
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 [203…    `mat[6]`

Out[203]:   ```
array([60, 61, 62, 63, 64, 65, 66, 67, 68, 69])
```

In [204…   `mat`

Out[204]:
```
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 [206…
```
# with slices
mat[:,col]
```

Out[206]:   `array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])`

In [207…   `mat`

Out[207]:
```
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 [208…   `mat[:,8]`

Out[208]:   `array([ 8, 18, 28, 38, 48, 58, 68, 78, 88, 98])`

In [209…   `mat`

Out[209]:
```
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 [210…   `mat[:col]`

Out[210]:
```
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 [211…   `mat[:6]`

Out[211]:
```
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 [212…
```
row
```

Out[212]: 4

In [213…
```
mat
```

Out[213]:
```
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 [214…
```
mat[:row]
```

Out[214]:
```
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 [215…
```
mat
```

Out[215]:
```
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 [216…
```
mat[row:]
```

Out[216]:
```
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 [217…
```
mat[:]
```

```
Out[217]:  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 [219… `mat[:,8]`

Out[219]: `array([ 8, 18, 28, 38, 48, 58, 68, 78, 88, 98])`

In [220… `mat`

```
Out[220]:  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 [221… `mat[:,-1]`

Out[221]: `array([ 9, 19, 29, 39, 49, 59, 69, 79, 89, 99])`

In [222… `mat`

```
Out[222]:  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 [223… `row`

Out[223]: 4

In [224… `col`

Out[224]: 6

In [226… `mat[:,col]`

Out[226]: `array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])`

In [227… `mat`

Out[227]:
```
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 [228…   `mat[1,4]`

Out[228]:   14

In [229…   `mat[:,col]`

Out[229]:   `array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])`

In [230…   `mat[1:4]`

Out[230]:
```
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 [231…   `mat`

Out[231]:
```
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 [232…   `mat[3:-3]`

Out[232]:
```
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 [233…   `mat`

Out[233]:
```
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 [234…   `mat[0]`

Out[234]:
```
array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])
```

In [235...
```
mat[6]
```

Out[235]:
```
array([60, 61, 62, 63, 64, 65, 66, 67, 68, 69])
```

In [236...
```
mat
```

Out[236]:
```
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 [237...
```
mat[6:]
```

Out[237]:
```
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 [238...
```
mat[:6]
```

Out[238]:
```
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 [239...
```
mat
```

Out[239]:
```
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 [240...
```
mat[5:7]
```

Out[240]:
```
array([[50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
       [60, 61, 62, 63, 64, 65, 66, 67, 68, 69]])
```

In [241...
```
mat[0:10]
```

```
Out[241]:   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 [242… `mat`

```
Out[242]:   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 [243… `mat[0:10:3]`

```
Out[243]:   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 [244… `mat[0:10]`

```
Out[244]:   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 [245… `mat`

```
Out[245]:   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 [246… `mat[4:]`

```
Out[246]:   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 [247…   `mat`

```
Out[247]:   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 [248…   `mat[::-1]`

```
Out[248]:   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 [249…   `mat`

```
Out[249]:   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 [250…   `mat[::-3]`

```
Out[250]:   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 [251…   `mat`

Out[251]:
```
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 [252…
```
mat[::-5]
```

Out[252]:
```
array([[90, 91, 92, 93, 94, 95, 96, 97, 98, 99],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49]])
```

In [253…
```
mat[2:6]
```

Out[253]:
```
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 [254…
```
mat
```

Out[254]:
```
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 [255…
```
mat[2:6,2:4]
```

Out[255]:
```
array([[22, 23],
       [32, 33],
       [42, 43],
       [52, 53]])
```

In [256…
```
mat
```

Out[256]:
```
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 [257…
```
mat[0,1]
```

Out[257]:
1

In [258…   `mat[1,6]`

Out[258]:   16

In [259…   `mat`

Out[259]:   ```
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 [260…     `mat[1:6]`

Out[260]:    ```
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 [261…   `mat[1:]`

Out[261]:   ```
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 [262…     `mat`

Out[262]:    ```
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 [263…   `mat[:6]`

Out[263]:   ```
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 [264…     `mat[0:1]`

Out[264]: `array([[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]])`

In [265…  `mat`

Out[265]:
```
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 [266…  `mat[3:5]`

Out[266]:
```
array([[30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49]])
```

In [267…  `mat[3,5]`

Out[267]: `35`

In [268…  `mat`

Out[268]:
```
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 [270…  `mat[1:2,2:4]`

Out[270]: `array([[12, 13]])`

In [271…  `mat`

Out[271]:
```
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 [272…  `mat[2:3,2:3]`

Out[272]: `array([[22]])`

In [273…    `mat`

Out[273]:  ```
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 [275…   `mat[2:4,3:8]`

Out[275]: ```
array([[23, 24, 25, 26, 27],
       [33, 34, 35, 36, 37]])
```

In [277…    `mat`

Out[277]:  ```
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 [278…   `mat[2:3,4:5]`

Out[278]: ```
array([[24]])
```

# Masking

In [279…    `mat`

Out[279]:  ```
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 [280…   `id(mat)`

Out[280]: `1627530599856`

In [281…   `mat`

```
Out[281]:  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 [282… `mat[mat<50]`

```
Out[282]:  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 [283… `mat > 50`

```
Out[283]:  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 [284… `mat[mat==50]`

```
Out[284]:  array([50])
```

In [285… `mat`

```
Out[285]:  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 [286… `mat == 50`

```
Out[286]:  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 [287…   `mat`

```
Out[287]:  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 [290…
```python
a1 = mat[mat<50]
a1
```

```
Out[290]:  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 [292…
```python
a2 = mat[mat<=50]
a2
```

```
Out[292]:  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 [294…
```python
a3 = mat[mat<=50]
a3
```

```
Out[294]:  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 [295…
```python
a4 = mat[mat==50]
a4
```

```
Out[295]:  array([50])
```

In [ ]: