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

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

```
Out[2]: '2.2.5'
```

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

```
Out[3]: '3.11.9 (tags/v3.11.9:de54cf5, Apr  2 2024, 10:12:12) [MSC v.1938 64 bit (AMD64)]'
```

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

```python
In [12]: np.arange(3.0)
```

```
Out[12]: array([0., 1., 2.])
```

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

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

```python
In [14]: np.arange(0, 5)
```

```
Out[14]:  array([0, 1, 2, 3, 4])

In [15]:  np.arange(10,20)

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

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

Out[ ]:  array([], dtype=int64)

In [17]:  np.arange(-20,10)

Out[17]:  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 [18]:  np.arange(-16,10)

Out[18]:  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 [19]:  np.arange(-20,-10)

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

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

Out[ ]:  array([], dtype=int64)

In [21]:  ar = np.arange(-30,20)
          ar

Out[21]:  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 [22]:  np.arange(10,10)

Out[22]:  array([], dtype=int64)

In [23]:  np.arange()
```

```
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
Cell In[23], line 1
----> 1 np.arange()

TypeError: arange() requires stop to be specified.
```

```
In [ ]:  np.arange(10,30,5)

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

In [25]:  np.arange(0,10,3)

Out[25]:  array([0, 3, 6, 9])
```

```
In [26]:  np.arange(10,30,5,8)
```

TypeError   Traceback (most recent call last)
Cell In[26], line 1
----> 1 np.arange(10,30,5,8)

TypeError: Cannot interpret '8' as a data type

```
In [ ]:   np.zeros(3)
```

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

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

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

```
In [29]:  np.zeros((2,2), dtype=int)
```

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

```
In [30]:  zero = np.zeros([2,2])
          print(zero)
          print(type(zero))
```

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

```
In [31]:  zero = np.zeros([2,2])
          print(zero)

          print('####')

          print(type(zero))
```

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

```
In [32]:  np.zeros((2,10))
```

```
Out[32]:  array([[0., 0., 0., 0., 0., 0., 0., 0., 0., 0.],
                 [0., 0., 0., 0., 0., 0., 0., 0., 0., 0.]])
```

```
In [33]:  np.zeros((2,2))
```

```
Out[33]:  array([[0., 0.],
                 [0., 0.]])
```

```
In [34]:  np.zeros((3,3))
```

```
Out[34]:  array([[0., 0., 0.],
                 [0., 0., 0.],
                 [0., 0., 0.]])
```

```
In [35]:  np.zeros((10,30))
```

```
Out[35]: 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.]])
```

```python
In [ ]: np.zeros((5,10))
```

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

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

```
[[0. 0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0.]]
```

```python
In [ ]: print(np.zeros(n,dtype=int))
```

```
[[0 0 0 0 0 0 0]
 [0 0 0 0 0 0 0]
 [0 0 0 0 0 0 0]
 [0 0 0 0 0 0 0]
 [0 0 0 0 0 0 0]
 [0 0 0 0 0 0 0]]
```

```python
In [39]: n
```

```
Out[39]: (6, 7)
```

```python
In [40]: n1
```

```
Out[40]: (6, 8)
```

```python
In [41]: 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 [42]: `np.ones(3)`

Out[42]: `array([1., 1., 1.])`

In [43]: `np.ones(4, dtype=int)`

Out[43]: `array([1, 1, 1, 1])`

In [44]: `np.ones(4)`

Out[44]: `array([1., 1., 1., 1.])`

In [45]: `n`

Out[45]: `(6, 7)`

In [46]: `np.ones(n)`

Out[46]:
```
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 [ ]: `np.ones((5,4),dtype=int)`

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

In [48]: `np.`

```
  Cell In[48], line 1
    np.
       ^
SyntaxError: invalid syntax
```

In [49]: `np.twos((2,3))`

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[49], line 1
----> 1 np.twos((2,3))

File ~\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\Loca
\local-packages\Python311\site-packages\numpy\__init__.py:427, in __getattr__(attr)
    424         import numpy.char as char
    425         return char.chararray
--> 427 raise AttributeError("module {!r} has no attribute "
    428                      "{!r}".format(__name__, attr))

AttributeError: module 'numpy' has no attribute 'twos'
```

In [50]: `np.three(2,3)`

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[50], line 1
----> 1 np.three(2,3)

File ~\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\Loca
\local-packages\Python311\site-packages\numpy\__init__.py:427, in __getattr__(attr)
    424         import numpy.char as char
    425         return char.chararray
--> 427 raise AttributeError("module {!r} has no attribute "
    428                      "{!r}".format(__name__, attr))

AttributeError: module 'numpy' has no attribute 'three'
```

In [51]: `np.ones(2)`

Out[51]: `array([1., 1.])`

In [52]: `np.ones((2,4))`

Out[52]: `array([[1., 1., 1., 1.],
               [1., 1., 1., 1.]])`

In [53]: `np.ones((6,10),dtype = int)`

Out[53]: `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 [54]: `np.twos((2,4))`
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[54], line 1
----> 1 np.twos((2,4))

File ~\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\Loca
\local-packages\Python311\site-packages\numpy\__init__.py:427, in __getattr__(attr)
    424         import numpy.char as char
    425         return char.chararray
--> 427 raise AttributeError("module {!r} has no attribute "
    428                      "{!r}".format(__name__, attr))

AttributeError: module 'numpy' has no attribute 'twos'
```

In [55]: `np.`

```
  Cell In[55], line 1
    np.
       ^
SyntaxError: invalid syntax
```

In [56]: `np.three((2,4))`

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[56], line 1
----> 1 np.three((2,4))

File ~\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\Loca
\local-packages\Python311\site-packages\numpy\__init__.py:427, in __getattr__(attr)
    424         import numpy.char as char
    425         return char.chararray
--> 427 raise AttributeError("module {!r} has no attribute "
    428                      "{!r}".format(__name__, attr))

AttributeError: module 'numpy' has no attribute 'three'
```

In [57]: `range(5)`

Out[57]: `range(0, 5)`

In [58]:
```
r = range(5)
r
```

Out[58]: `range(0, 5)`

In [59]:
```
for i in r:
    print(i)
```

```
0
1
2
3
4
```

In [60]: `list(range(5))`

Out[60]: `[0, 1, 2, 3, 4]`

```
In [61]: range(1,10)
```

Out[61]: range(1, 10)

```
In [62]: list(range(1,10))
```

Out[62]: [1, 2, 3, 4, 5, 6, 7, 8, 9]

```
In [63]: list(range(1,10,3))
```

Out[63]: [1, 4, 7]

```
In [64]: y = list(range(12))
         y
```

Out[64]: [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11]

```
In [65]: rand(3,2)
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
Cell In[65], line 1
----> 1 rand(3,2)

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

```
In [66]: rand(3,2)
         random.rand(3,2)
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
Cell In[66], line 1
----> 1 rand(3,2)
      2 random.rand(3,2)

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

```
In [67]: np.random.rand(5)
```

Out[67]: array([0.66719554, 0.06928875, 0.5097096 , 0.39888665, 0.68356015])

```
In [68]: np.rand(4)
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[68], line 1
----> 1 np.rand(4)

File ~\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\Loca
\local-packages\Python311\site-packages\numpy\__init__.py:427, in __getattr__(attr)
    424         import numpy.char as char
    425         return char.chararray
--> 427 raise AttributeError("module {!r} has no attribute "
    428                      "{!r}".format(__name__, attr))

AttributeError: module 'numpy' has no attribute 'rand'
```

```
In [69]: np.random.rand(2,4)
```

```
Out[69]: array([[0.03401504, 0.15425658, 0.6446951 , 0.93465966],
                [0.19114269, 0.18166702, 0.69116128, 0.54419999]])
```

```
In [70]: np.random.randint(2,4)
```

```
Out[70]: 2
```

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

```
Out[ ]: 16
```

```
In [72]: np.random.randint(0,1)
```

```
Out[72]: 0
```

```
In [73]: np.random.randint(10,20,5)
```

```
Out[73]: array([19, 16, 12, 14, 10], dtype=int32)
```

```
In [74]: np.random.randint(1,6,4)
```

```
Out[74]: array([4, 1, 4, 4], dtype=int32)
```

```
In [75]: np.random.rand(3)
```

```
Out[75]: array([0.21676669, 0.72458972, 0.01776413])
```

```
In [76]: np.random.randint(1)
```

```
Out[76]: 0
```

```
In [77]: np.random.randint(30,20,10)
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[77], line 1
----> 1 np.random.randint(30,20,10)

File numpy\\random\\mtrand.pyx:794, in numpy.random.mtrand.RandomState.randint()

File numpy\\random\\_bounded_integers.pyx:2885, in numpy.random._bounded_integers._ra
32()

ValueError: low >= high
```

```
In [78]: np.random.randint(-30,20,10)
```

```
Out[78]: array([  3, -28,  -1, -10,  -4,   8,  11,  13, -13, -25], dtype=int32)
```

```
In [79]: np.random.randint(20,30,10)
```

```
Out[79]: array([20, 25, 28, 22, 25, 21, 21, 25, 27, 25], dtype=int32)
```

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

```
Out[ ]: 7
```

```
In [81]: np.random.randint(10,21,3)
```

```
Out[81]: array([17, 16, 10], dtype=int32)
```

```
In [82]: np.random.randint(1,12,10)
```

```
Out[82]: array([ 1,  5,  6,  6, 10,  3,  6,  3,  3,  9], dtype=int32)
```

