30th Oct 2025 Today's work completed

Numpy Crash Course

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

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

```
Out[2]: '2.1.3'
```

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

```
Out[3]: '3.13.5 | packaged by Anaconda, Inc. | (main, Jun 12 2025, 16:37:03) [MSC v.1929 64 bit (AMD64)]'
```

Creating Arrays

```
In [215… my_list = [0,1,2,3,4,5,]
         my_list
```

```
Out[215… [0, 1, 2, 3, 4, 5]
```

```
In [216… type(my_list)
```

```
Out[216… list
```

```
In [217… arr = np.array(my_list)
```

```
In [218… arr
```

```
Out[218… array([0, 1, 2, 3, 4, 5])
```

```
In [219…  type(arr)
```

```
Out[219…  numpy.ndarray
```

```
In [220…  type(my_list)
```

```
Out[220…  list
```

```
In [221…  np. # we learn important function
```

```
  Cell In[221], line 1
    np. # we learn important function
       ^
SyntaxError: invalid syntax
```

```
In [222…  np.arange(15)
```

```
Out[222…  array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14])
```

```
In [223…  np.arange(3.0)
```

```
Out[223…  array([0., 1., 2.])
```

```
In [224…  np.arange(10)
```

```
Out[224…  array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])
```

```
In [225…  np.arange(0, 5)
```

```
Out[225…  array([0, 1, 2, 3, 4])
```

```
In [226…  np.arange(10,20)
```

```
Out[226…  array([10, 11, 12, 13, 14, 15, 16, 17, 18, 19])
```

```
In [227…  np.arange(20,10) # 1st arg < 2nd arg
```

Out[227…   `array([], dtype=int64)`

In [228…
```python
np.arange(-20,10)
```

Out[228…
```
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 [229…
```python
np.arange(-16,10)
```

Out[229…
```
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 [230…
```python
np.arange(-20,-10)
```

Out[230…
```
array([-20, -19, -18, -17, -16, -15, -14, -13, -12, -11])
```

In [231…
```python
np.arange(30,20)   # 1st arg always be < then 2nd arg
```

Out[231…   `array([], dtype=int64)`

In [232…
```python
ar = np.arange(-30,20)
ar
```

Out[232…
```
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 [233…
```python
np.arange(10,10)
```

Out[233…   `array([], dtype=int64)`

In [234…
```python
np.arange()
```

```
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
Cell In[234], line 1
----> 1 np.arange()

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

```
In [235… np.arange(10,30,5)  # 10- starting from 30- end point 5 - step count
```

```
Out[235…  array([10, 15, 20, 25])
```

```
In [236… np.arange(0,10,3)
```

```
Out[236…  array([0, 3, 6, 9])
```

```
In [237… np.arange(10,30,5,8)
```

```
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
Cell In[237], line 1
----> 1 np.arange(10,30,5,8)

TypeError: Cannot interpret '8' as a data type
```

```
In [238… np.zeros(3) # parameter  tunning
```

```
Out[238…  array([0., 0., 0.])
```

```
In [239… np.zeros(5, dtype=int) # hyperparameter tunning
```

```
Out[239…  array([0, 0, 0, 0, 0])
```

```
In [240… np.zeros((2,2), dtype=int)
```

```
Out[240…  array([[0, 0],
                 [0, 0]])
```

```
In [241… zero = np.zeros([2,2])
         print(zero)
```

```
print(type(zero))
```

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

In [242...
```
zero = np.zeros([2,2])
print(zero)

print('####')

print(type(zero))
```

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

In [243...
```
np.zeros((2,10))
```

Out[243...
```
array([[0., 0., 0., 0., 0., 0., 0., 0., 0., 0.],
       [0., 0., 0., 0., 0., 0., 0., 0., 0., 0.]])
```

In [244...
```
np.zeros((2,2))
```

Out[244...
```
array([[0., 0.],
       [0., 0.]])
```

In [245...
```
np.zeros((3,3))
```

Out[245...
```
array([[0., 0., 0.],
       [0., 0., 0.],
       [0., 0., 0.]])
```

In [246...
```
np.zeros((10,30))
```

```
Out[246…   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.]])
```

```python
In [247…   np.zeros((5,10)) # bydefaul 1arge -- will give row & 2nd arg - columns
```

```
Out[247…   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 [248…   n = (6,7)
           n1 = (6,8)
           print(np.zeros(n1)) # parameter tunnin g
```

```
[[0. 0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0.]
 [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 [249... `print(np.zeros(n,dtype=int)) ## hypyerparameter 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 [250... `n`

Out[250... `(6, 7)`

In [251... `n1`

Out[251... `(6, 8)`

In [252... `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 [253... `np.ones(3)`

Out[253... `array([1., 1., 1.])`

In [254... `np.ones(4, dtype=int)`

Out[254... `array([1, 1, 1, 1])`

In [255... `np.ones(4)`

Out[255... `array([1., 1., 1., 1.])`

In [256... `n`

Out[256…   (6, 7)

In [257…   `np.ones(n)`

Out[257…   ```
           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 [258…   `np.ones((5,4),dtype=int) # by default 5- rows & 4 - columns`

Out[258…   ```
           array([[1, 1, 1, 1],
                  [1, 1, 1, 1],
                  [1, 1, 1, 1],
                  [1, 1, 1, 1],
                  [1, 1, 1, 1]])
           ```

In [259…   `np.`

```
  Cell In[259], line 1
    np.
       ^
SyntaxError: invalid syntax
```

In [260…   `np.twos((2,3))`

```
---------------------------------------------------------------------------
AttributeError                           Traceback (most recent call last)
Cell In[260], line 1
----> 1 np.twos((2,3))

File ~\anaconda3\Lib\site-packages\numpy\__init__.py:414, in __getattr__(attr)
    411         import numpy.char as char
    412         return char.chararray
--> 414 raise AttributeError("module {!r} has no attribute "
    415                      "{!r}".format(__name__, attr))

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

```
In [261...   np.three(2,3)
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[261], line 1
----> 1 np.three(2,3)

File ~\anaconda3\Lib\site-packages\numpy\__init__.py:414, in __getattr__(attr)
    411         import numpy.char as char
    412         return char.chararray
--> 414 raise AttributeError("module {!r} has no attribute "
    415                       "{!r}".format(__name__, attr))

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

```
In [262...   np.ones(2)
```

```
Out[262...   array([1., 1.])
```

```
In [263...   np.ones((2,4))
```

```
Out[263...   array([[1., 1., 1., 1.],
                    [1., 1., 1., 1.]])
```

```
In [264...   np.ones((6,10),dtype = int)
```

```
Out[264...   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 [265...   np.twos((2,4))
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[265], line 1
----> 1 np.twos((2,4))

File ~\anaconda3\Lib\site-packages\numpy\__init__.py:414, in __getattr__(attr)
    411         import numpy.char as char
    412         return char.chararray
--> 414 raise AttributeError("module {!r} has no attribute "
    415                      "{!r}".format(__name__, attr))

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

In [266… `np.`

```
  Cell In[266], line 1
    np.
       ^
SyntaxError: invalid syntax
```

In [267… `np.three((2,4))`

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[267], line 1
----> 1 np.three((2,4))

File ~\anaconda3\Lib\site-packages\numpy\__init__.py:414, in __getattr__(attr)
    411         import numpy.char as char
    412         return char.chararray
--> 414 raise AttributeError("module {!r} has no attribute "
    415                      "{!r}".format(__name__, attr))

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

In [268… `range(6)`

Out[268… `range(0, 6)`

```
In [269…    r = range(6)
            r
```

```
Out[269…    range(0, 6)
```

```
In [270…    for i in r:
                print(i)
```

```
0
1
2
3
4
5
```

```
In [271…    list(range(6))
```

```
Out[271…    [0, 1, 2, 3, 4, 5]
```

```
In [272…    range(1,10)
```

```
Out[272…    range(1, 10)
```

```
In [273…    list(range(1,10))
```

```
Out[273…    [1, 2, 3, 4, 5, 6, 7, 8, 9]
```

```
In [274…    list(range(1,10,3))
```

```
Out[274…    [1, 4, 7]
```

```
In [275…    y = list(range(12))
            y
```

```
Out[275…    [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11]
```

```
In [276…    rand(3,2)
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
Cell In[276], line 1
----> 1 rand(3,2)

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

In [277…
```
rand(3,2)
random.rand(3,2)
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
Cell In[277], line 1
----> 1 rand(3,2)
      2 random.rand(3,2)

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

In [278…
```
np.random.rand(6)
```

Out[278…
```
array([0.15130228, 0.17785391, 0.11497404, 0.75328644, 0.55964337,
       0.84057633])
```

In [279…
```
np.rand(5)
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[279], line 1
----> 1 np.rand(5)

File ~\anaconda3\Lib\site-packages\numpy\__init__.py:414, in __getattr__(attr)
    411         import numpy.char as char
    412         return char.chararray
--> 414     raise AttributeError("module {!r} has no attribute "
    415                          "{!r}".format(__name__, attr))

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

In [280…
```
np.random.rand(2,5)
```

```
Out[280...   array([[0.92061985, 0.33833524, 0.37562445, 0.69511367, 0.51718747],
                    [0.3498196 , 0.52159953, 0.3045332 , 0.54829529, 0.0798458 ]])
```

```
In [281...   np.random.randint(2,3)
```

```
Out[281...   2
```

```
In [282...   np.random.randint(2,20) # 2nd argument is exlusive
```

```
Out[282...   7
```

```
In [283...   np.random.randint(0,1)
```

```
Out[283...   0
```

```
In [284...   np.random.randint(10,20,5)
```

```
Out[284...   array([16, 19, 14, 19, 10], dtype=int32)
```

```
In [285...   np.random.randint(1,6,4)
```

```
Out[285...   array([5, 1, 2, 2], dtype=int32)
```

```
In [286...   np.random.rand(3)
```

```
Out[286...   array([0.67011394, 0.02550773, 0.96249507])
```

```
In [287...   np.random.randint(1)
```

```
Out[287...   0
```

```
In [288...   np.random.randint(40,20,10)
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[288], line 1
----> 1 np.random.randint(40,20,10)

File numpy\\random\\mtrand.pyx:796, in numpy.random.mtrand.RandomState.randint()

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

ValueError: low >= high
```

In [289…   `np.random.randint(-40,20,10)`

Out[289…   `array([-14, -31, -20,  13,  17, -10, -32,   6, -25,   5], dtype=int32)`

In [290…   `np.random.randint(20,40,10)`

Out[290…   `array([37, 32, 21, 34, 21, 24, 36, 33, 31, 22], dtype=int32)`

In [291…   `np.random.randint(5,9)   #GET THE VALUE <=1 & >=5`

Out[291…   `8`

In [292…   `np.random.randint(10,21,3)`

Out[292…   `array([17, 12, 19], dtype=int32)`

In [293…   `np.random.randint(1,12,10)`

Out[293…   `array([ 4,  9,  1,  6, 11,  8,  4,  1,  7,  6], dtype=int32)`

In [294…   `np.random.randint(10,40,(10,10)) #generre the element 10 -30 with 4*4 mtri`