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

```
Out[ ]: array([[28, 39, 15, 26, 35, 14, 32, 39, 39, 15],
               [14, 23, 17, 14, 39, 13, 37, 33, 37, 22],
               [22, 23, 38, 36, 27, 36, 11, 21, 13, 22],
               [19, 30, 30, 34, 21, 10, 30, 24, 21, 16],
               [19, 11, 22, 12, 32, 39, 32, 34, 26, 20],
               [24, 39, 31, 29, 23, 16, 10, 20, 36, 21],
               [34, 18, 10, 38, 11, 23, 29, 17, 13, 21],
               [33, 10, 32, 11, 21, 13, 28, 20, 30, 29],
               [16, 22, 22, 21, 24, 34, 20, 24, 20, 35],
               [18, 30, 39, 14, 11, 20, 15, 22, 26, 39]], dtype=int32)
```

```
In [ ]: np.random.randint(1,100,(12,12))
```

```
Out[ ]: array([[99, 39, 88, 40, 19,  9, 23, 87, 64, 81, 91, 98],
               [67,  4, 94, 70, 13, 36, 21, 13, 51, 90, 33, 13],
               [23, 89, 52, 36, 73,  9, 93, 84, 92, 67, 10, 26],
               [35, 19, 69, 50, 37, 85, 46, 33, 67, 76, 80, 55],
               [23, 69, 75, 91, 62, 27, 56, 73, 78, 64, 10, 38],
               [77, 84, 82, 42, 57, 18, 18,  3, 12, 53, 72, 36],
               [87, 62, 37, 56, 61, 58, 20, 14, 82, 98, 94, 31],
               [52, 75, 83, 79, 99, 41, 65, 80, 62, 85, 81, 99],
               [79, 38, 88, 80, 82, 41, 56, 64, 69,  6, 77, 33],
               [25, 15, 19, 77, 35, 81, 95, 37, 27, 14,  4, 64],
               [83, 20, 73, 58, 62, 17, 20,  7, 20, 19, 96, 39],
               [29, 51, 97, 26,  4, 57, 49,  8, 69, 80, 75, 44]], dtype=int32)
```

```
In [87]: np.arange(1,13).reshape(3,4)
```

```
Out[87]: array([[ 1,  2,  3,  4],
               [ 5,  6,  7,  8],
               [ 9, 10, 11, 12]])
```

```
In [88]: np.arange(1,13).reshape(12, 1)
```

```
Out[88]: array([[ 1],
               [ 2],
               [ 3],
               [ 4],
               [ 5],
               [ 6],
               [ 7],
               [ 8],
               [ 9],
               [10],
               [11],
               [12]])
```

```
In [89]: b = np.random.randint(10,20,(5,4))
         b
```

```
Out[89]:   array([[12, 10, 14, 19],
                  [19, 17, 14, 17],
                  [11, 11, 14, 15],
                  [12, 13, 16, 18],
                  [18, 12, 19, 11]], dtype=int32)
```

```
In [90]:  type(b)
```

```
Out[90]:   numpy.ndarray
```

```
In [91]:  b
```

```
Out[91]:   array([[12, 10, 14, 19],
                  [19, 17, 14, 17],
                  [11, 11, 14, 15],
                  [12, 13, 16, 18],
                  [18, 12, 19, 11]], dtype=int32)
```

```
In [92]:  b[:]
```

```
Out[92]:   array([[12, 10, 14, 19],
                  [19, 17, 14, 17],
                  [11, 11, 14, 15],
                  [12, 13, 16, 18],
                  [18, 12, 19, 11]], dtype=int32)
```

```
In [93]:  b[1:3]
```

```
Out[93]:   array([[19, 17, 14, 17],
                  [11, 11, 14, 15]], dtype=int32)
```

```
In [94]:  b
```

```
Out[94]:   array([[12, 10, 14, 19],
                  [19, 17, 14, 17],
                  [11, 11, 14, 15],
                  [12, 13, 16, 18],
                  [18, 12, 19, 11]], dtype=int32)
```

```
In [95]:  b[1,2]
```

```
Out[95]:   np.int32(14)
```

```
In [96]:  b
```

```
Out[96]:   array([[12, 10, 14, 19],
                  [19, 17, 14, 17],
                  [11, 11, 14, 15],
                  [12, 13, 16, 18],
                  [18, 12, 19, 11]], dtype=int32)
```

```
In [97]:  b[1,3]
```

```
Out[97]:   np.int32(17)
```

```
In [98]:  b[1,-1]
```

```
Out[98]:   np.int32(17)
```

```
In [99]:    b
```

```
Out[99]:  array([[12, 10, 14, 19],
                 [19, 17, 14, 17],
                 [11, 11, 14, 15],
                 [12, 13, 16, 18],
                 [18, 12, 19, 11]], dtype=int32)
```

```
In [100…   b[2:3]
```

```
Out[100…  array([[11, 11, 14, 15]], dtype=int32)
```

```
In [101…   b
```

```
Out[101…  array([[12, 10, 14, 19],
                 [19, 17, 14, 17],
                 [11, 11, 14, 15],
                 [12, 13, 16, 18],
                 [18, 12, 19, 11]], dtype=int32)
```

```
In [102…   b[0:-2]
```

```
Out[102…  array([[12, 10, 14, 19],
                 [19, 17, 14, 17],
                 [11, 11, 14, 15]], dtype=int32)
```

```
In [103…   b
```

```
Out[103…  array([[12, 10, 14, 19],
                 [19, 17, 14, 17],
                 [11, 11, 14, 15],
                 [12, 13, 16, 18],
                 [18, 12, 19, 11]], dtype=int32)
```

```
In [104…   b[0,2]
```

```
Out[104…  np.int32(14)
```

```
In [105…   b
```

```
Out[105…  array([[12, 10, 14, 19],
                 [19, 17, 14, 17],
                 [11, 11, 14, 15],
                 [12, 13, 16, 18],
                 [18, 12, 19, 11]], dtype=int32)
```

```
In [106…   b[-5,-3]
```

```
Out[106…  np.int32(10)
```

```
In [107…   b
```

```
Out[107…  array([[12, 10, 14, 19],
                 [19, 17, 14, 17],
                 [11, 11, 14, 15],
                 [12, 13, 16, 18],
                 [18, 12, 19, 11]], dtype=int32)
```

```
In [108...  b[-4,2]
```

```
Out[108...  np.int32(14)
```

```
In [109...  np.random.randint(10,20,(4,4))
```

```
Out[109...  array([[18, 15, 10, 17],
               [15, 16, 14, 18],
               [11, 18, 10, 12],
               [10, 15, 11, 17]], dtype=int32)
```

```
In [110...  b
```

```
Out[110...  array([[12, 10, 14, 19],
               [19, 17, 14, 17],
               [11, 11, 14, 15],
               [12, 13, 16, 18],
               [18, 12, 19, 11]], dtype=int32)
```

```
In [111...  b[-4,-2]
```

```
Out[111...  np.int32(14)
```

```
In [112...  b
```

```
Out[112...  array([[12, 10, 14, 19],
               [19, 17, 14, 17],
               [11, 11, 14, 15],
               [12, 13, 16, 18],
               [18, 12, 19, 11]], dtype=int32)
```

```
In [113...  b[-4:2]
```

```
Out[113...  array([[19, 17, 14, 17]], dtype=int32)
```

```
In [114...  b[:]
```

```
Out[114...  array([[12, 10, 14, 19],
               [19, 17, 14, 17],
               [11, 11, 14, 15],
               [12, 13, 16, 18],
               [18, 12, 19, 11]], dtype=int32)
```

```
In [115...  a = np.random.randint(10,20,10)
           a
```

```
Out[115...  array([14, 19, 16, 14, 10, 10, 16, 10, 11, 15], dtype=int32)
```

```
In [116...  id(a)
```

```
Out[116...  1663091268112
```

```
In [117...  arr
```

```
Out[117...  array([0, 1, 2, 3, 4, 5])
```

```
In [118...  arr2 = np.random.randint(0,100,(10,10))
```

```
In [119… arr2
```

```
Out[119… array([[94, 54, 98, 87, 23, 77, 59, 52,  7, 76],
               [54, 31, 74, 74, 12, 90, 92, 70, 40, 36],
               [ 5, 91, 77, 60,  2, 34, 61, 54, 54, 21],
               [73, 24,  1, 79, 91, 36, 57, 78, 32, 59],
               [78,  9, 83, 56, 64, 82, 73, 93, 12, 47],
               [65, 79, 31, 83, 66, 33, 25, 81, 47, 75],
               [25, 80, 75, 82, 30, 72, 87, 11, 53, 88],
               [ 0, 18, 30, 87,  0, 75, 13, 27, 36, 66],
               [ 8, 76, 52, 43, 17, 31, 42, 83, 63, 60],
               [55, 70, 40, 92, 48, 81,  7, 62, 52, 89]], dtype=int32)
```

```
In [120… arr
```

```
Out[120… array([0, 1, 2, 3, 4, 5])
```

```
In [121… arr[:]
```

```
Out[121… array([0, 1, 2, 3, 4, 5])
```

```
In [122… arr
```

```
Out[122… array([0, 1, 2, 3, 4, 5])
```

```
In [123… arr[:4]
```

```
Out[123… array([0, 1, 2, 3])
```

```
In [124… arr2[:]
```

```
Out[124… array([[94, 54, 98, 87, 23, 77, 59, 52,  7, 76],
               [54, 31, 74, 74, 12, 90, 92, 70, 40, 36],
               [ 5, 91, 77, 60,  2, 34, 61, 54, 54, 21],
               [73, 24,  1, 79, 91, 36, 57, 78, 32, 59],
               [78,  9, 83, 56, 64, 82, 73, 93, 12, 47],
               [65, 79, 31, 83, 66, 33, 25, 81, 47, 75],
               [25, 80, 75, 82, 30, 72, 87, 11, 53, 88],
               [ 0, 18, 30, 87,  0, 75, 13, 27, 36, 66],
               [ 8, 76, 52, 43, 17, 31, 42, 83, 63, 60],
               [55, 70, 40, 92, 48, 81,  7, 62, 52, 89]], dtype=int32)
```

```
In [125… arr2[0:5]
```

```
Out[125… array([[94, 54, 98, 87, 23, 77, 59, 52,  7, 76],
               [54, 31, 74, 74, 12, 90, 92, 70, 40, 36],
               [ 5, 91, 77, 60,  2, 34, 61, 54, 54, 21],
               [73, 24,  1, 79, 91, 36, 57, 78, 32, 59],
               [78,  9, 83, 56, 64, 82, 73, 93, 12, 47]], dtype=int32)
```

```
In [126… arr2
```

```
Out[126...  array([[94, 54, 98, 87, 23, 77, 59, 52,  7, 76],
                   [54, 31, 74, 74, 12, 90, 92, 70, 40, 36],
                   [ 5, 91, 77, 60,  2, 34, 61, 54, 54, 21],
                   [73, 24,  1, 79, 91, 36, 57, 78, 32, 59],
                   [78,  9, 83, 56, 64, 82, 73, 93, 12, 47],
                   [65, 79, 31, 83, 66, 33, 25, 81, 47, 75],
                   [25, 80, 75, 82, 30, 72, 87, 11, 53, 88],
                   [ 0, 18, 30, 87,  0, 75, 13, 27, 36, 66],
                   [ 8, 76, 52, 43, 17, 31, 42, 83, 63, 60],
                   [55, 70, 40, 92, 48, 81,  7, 62, 52, 89]], dtype=int32)
```