```
Out[294…   array([[25, 16, 14, 15, 22, 12, 38, 22, 35, 11],
                  [30, 26, 11, 10, 16, 14, 22, 15, 13, 14],
                  [27, 22, 16, 12, 33, 32, 34, 21, 14, 26],
                  [18, 17, 22, 10, 30, 38, 29, 13, 35, 13],
                  [35, 29, 17, 29, 17, 17, 39, 36, 11, 29],
                  [31, 22, 17, 16, 32, 32, 24, 27, 14, 36],
                  [37, 25, 27, 22, 21, 29, 24, 31, 12, 22],
                  [23, 38, 14, 10, 21, 10, 30, 31, 11, 35],
                  [16, 34, 31, 17, 36, 34, 26, 12, 39, 14],
                  [33, 32, 36, 21, 30, 35, 29, 22, 30, 16]], dtype=int32)
```

```
In [295…   np.random.randint(1,100,(12,12)) #generre the element 10 -30 with 4*4 mtri
```

```
Out[295…   array([[ 3, 48, 20, 95, 87, 81,  7, 67, 41, 14, 95, 61],
                  [89, 33, 18, 68, 75, 50,  2, 59, 75, 42, 19, 23],
                  [89, 68, 63, 63, 27, 91,  8,  3, 22, 30, 77, 60],
                  [74,  7, 90, 62, 92, 93, 61, 90, 59, 19, 83, 38],
                  [59, 30,  9, 72, 35, 27, 98, 11,  1, 83,  6, 66],
                  [71, 49, 30, 72, 78, 10, 21, 16,  8, 56, 38, 48],
                  [24, 62, 25, 25, 81, 81, 50,  2,  3, 51, 54,  9],
                  [28, 63, 73, 67, 68,  7, 62, 51,  1, 47, 29, 28],
                  [80,  6, 92, 98,  7, 37, 82, 56, 70, 12, 13, 65],
                  [79, 68, 11, 58, 67, 76, 30, 52, 58, 20,  8, 97],
                  [21, 31,  8, 23, 90,  9, 98, 96, 15, 97,  5, 61],
                  [20,  6, 73, 32, 52, 59,  5, 98, 90, 57, 55, 23]], dtype=int32)
```

```
In [296…   np.arange(1,13).reshape(3,4)
```

```
Out[296…   array([[ 1,  2,  3,  4],
                  [ 5,  6,  7,  8],
                  [ 9, 10, 11, 12]])
```

```
In [297…   np.arange(1,13).reshape(12, 1)
```

```
Out[297…   array([[ 1],
                  [ 2],
                  [ 3],
                  [ 4],
                  [ 5],
                  [ 6],
                  [ 7],
                  [ 8],
                  [ 9],
                  [10],
                  [11],
                  [12]])
```

In [298…
```
b = np.random.randint(10,20,(5,4))
b
```

```
Out[298…   array([[13, 15, 18, 16],
                  [14, 17, 12, 19],
                  [18, 14, 16, 13],
                  [12, 10, 13, 10],
                  [19, 12, 12, 12]], dtype=int32)
```

In [299…
```
type(b)
```

```
Out[299…   numpy.ndarray
```

In [300…
```
b
```

```
Out[300…   array([[13, 15, 18, 16],
                  [14, 17, 12, 19],
                  [18, 14, 16, 13],
                  [12, 10, 13, 10],
                  [19, 12, 12, 12]], dtype=int32)
```

In [301…
```
b[:]
```

```
Out[301...   array([[13, 15, 18, 16],
                    [14, 17, 12, 19],
                    [18, 14, 16, 13],
                    [12, 10, 13, 10],
                    [19, 12, 12, 12]], dtype=int32)
```

```
In [302...   b[1:3]
```

```
Out[302...   array([[14, 17, 12, 19],
                    [18, 14, 16, 13]], dtype=int32)
```

```
In [303...   b
```

```
Out[303...   array([[13, 15, 18, 16],
                    [14, 17, 12, 19],
                    [18, 14, 16, 13],
                    [12, 10, 13, 10],
                    [19, 12, 12, 12]], dtype=int32)
```

```
In [304...   b[1,2]
```

```
Out[304...   np.int32(12)
```

```
In [305...   b
```

```
Out[305...   array([[13, 15, 18, 16],
                    [14, 17, 12, 19],
                    [18, 14, 16, 13],
                    [12, 10, 13, 10],
                    [19, 12, 12, 12]], dtype=int32)
```

```
In [306...   b[1,3]
```

```
Out[306...   np.int32(19)
```

```
In [307...   b[1,-1]
```

```
Out[307...   np.int32(19)
```

In [308…   `b`

Out[308…   ```
array([[13, 15, 18, 16],
       [14, 17, 12, 19],
       [18, 14, 16, 13],
       [12, 10, 13, 10],
       [19, 12, 12, 12]], dtype=int32)
```

In [309…    `b[2:3]`

Out[309…   `array([[18, 14, 16, 13]], dtype=int32)`

In [310…    `b`

Out[310…   ```
array([[13, 15, 18, 16],
       [14, 17, 12, 19],
       [18, 14, 16, 13],
       [12, 10, 13, 10],
       [19, 12, 12, 12]], dtype=int32)
```

In [311…   `b[0:-2]`

Out[311…   ```
array([[13, 15, 18, 16],
       [14, 17, 12, 19],
       [18, 14, 16, 13]], dtype=int32)
```