In [127... `arr2[1,4]`

Out[127... `np.int32(12)`

In [128... `arr2`

```
Out[128...  array([[94, 54, 98, 87, 23, 77, 59, 52,  7, 76],
                   [54, 31, 74, 74, 12, 90, 92, 70, 40, 36],
                   [ 5, 91, 77, 60,  2, 34, 61, 54, 54, 21],
                   [73, 24,  1, 79, 91, 36, 57, 78, 32, 59],
                   [78,  9, 83, 56, 64, 82, 73, 93, 12, 47],
                   [65, 79, 31, 83, 66, 33, 25, 81, 47, 75],
                   [25, 80, 75, 82, 30, 72, 87, 11, 53, 88],
                   [ 0, 18, 30, 87,  0, 75, 13, 27, 36, 66],
                   [ 8, 76, 52, 43, 17, 31, 42, 83, 63, 60],
                   [55, 70, 40, 92, 48, 81,  7, 62, 52, 89]], dtype=int32)
```

In [129... `arr2[-5,5]`

Out[129... `np.int32(33)`

In [130... `arr2[-5,-5]`

Out[130... `np.int32(33)`

In [131... `arr2`

```
Out[131...  array([[94, 54, 98, 87, 23, 77, 59, 52,  7, 76],
                   [54, 31, 74, 74, 12, 90, 92, 70, 40, 36],
                   [ 5, 91, 77, 60,  2, 34, 61, 54, 54, 21],
                   [73, 24,  1, 79, 91, 36, 57, 78, 32, 59],
                   [78,  9, 83, 56, 64, 82, 73, 93, 12, 47],
                   [65, 79, 31, 83, 66, 33, 25, 81, 47, 75],
                   [25, 80, 75, 82, 30, 72, 87, 11, 53, 88],
                   [ 0, 18, 30, 87,  0, 75, 13, 27, 36, 66],
                   [ 8, 76, 52, 43, 17, 31, 42, 83, 63, 60],
                   [55, 70, 40, 92, 48, 81,  7, 62, 52, 89]], dtype=int32)
```

In [132... `arr2[-5,-5]`

Out[132... `np.int32(33)`

In [133... `arr2`

```
Out[133…    array([[94, 54, 98, 87, 23, 77, 59, 52,  7, 76],
                  [54, 31, 74, 74, 12, 90, 92, 70, 40, 36],
                  [ 5, 91, 77, 60,  2, 34, 61, 54, 54, 21],
                  [73, 24,  1, 79, 91, 36, 57, 78, 32, 59],
                  [78,  9, 83, 56, 64, 82, 73, 93, 12, 47],
                  [65, 79, 31, 83, 66, 33, 25, 81, 47, 75],
                  [25, 80, 75, 82, 30, 72, 87, 11, 53, 88],
                  [ 0, 18, 30, 87,  0, 75, 13, 27, 36, 66],
                  [ 8, 76, 52, 43, 17, 31, 42, 83, 63, 60],
                  [55, 70, 40, 92, 48, 81,  7, 62, 52, 89]], dtype=int32)
```

In [134…
```
arr2[-1,-2]
```

Out[134…
```
np.int32(52)
```

In [135…
```
arr2
```

Out[135…
```
array([[94, 54, 98, 87, 23, 77, 59, 52,  7, 76],
       [54, 31, 74, 74, 12, 90, 92, 70, 40, 36],
       [ 5, 91, 77, 60,  2, 34, 61, 54, 54, 21],
       [73, 24,  1, 79, 91, 36, 57, 78, 32, 59],
       [78,  9, 83, 56, 64, 82, 73, 93, 12, 47],
       [65, 79, 31, 83, 66, 33, 25, 81, 47, 75],
       [25, 80, 75, 82, 30, 72, 87, 11, 53, 88],
       [ 0, 18, 30, 87,  0, 75, 13, 27, 36, 66],
       [ 8, 76, 52, 43, 17, 31, 42, 83, 63, 60],
       [55, 70, 40, 92, 48, 81,  7, 62, 52, 89]], dtype=int32)
```

In [136…
```
arr2[::-1]
```

Out[136…
```
array([[55, 70, 40, 92, 48, 81,  7, 62, 52, 89],
       [ 8, 76, 52, 43, 17, 31, 42, 83, 63, 60],
       [ 0, 18, 30, 87,  0, 75, 13, 27, 36, 66],
       [25, 80, 75, 82, 30, 72, 87, 11, 53, 88],
       [65, 79, 31, 83, 66, 33, 25, 81, 47, 75],
       [78,  9, 83, 56, 64, 82, 73, 93, 12, 47],
       [73, 24,  1, 79, 91, 36, 57, 78, 32, 59],
       [ 5, 91, 77, 60,  2, 34, 61, 54, 54, 21],
       [54, 31, 74, 74, 12, 90, 92, 70, 40, 36],
       [94, 54, 98, 87, 23, 77, 59, 52,  7, 76]], dtype=int32)
```

In [137…
```
arr2
```

Out[137…
```
array([[94, 54, 98, 87, 23, 77, 59, 52,  7, 76],
       [54, 31, 74, 74, 12, 90, 92, 70, 40, 36],
       [ 5, 91, 77, 60,  2, 34, 61, 54, 54, 21],
       [73, 24,  1, 79, 91, 36, 57, 78, 32, 59],
       [78,  9, 83, 56, 64, 82, 73, 93, 12, 47],
       [65, 79, 31, 83, 66, 33, 25, 81, 47, 75],
       [25, 80, 75, 82, 30, 72, 87, 11, 53, 88],
       [ 0, 18, 30, 87,  0, 75, 13, 27, 36, 66],
       [ 8, 76, 52, 43, 17, 31, 42, 83, 63, 60],
       [55, 70, 40, 92, 48, 81,  7, 62, 52, 89]], dtype=int32)
```

In [138…
```
arr2[::-2]
```

```
Out[138…   array([[55, 70, 40, 92, 48, 81,  7, 62, 52, 89],
               [ 0, 18, 30, 87,  0, 75, 13, 27, 36, 66],
               [65, 79, 31, 83, 66, 33, 25, 81, 47, 75],
               [73, 24,  1, 79, 91, 36, 57, 78, 32, 59],
               [54, 31, 74, 74, 12, 90, 92, 70, 40, 36]], dtype=int32)
```

```
In [139…   arr2
```

```
Out[139…   array([[94, 54, 98, 87, 23, 77, 59, 52,  7, 76],
               [54, 31, 74, 74, 12, 90, 92, 70, 40, 36],
               [ 5, 91, 77, 60,  2, 34, 61, 54, 54, 21],
               [73, 24,  1, 79, 91, 36, 57, 78, 32, 59],
               [78,  9, 83, 56, 64, 82, 73, 93, 12, 47],
               [65, 79, 31, 83, 66, 33, 25, 81, 47, 75],
               [25, 80, 75, 82, 30, 72, 87, 11, 53, 88],
               [ 0, 18, 30, 87,  0, 75, 13, 27, 36, 66],
               [ 8, 76, 52, 43, 17, 31, 42, 83, 63, 60],
               [55, 70, 40, 92, 48, 81,  7, 62, 52, 89]], dtype=int32)
```

```
In [140…   arr2[::-3]
```

```
Out[140…   array([[55, 70, 40, 92, 48, 81,  7, 62, 52, 89],
               [25, 80, 75, 82, 30, 72, 87, 11, 53, 88],
               [73, 24,  1, 79, 91, 36, 57, 78, 32, 59],
               [94, 54, 98, 87, 23, 77, 59, 52,  7, 76]], dtype=int32)
```

```
In [141…   arr2
```

```
Out[141…   array([[94, 54, 98, 87, 23, 77, 59, 52,  7, 76],
               [54, 31, 74, 74, 12, 90, 92, 70, 40, 36],
               [ 5, 91, 77, 60,  2, 34, 61, 54, 54, 21],
               [73, 24,  1, 79, 91, 36, 57, 78, 32, 59],
               [78,  9, 83, 56, 64, 82, 73, 93, 12, 47],
               [65, 79, 31, 83, 66, 33, 25, 81, 47, 75],
               [25, 80, 75, 82, 30, 72, 87, 11, 53, 88],
               [ 0, 18, 30, 87,  0, 75, 13, 27, 36, 66],
               [ 8, 76, 52, 43, 17, 31, 42, 83, 63, 60],
               [55, 70, 40, 92, 48, 81,  7, 62, 52, 89]], dtype=int32)
```

```
In [142…   arr2[:-3]
```

```
Out[142…   array([[94, 54, 98, 87, 23, 77, 59, 52,  7, 76],
               [54, 31, 74, 74, 12, 90, 92, 70, 40, 36],
               [ 5, 91, 77, 60,  2, 34, 61, 54, 54, 21],
               [73, 24,  1, 79, 91, 36, 57, 78, 32, 59],
               [78,  9, 83, 56, 64, 82, 73, 93, 12, 47],
               [65, 79, 31, 83, 66, 33, 25, 81, 47, 75],
               [25, 80, 75, 82, 30, 72, 87, 11, 53, 88]], dtype=int32)
```

```
In [143…   arr
```

```
Out[143…   array([0, 1, 2, 3, 4, 5])
```

```
In [144…   arr.max()
```

```
Out[144…   np.int64(5)
```

```
In [145…   arr.min()
```

```
Out[145…   np.int64(0)

In [146…   arr

Out[146…   array([0, 1, 2, 3, 4, 5])

In [147…   arr.mean()

Out[147…   np.float64(2.5)

In [148…   arr

Out[148…   array([0, 1, 2, 3, 4, 5])

In [149…   arr.median()

---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[149], line 1
----> 1 arr.median()

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

In [150…   from numpy import *
           a = array([1,2,3,4,9])
           median(a)

Out[150…   np.float64(3.0)

In [151…   arr

Out[151…   array([0, 1, 2, 3, 4, 5])

In [152…   arr.reshape(3,2)

Out[152…   array([[0, 1],
                  [2, 3],
                  [4, 5]])

In [153…   arr.reshape(6,1)

Out[153…   array([[0],
                  [1],
                  [2],
                  [3],
                  [4],
                  [5]])

In [154…   arr.reshape(1,6)

Out[154…   array([[0, 1, 2, 3, 4, 5]])

In [155…   arr

Out[155…   array([0, 1, 2, 3, 4, 5])

In [156…   arr.reshape(2,4)
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[156], line 1
----> 1 arr.reshape(2,4)

ValueError: cannot reshape array of size 6 into shape (2,4)
```