In [312…    `b`

Out[312…   ```
array([[13, 15, 18, 16],
       [14, 17, 12, 19],
       [18, 14, 16, 13],
       [12, 10, 13, 10],
       [19, 12, 12, 12]], dtype=int32)
```

In [313…   `b[0,2]`

Out[313…   `np.int32(18)`

In [314…   `b`

```
Out[314... array([[13, 15, 18, 16],
              [14, 17, 12, 19],
              [18, 14, 16, 13],
              [12, 10, 13, 10],
              [19, 12, 12, 12]], dtype=int32)
```

```
In [315... b[-5,-3]
```

```
Out[315... np.int32(15)
```

```
In [316... b
```

```
Out[316... array([[13, 15, 18, 16],
              [14, 17, 12, 19],
              [18, 14, 16, 13],
              [12, 10, 13, 10],
              [19, 12, 12, 12]], dtype=int32)
```

```
In [317... b[-4,2]
```

```
Out[317... np.int32(12)
```

```
In [318... np.random.randint(10,20,(4,4))
```

```
Out[318... array([[11, 11, 10, 16],
              [11, 13, 10, 17],
              [11, 11, 11, 10],
              [14, 13, 17, 12]], dtype=int32)
```

```
In [319... b
```

```
Out[319... array([[13, 15, 18, 16],
              [14, 17, 12, 19],
              [18, 14, 16, 13],
              [12, 10, 13, 10],
              [19, 12, 12, 12]], dtype=int32)
```

```
In [320... b[-4,-2]
```

Out[320…   np.int32(12)

In [321…   b

Out[321…   array([[13, 15, 18, 16],
                    [14, 17, 12, 19],
                    [18, 14, 16, 13],
                    [12, 10, 13, 10],
                    [19, 12, 12, 12]], dtype=int32)

In [322…   b[-4:2]

Out[322…   array([[14, 17, 12, 19]], dtype=int32)

In [323…   b[:]

Out[323…   array([[13, 15, 18, 16],
                    [14, 17, 12, 19],
                    [18, 14, 16, 13],
                    [12, 10, 13, 10],
                    [19, 12, 12, 12]], dtype=int32)

Operations

In [324…   a = np.random.randint(20,30,20)
             a

Out[324…   array([29, 26, 24, 24, 29, 25, 24, 22, 27, 20, 26, 24, 22, 20, 23, 22, 24,
                    29, 20, 22], dtype=int32)

In [325…   id(a)

Out[325…   1760002826640

In [326…   arr

Out[326…   array([0, 1, 2, 3, 4, 5])

In [327…   ```python
           arr2 = np.random.randint(0,100,(10,10))
           ```

In [328…   ```python
           arr2
           ```

Out[328…   ```
           array([[4, 6, 69, 12, 35, 31, 6, 72, 11, 2],
                  [53, 5, 17, 78, 22, 24, 6, 42, 71, 53],
                  [38, 89, 66, 87, 16, 63, 77, 77, 55, 20],
                  [18, 54, 65, 31, 46, 43, 86, 5, 63, 14],
                  [2, 83, 39, 12, 99, 76, 37, 24, 34, 78],
                  [94, 23, 64, 92, 76, 55, 40, 12, 28, 24],
                  [35, 36, 83, 52, 63, 99, 91, 66, 1, 0],
                  [71, 78, 75, 17, 60, 83, 91, 67, 9, 91],
                  [1, 49, 11, 30, 96, 87, 16, 92, 85, 79],
                  [82, 40, 6, 79, 67, 24, 33, 91, 56, 45]], dtype=int32)
           ```

In [329…   ```python
           arr
           ```

Out[329…   ```
           array([0, 1, 2, 3, 4, 5])
           ```

In [330…   ```python
           arr[:]
           ```

Out[330…   ```
           array([0, 1, 2, 3, 4, 5])
           ```

In [331…   ```python
           arr
           ```

Out[331…   ```
           array([0, 1, 2, 3, 4, 5])
           ```

In [332…   ```python
           arr[:4]
           ```

Out[332…   ```
           array([0, 1, 2, 3])
           ```

In [333…   ```python
           arr2[:]
           ```

```
Out[333…   array([[ 4,  6, 69, 12, 35, 31,  6, 72, 11,  2],
                  [53,  5, 17, 78, 22, 24,  6, 42, 71, 53],
                  [38, 89, 66, 87, 16, 63, 77, 77, 55, 20],
                  [18, 54, 65, 31, 46, 43, 86,  5, 63, 14],
                  [ 2, 83, 39, 12, 99, 76, 37, 24, 34, 78],
                  [94, 23, 64, 92, 76, 55, 40, 12, 28, 24],
                  [35, 36, 83, 52, 63, 99, 91, 66,  1,  0],
                  [71, 78, 75, 17, 60, 83, 91, 67,  9, 91],
                  [ 1, 49, 11, 30, 96, 87, 16, 92, 85, 79],
                  [82, 40,  6, 79, 67, 24, 33, 91, 56, 45]], dtype=int32)
```

In [334…
```
arr2[0:5]
```

```
Out[334…   array([[ 4,  6, 69, 12, 35, 31,  6, 72, 11,  2],
                  [53,  5, 17, 78, 22, 24,  6, 42, 71, 53],
                  [38, 89, 66, 87, 16, 63, 77, 77, 55, 20],
                  [18, 54, 65, 31, 46, 43, 86,  5, 63, 14],
                  [ 2, 83, 39, 12, 99, 76, 37, 24, 34, 78]], dtype=int32)
```

In [335…
```
arr2
```