In [157…   `arr`

Out[157…   `array([0, 1, 2, 3, 4, 5])`

In [158…   `arr.reshape(2,3,order='C')`

Out[158…   ```
array([[0, 1, 2],
       [3, 4, 5]])
```

In [ ]:   `arr.reshape(2,3,order='F')`

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

In [ ]:   `arr.reshape(2,3,order='A')`

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

In [161…   `arr`

Out[161…   `array([0, 1, 2, 3, 4, 5])`

In [162…   `arr.reshape(2,3)`

Out[162…   ```
array([[0, 1, 2],
       [3, 4, 5]])
```

In [163…   `arr.reshape(1,4)`

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[163], line 1
----> 1 arr.reshape(1,4)

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

In [164…   `arr.reshape(1,6)`

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

In [165…   `arr.reshape(6,1)`

Out[165…   ```
array([[0],
       [1],
       [2],
       [3],
       [4],
       [5]])
```

In [166…   `arr.reshape(2,6)`

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[166], line 1
----> 1 arr.reshape(2,6)

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

In [167…   `arr.reshape(3,3)`

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[167], line 1
----> 1 arr.reshape(3,3)

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

In [168…   `arr`

Out[168…   `array([0, 1, 2, 3, 4, 5])`

In [169…   `arr.reshape(3,2)`

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

In [170…   `mat = np.arange(0,100).reshape(10,10)`

In [171…   `mat`

Out[171…
```
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 [172…
```
row = 4
col = 5
```

In [173…   `col`

Out[173…   `5`

In [174…   `row`

Out[174…   `4`

In [175…   `mat`

```
Out[175…   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 [176…
```
mat[row,col]
```

Out[176…
```
np.int64(45)
```

In [177…
```
mat[4,5]
```

Out[177…
```
np.int64(45)
```

In [178…
```
mat
```

Out[178…
```
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 [179…
```
mat[:]
```

Out[179…
```
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 [180…
```
col = 6
```

In [181…
```
mat
```

Out[181…
```
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 [ ]:   mat[6]

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

In [183…   mat

Out[183…   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 [ ]:   mat[:,col]

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

In [185…   mat

Out[185…   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 [186…   mat[row,:]

Out[186…   array([40, 41, 42, 43, 44, 45, 46, 47, 48, 49])

In [187…   mat

Out[187…   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 [188…   mat[:,8]

Out[188…   array([ 8, 18, 28, 38, 48, 58, 68, 78, 88, 98])

In [189…   mat
```

```
Out[189…  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 [190…  mat[:col]
```

```
Out[190…  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 [191…  mat[:6]
```

```
Out[191…  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 [192…  row
```

```
Out[192…  4
```

```
In [193…  mat
```

```
Out[193…  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 [194…  mat[:row]
```

```
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]])
```

```
In [195…  mat
```

```
Out[195…   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 [196…
```
mat[row:]
```

```
Out[196…   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 [197…
```
mat[:]
```

```
Out[197…   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 [198…
```
mat[:,8]
```

```
Out[198…   array([ 8, 18, 28, 38, 48, 58, 68, 78, 88, 98])
```

In [199…
```
mat
```

```
Out[199…   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 [200…
```
mat[:,-1]
```

```
Out[200…   array([ 9, 19, 29, 39, 49, 59, 69, 79, 89, 99])
```

In [201…
```
mat
```

```
Out[201...   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 [202...
```
row
```

Out[202...   4

In [203...
```
col
```

Out[203...   6

In [204...
```
mat[:,col]
```

Out[204...
```
array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])
```

In [205...
```
mat
```

Out[205...   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...
```
mat[1,4]
```