```
Out[335…   array([[ 4,  6, 69, 12, 35, 31,  6, 72, 11,  2],
                  [53,  5, 17, 78, 22, 24,  6, 42, 71, 53],
                  [38, 89, 66, 87, 16, 63, 77, 77, 55, 20],
                  [18, 54, 65, 31, 46, 43, 86,  5, 63, 14],
                  [ 2, 83, 39, 12, 99, 76, 37, 24, 34, 78],
                  [94, 23, 64, 92, 76, 55, 40, 12, 28, 24],
                  [35, 36, 83, 52, 63, 99, 91, 66,  1,  0],
                  [71, 78, 75, 17, 60, 83, 91, 67,  9, 91],
                  [ 1, 49, 11, 30, 96, 87, 16, 92, 85, 79],
                  [82, 40,  6, 79, 67, 24, 33, 91, 56, 45]], dtype=int32)
```

In [336…
```
arr2[1,4]
```

Out[336…
```
np.int32(22)
```

In [337…
```
arr2
```

```
Out[337…   array([[ 4,  6, 69, 12, 35, 31,  6, 72, 11,  2],
                  [53,  5, 17, 78, 22, 24,  6, 42, 71, 53],
                  [38, 89, 66, 87, 16, 63, 77, 77, 55, 20],
                  [18, 54, 65, 31, 46, 43, 86,  5, 63, 14],
                  [ 2, 83, 39, 12, 99, 76, 37, 24, 34, 78],
                  [94, 23, 64, 92, 76, 55, 40, 12, 28, 24],
                  [35, 36, 83, 52, 63, 99, 91, 66,  1,  0],
                  [71, 78, 75, 17, 60, 83, 91, 67,  9, 91],
                  [ 1, 49, 11, 30, 96, 87, 16, 92, 85, 79],
                  [82, 40,  6, 79, 67, 24, 33, 91, 56, 45]], dtype=int32)
```

In [338…
```
arr2[-5,5]
```

Out[338…
```
np.int32(55)
```

In [339…
```
arr2[-5,-5]
```

Out[339…
```
np.int32(55)
```

In [340…
```
arr2
```

Out[340…
```
array([[ 4,  6, 69, 12, 35, 31,  6, 72, 11,  2],
       [53,  5, 17, 78, 22, 24,  6, 42, 71, 53],
       [38, 89, 66, 87, 16, 63, 77, 77, 55, 20],
       [18, 54, 65, 31, 46, 43, 86,  5, 63, 14],
       [ 2, 83, 39, 12, 99, 76, 37, 24, 34, 78],
       [94, 23, 64, 92, 76, 55, 40, 12, 28, 24],
       [35, 36, 83, 52, 63, 99, 91, 66,  1,  0],
       [71, 78, 75, 17, 60, 83, 91, 67,  9, 91],
       [ 1, 49, 11, 30, 96, 87, 16, 92, 85, 79],
       [82, 40,  6, 79, 67, 24, 33, 91, 56, 45]], dtype=int32)
```

In [341…
```
arr2[-5,-5]
```

Out[341…
```
np.int32(55)
```

In [342…
```
arr2
```

```
Out[342…   array([[ 4,  6, 69, 12, 35, 31,  6, 72, 11,  2],
                  [53,  5, 17, 78, 22, 24,  6, 42, 71, 53],
                  [38, 89, 66, 87, 16, 63, 77, 77, 55, 20],
                  [18, 54, 65, 31, 46, 43, 86,  5, 63, 14],
                  [ 2, 83, 39, 12, 99, 76, 37, 24, 34, 78],
                  [94, 23, 64, 92, 76, 55, 40, 12, 28, 24],
                  [35, 36, 83, 52, 63, 99, 91, 66,  1,  0],
                  [71, 78, 75, 17, 60, 83, 91, 67,  9, 91],
                  [ 1, 49, 11, 30, 96, 87, 16, 92, 85, 79],
                  [82, 40,  6, 79, 67, 24, 33, 91, 56, 45]], dtype=int32)
```

In [343…
```
arr2[-1,-2]
```

Out[343…
```
np.int32(56)
```

In [344…
```
arr2
```

Out[344…
```
array([[ 4,  6, 69, 12, 35, 31,  6, 72, 11,  2],
       [53,  5, 17, 78, 22, 24,  6, 42, 71, 53],
       [38, 89, 66, 87, 16, 63, 77, 77, 55, 20],
       [18, 54, 65, 31, 46, 43, 86,  5, 63, 14],
       [ 2, 83, 39, 12, 99, 76, 37, 24, 34, 78],
       [94, 23, 64, 92, 76, 55, 40, 12, 28, 24],
       [35, 36, 83, 52, 63, 99, 91, 66,  1,  0],
       [71, 78, 75, 17, 60, 83, 91, 67,  9, 91],
       [ 1, 49, 11, 30, 96, 87, 16, 92, 85, 79],
       [82, 40,  6, 79, 67, 24, 33, 91, 56, 45]], dtype=int32)
```

In [345…
```
arr2[::-1]
```

Out[345…
```
array([[82, 40,  6, 79, 67, 24, 33, 91, 56, 45],
       [ 1, 49, 11, 30, 96, 87, 16, 92, 85, 79],
       [71, 78, 75, 17, 60, 83, 91, 67,  9, 91],
       [35, 36, 83, 52, 63, 99, 91, 66,  1,  0],
       [94, 23, 64, 92, 76, 55, 40, 12, 28, 24],
       [ 2, 83, 39, 12, 99, 76, 37, 24, 34, 78],
       [18, 54, 65, 31, 46, 43, 86,  5, 63, 14],
       [38, 89, 66, 87, 16, 63, 77, 77, 55, 20],
       [53,  5, 17, 78, 22, 24,  6, 42, 71, 53],
       [ 4,  6, 69, 12, 35, 31,  6, 72, 11,  2]], dtype=int32)
```

In [346… `arr2`

Out[346…
```
array([[ 4,  6, 69, 12, 35, 31,  6, 72, 11,  2],
       [53,  5, 17, 78, 22, 24,  6, 42, 71, 53],
       [38, 89, 66, 87, 16, 63, 77, 77, 55, 20],
       [18, 54, 65, 31, 46, 43, 86,  5, 63, 14],
       [ 2, 83, 39, 12, 99, 76, 37, 24, 34, 78],
       [94, 23, 64, 92, 76, 55, 40, 12, 28, 24],
       [35, 36, 83, 52, 63, 99, 91, 66,  1,  0],
       [71, 78, 75, 17, 60, 83, 91, 67,  9, 91],
       [ 1, 49, 11, 30, 96, 87, 16, 92, 85, 79],
       [82, 40,  6, 79, 67, 24, 33, 91, 56, 45]], dtype=int32)
```

In [347… `arr2[::-2]`

Out[347…
```
array([[82, 40,  6, 79, 67, 24, 33, 91, 56, 45],
       [71, 78, 75, 17, 60, 83, 91, 67,  9, 91],
       [94, 23, 64, 92, 76, 55, 40, 12, 28, 24],
       [18, 54, 65, 31, 46, 43, 86,  5, 63, 14],
       [53,  5, 17, 78, 22, 24,  6, 42, 71, 53]], dtype=int32)
```

In [348… `arr2`

Out[348…
```
array([[ 4,  6, 69, 12, 35, 31,  6, 72, 11,  2],
       [53,  5, 17, 78, 22, 24,  6, 42, 71, 53],
       [38, 89, 66, 87, 16, 63, 77, 77, 55, 20],
       [18, 54, 65, 31, 46, 43, 86,  5, 63, 14],
       [ 2, 83, 39, 12, 99, 76, 37, 24, 34, 78],
       [94, 23, 64, 92, 76, 55, 40, 12, 28, 24],
       [35, 36, 83, 52, 63, 99, 91, 66,  1,  0],
       [71, 78, 75, 17, 60, 83, 91, 67,  9, 91],
       [ 1, 49, 11, 30, 96, 87, 16, 92, 85, 79],
       [82, 40,  6, 79, 67, 24, 33, 91, 56, 45]], dtype=int32)
```

In [349… `arr2[::-3]`

Out[349…
```
array([[82, 40,  6, 79, 67, 24, 33, 91, 56, 45],
       [35, 36, 83, 52, 63, 99, 91, 66,  1,  0],
       [18, 54, 65, 31, 46, 43, 86,  5, 63, 14],
       [ 4,  6, 69, 12, 35, 31,  6, 72, 11,  2]], dtype=int32)
```

In [350…   `arr2`

Out[350…   ```
array([[4, 6, 69, 12, 35, 31, 6, 72, 11, 2],
       [53, 5, 17, 78, 22, 24, 6, 42, 71, 53],
       [38, 89, 66, 87, 16, 63, 77, 77, 55, 20],
       [18, 54, 65, 31, 46, 43, 86, 5, 63, 14],
       [2, 83, 39, 12, 99, 76, 37, 24, 34, 78],
       [94, 23, 64, 92, 76, 55, 40, 12, 28, 24],
       [35, 36, 83, 52, 63, 99, 91, 66, 1, 0],
       [71, 78, 75, 17, 60, 83, 91, 67, 9, 91],
       [1, 49, 11, 30, 96, 87, 16, 92, 85, 79],
       [82, 40, 6, 79, 67, 24, 33, 91, 56, 45]], dtype=int32)
```

In [351…    `arr2[:-3]`

Out[351…    ```
array([[ 4,  6, 69, 12, 35, 31,  6, 72, 11,  2],
       [53,  5, 17, 78, 22, 24,  6, 42, 71, 53],
       [38, 89, 66, 87, 16, 63, 77, 77, 55, 20],
       [18, 54, 65, 31, 46, 43, 86,  5, 63, 14],
       [ 2, 83, 39, 12, 99, 76, 37, 24, 34, 78],
       [94, 23, 64, 92, 76, 55, 40, 12, 28, 24],
       [35, 36, 83, 52, 63, 99, 91, 66,  1,  0]], dtype=int32)
```

In [352…   `arr`

Out[352…   `array([0, 1, 2, 3, 4, 5])`

In [353…   `arr.max()`

Out[353…   `np.int64(5)`

In [354…   `arr.min()`

Out[354…   `np.int64(0)`

In [355…   `arr`

Out[355…   `array([0, 1, 2, 3, 4, 5])`

In [356...   `arr.mean()`

Out[356...   `np.float64(2.5)`

In [357...   `arr`

Out[357...   `array([0, 1, 2, 3, 4, 5])`

In [358...   `arr.median()`

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[358], line 1
----> 1 arr.median()

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

In [359...
```python
from numpy import *
a = array([1,2,3,4,9])
median(a)
```

Out[359...   `np.float64(3.0)`

(Without work on import* can you please find the median, mode)

In [360...   `arr`

Out[360...   `array([0, 1, 2, 3, 4, 5])`

In [361...   `arr.reshape(3,2)`

Out[361...
```
array([[0, 1],
       [2, 3],
       [4, 5]])
```

In [362...   `arr.reshape(6,1)`