Out[206...
```
np.int64(14)
```

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[1:4]
```

Out[208...   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]])
```

```python
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]])
```

```python
In [210...  mat[3:-3]
```

```
Out[210...  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]])
```

```python
In [211...  mat
```

```
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],
               [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]])
```

```python
In [212...  mat[0]
```

```
Out[212...  array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])
```

```python
In [213...  mat[6]
```

```
Out[213...  array([60, 61, 62, 63, 64, 65, 66, 67, 68, 69])
```

```python
In [214...  mat
```

```
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],
               [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]])
```

```python
In [215...  mat[6:]
```

```
Out[215...   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 [216...   `mat[:6]`

```
Out[216...   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 [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 [218...   `mat[5:7]`

```
Out[218...   array([[50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
                    [60, 61, 62, 63, 64, 65, 66, 67, 68, 69]])
```

In [219...   `mat`

```
Out[219...   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 [220...   `mat[0:10]`

```
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`

```
Out[221...  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 [222...
```
mat[0:10:3]
```

```
Out[222...  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 [223...
```
mat[0:10]
```

```
Out[223...  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 [224...
```
mat[0:10:3]
```

```
Out[224...  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 [225...
```
mat
```

```
Out[225...  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 [226...
```
mat[4:]
```

```
Out[226...  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 [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[:4]
```

```
Out[228… 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 [229… mat
```

```
Out[229… 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 [230… mat[::-1]
```

```
Out[230… 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 [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]
```

```
Out[232... 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 [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[::-3]
```

```
Out[234... 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 [235... mat
```

```
Out[235... 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 [236... mat[::-5]
```

```
Out[236... array([[90, 91, 92, 93, 94, 95, 96, 97, 98, 99],
               [40, 41, 42, 43, 44, 45, 46, 47, 48, 49]])
```

```
In [237... mat
```

```
Out[237... 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 [238... mat[2:6]
```

```
Out[238...   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 [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 [ ]:   `mat[2:6,2:4]`

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

In [241...   `mat`

```
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[0,1]`

Out[242...   `np.int64(1)`

In [243...   `mat[1,6]`

Out[243...   `np.int64(16)`

In [244...   `mat`

```
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]])
```

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

```
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]])
```

```python
mat[1:]
```

```
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]])
```

```python
mat
```

```
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]])
```

```python
mat[:6]
```

```
array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
       [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
       [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
       [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
       [50, 51, 52, 53, 54, 55, 56, 57, 58, 59]])
```

```python
mat[0:1]
```

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

```python
mat
```

```
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 [251...   mat[3:5]

Out[251...   array([[30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
                    [40, 41, 42, 43, 44, 45, 46, 47, 48, 49]])

In [252...   mat[3,5]

Out[252...   np.int64(35)

In [253...   mat

Out[253...   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 [254...   mat[1:2,2:4]

Out[254...   array([[12, 13]])

In [255...   mat

Out[255...   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 [256...   mat[2:3,2:3]

Out[256...   array([[22]])

In [257...   mat

Out[257...   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 [258...   mat[2:4,3:5]
```

```
Out[258…  array([[23, 24],
                 [33, 34]])

In [259…  mat[3:5,2:4]

Out[259…  array([[32, 33],
                 [42, 43]])

In [260…  mat

Out[260…  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 [261…  mat[2:3,4:5]

Out[261…  array([[24]])

In [ ]:   mat

Out[ ]:   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…  id(mat)

Out[263…  1663481173776

In [264…  mat

Out[264…  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 [265…  mat[mat<50]
```

```
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])
```

```
In [266…   mat[mat<=50]
```

```
Out[266…   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 [267…   mat > 50
```

```
Out[267…   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 [268…   mat[mat==50]
```

```
Out[268…   array([50])
```

```
In [269…   mat
```

```
Out[269…   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 == 50
```

```
Out[270…   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 [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…   a1 = mat[mat<50]
           a1

```
Out[272…   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 [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 [274…   a2 = mat[mat>50]
           a2
```

```
Out[274...  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])
```

```python
In [275...  a3 = mat[mat<=50]
           a3
```

```
Out[275...  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])
```

```python
In [276...  a4 = mat[mat==50]
           a4
```

```
Out[276...  array([50])
```

```python
In [ ]:  import random

         def generate_otp(length=4):
             """Generate a numeric OTP of a specified length."""
             digits = '012345'
             otp = ''.join(random.choice(digits) for _ in range(length))
             return otp

         otp_length = 4
         otp = generate_otp(otp_length)
         print(f"Your OTP is: {otp}")
```

```
Your OTP is: 0323
```

```python
In [278...  def wish():
               print('good even')
           wish()

           def wish():
               print('good even')
           wish()

           def wish():
               print('good even')
           wish()
```

```
good even
good even
good even
```

```python
In [279...  def wish():
               print('good even')
           wish()

           wish()

           wish()
```

```
good even
good even
good even
```

```python
In [280...  list1=['a','b','g',1,5]
           print(list1.pop)
```

```
<built-in method pop of list object at 0x000001834F350440>
```

In [281…
```python
x = [1, 2, 3]
y = x.copy()
x.append(4)
print(x)
```

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