```
Out[362…   array([[0],
                  [1],
                  [2],
                  [3],
                  [4],
                  [5]])
```

```
In [363…   arr.reshape(1,6)
```

```
Out[363…   array([[0, 1, 2, 3, 4, 5]])
```

```
In [364…   arr
```

```
Out[364…   array([0, 1, 2, 3, 4, 5])
```

```
In [365…   arr.reshape(2,4)
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[365], line 1
----> 1 arr.reshape(2,4)

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

```
In [366…   arr
```

```
Out[366…   array([0, 1, 2, 3, 4, 5])
```

```
In [367…   arr.reshape(2,3,order='C')
```

```
Out[367…   array([[0, 1, 2],
                  [3, 4, 5]])
```

```
In [368…   arr.reshape(2,3,order='F') # print element with fortran
```

```
Out[368…   array([[0, 2, 4],
                  [1, 3, 5]])
```

```
In [369…   arr.reshape(2,3,order='A') # A almost give you c type output
```

Out[369…   array([[0, 1, 2],
                   [3, 4, 5]])

In [370…   `arr`

Out[370…   array([0, 1, 2, 3, 4, 5])

In [371…   `arr.reshape(2,3)`

Out[371…   array([[0, 1, 2],
                   [3, 4, 5]])

In [381…   `arr.reshape(6,1)`

Out[381…   array([[0],
                   [1],
                   [2],
                   [3],
                   [4],
                   [5]])

In [382…   `arr.reshape(1,6)`

Out[382…   array([[0, 1, 2, 3, 4, 5]])

In [383…   `arr.reshape(6,1)`

Out[383…   array([[0],
                   [1],
                   [2],
                   [3],
                   [4],
                   [5]])

In [384…   `arr.reshape(2,6)`

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[384], line 1
----> 1 arr.reshape(2,6)

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

In [385…   `arr.reshape(3,3)`

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[385], line 1
----> 1 arr.reshape(3,3)

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

In [386…   `arr`

Out[386…   `array([0, 1, 2, 3, 4, 5])`

In [387…   `arr.reshape(3,2)`

Out[387…
```
array([[0, 1],
       [2, 3],
       [4, 5]])
```

Indexing

In [403…   `mat = np.arange(0,200).reshape(20,10)`

In [404…   `mat`

```
Out[404…   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],
                  [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                  [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                  [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                  [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                  [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                  [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                  [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                  [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                  [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                  [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

```
In [405…   row = 4
           col = 5
```

```
In [406…   col
```

```
Out[406…   5
```

```
In [407…   row
```

```
Out[407…   4
```

```
In [408…   mat
```

```
Out[408…    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],
                   [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                   [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                   [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                   [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                   [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                   [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                   [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                   [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                   [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                   [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [409…   `mat[row,col]`

Out[409…   `np.int64(45)`

In [410…   `mat[4,5]`

Out[410…   `np.int64(45)`

In [411…   `mat`

```
Out[411…    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],
                   [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                   [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                   [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                   [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                   [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                   [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                   [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                   [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                   [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                   [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

```
In [412…    mat[:]
```

```
Out[412…   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],
                  [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                  [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                  [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                  [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                  [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                  [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                  [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                  [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                  [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                  [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

```
In [413…   col = 6
```

```
In [414…   mat
```

```
Out[414…   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],
                  [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                  [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                  [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                  [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                  [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                  [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                  [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                  [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                  [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                  [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

```
In [415…   mat[6] # befault it represent to rows
```

```
Out[415…   array([60, 61, 62, 63, 64, 65, 66, 67, 68, 69])
```

```
In [416…   mat
```

```
Out[416…   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],
                  [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                  [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                  [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                  [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                  [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                  [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                  [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                  [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                  [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                  [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [417…
```python
# With Slices
mat[:,col]
```

Out[417…
```
array([  6,  16,  26,  36,  46,  56,  66,  76,  86,  96, 106, 116, 126,
        136, 146, 156, 166, 176, 186, 196])
```

In [418…
```python
mat
```

```
Out[418…   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],
                  [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                  [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                  [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                  [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                  [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                  [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                  [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                  [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                  [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                  [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [419…   `mat[row,:]`

Out[419…   `array([40, 41, 42, 43, 44, 45, 46, 47, 48, 49])`

In [420…   `mat`

```
Out[420…  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],
                 [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                 [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                 [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                 [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                 [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                 [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                 [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                 [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                 [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                 [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [421… `mat[:,8]`

```
Out[421…  array([  8,  18,  28,  38,  48,  58,  68,  78,  88,  98, 108, 118, 128,
               138, 148, 158, 168, 178, 188, 198])
```

In [422… `mat`

```
Out[422…   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],
                  [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                  [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                  [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                  [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                  [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                  [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                  [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                  [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                  [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                  [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

```
In [423…   mat[:col]
```

```
Out[423…   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 [424…   mat[:6]
```

```
Out[424…   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 [425…   row
```

Out[425…   4

In [426…   `mat`

Out[426…
```
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],
       [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
       [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
       [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
       [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
       [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
       [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
       [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
       [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
       [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
       [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [427…   `mat[:row]`

Out[427…
```
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 [428…   `mat`

```
Out[428…  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],
                 [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                 [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                 [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                 [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                 [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                 [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                 [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                 [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                 [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                 [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

```
In [429…  mat[row:]
```

```
Out[429…  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],
                 [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                 [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                 [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                 [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                 [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                 [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                 [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                 [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                 [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                 [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [430...   `mat[:]`

Out[430...
```
array([[  0,   1,   2,   3,   4,   5,   6,   7,   8,   9],
       [ 10,  11,  12,  13,  14,  15,  16,  17,  18,  19],
       [ 20,  21,  22,  23,  24,  25,  26,  27,  28,  29],
       [ 30,  31,  32,  33,  34,  35,  36,  37,  38,  39],
       [ 40,  41,  42,  43,  44,  45,  46,  47,  48,  49],
       [ 50,  51,  52,  53,  54,  55,  56,  57,  58,  59],
       [ 60,  61,  62,  63,  64,  65,  66,  67,  68,  69],
       [ 70,  71,  72,  73,  74,  75,  76,  77,  78,  79],
       [ 80,  81,  82,  83,  84,  85,  86,  87,  88,  89],
       [ 90,  91,  92,  93,  94,  95,  96,  97,  98,  99],
       [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
       [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
       [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
       [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
       [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
       [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
       [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
       [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
       [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
       [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [431...   `mat[:,8]`

Out[431...
```
array([  8,  18,  28,  38,  48,  58,  68,  78,  88,  98, 108, 118, 128,
       138, 148, 158, 168, 178, 188, 198])
```

In [432...   `mat`

```
Out[432…  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],
                 [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                 [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                 [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                 [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                 [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                 [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                 [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                 [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                 [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                 [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

```
In [433…  mat[:,-1]
```

```
Out[433…  array([  9,  19,  29,  39,  49,  59,  69,  79,  89,  99, 109, 119, 129,
                 139, 149, 159, 169, 179, 189, 199])
```

```
In [434…  mat
```

```
Out[434…  array([[  0,   1,   2,   3,   4,   5,   6,   7,   8,   9],
                 [ 10,  11,  12,  13,  14,  15,  16,  17,  18,  19],
                 [ 20,  21,  22,  23,  24,  25,  26,  27,  28,  29],
                 [ 30,  31,  32,  33,  34,  35,  36,  37,  38,  39],
                 [ 40,  41,  42,  43,  44,  45,  46,  47,  48,  49],
                 [ 50,  51,  52,  53,  54,  55,  56,  57,  58,  59],
                 [ 60,  61,  62,  63,  64,  65,  66,  67,  68,  69],
                 [ 70,  71,  72,  73,  74,  75,  76,  77,  78,  79],
                 [ 80,  81,  82,  83,  84,  85,  86,  87,  88,  89],
                 [ 90,  91,  92,  93,  94,  95,  96,  97,  98,  99],
                 [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                 [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                 [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                 [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                 [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                 [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                 [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                 [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                 [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                 [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [435…
```
row
```

Out[435…
```
4
```

In [436…
```
col
```

Out[436…
```
6
```

In [437…
```
mat[:,col]
```

Out[437…
```
array([  6,  16,  26,  36,  46,  56,  66,  76,  86,  96, 106, 116, 126,
       136, 146, 156, 166, 176, 186, 196])
```

In [438…
```
mat
```

```
Out[438…    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],
                   [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                   [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                   [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                   [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                   [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                   [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                   [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                   [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                   [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                   [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [439…   `mat[1,4]`

Out[439…   np.int64(14)

In [440…   `mat`

```
Out[440…   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],
                  [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                  [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                  [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                  [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                  [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                  [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                  [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                  [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                  [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                  [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

```
In [460…   mat[1:15]
```

```
Out[460…   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],
                  [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                  [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                  [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                  [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                  [140, 141, 142, 143, 144, 145, 146, 147, 148, 149]])
```

```
In [442…   mat
```

```
Out[442…  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],
                 [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                 [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                 [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                 [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                 [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                 [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                 [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                 [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                 [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                 [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [443… `mat[3:-3]`

```
Out[443…  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],
                 [ 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],
                 [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                 [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                 [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                 [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                 [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                 [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                 [160, 161, 162, 163, 164, 165, 166, 167, 168, 169]])
```

In [444… `mat`

```
Out[444…  array([[  0,   1,   2,   3,   4,   5,   6,   7,   8,   9],
                 [ 10,  11,  12,  13,  14,  15,  16,  17,  18,  19],
                 [ 20,  21,  22,  23,  24,  25,  26,  27,  28,  29],
                 [ 30,  31,  32,  33,  34,  35,  36,  37,  38,  39],
                 [ 40,  41,  42,  43,  44,  45,  46,  47,  48,  49],
                 [ 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],
                 [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                 [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                 [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                 [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                 [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                 [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                 [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                 [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                 [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                 [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [445… `mat[0]`

Out[445… `array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])`

In [446… `mat[6]`

Out[446… `array([60, 61, 62, 63, 64, 65, 66, 67, 68, 69])`

In [447… `mat`

```
Out[447…   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],
                  [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                  [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                  [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                  [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                  [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                  [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                  [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                  [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                  [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                  [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

```
In [448…   mat[6:]
```

```
Out[448…   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],
                  [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                  [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                  [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                  [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                  [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                  [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                  [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                  [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                  [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                  [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

```
In [449…   mat[:6]
```

```
Out[449…   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 [450…   `mat`

```
Out[450…   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],
                  [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                  [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                  [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                  [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                  [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                  [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                  [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                  [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                  [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                  [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [451…   `mat[5:7]`

```
Out[451…   array([[50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
                  [60, 61, 62, 63, 64, 65, 66, 67, 68, 69]])
```

In [452…   `mat`

```
Out[452…   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],
                  [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                  [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                  [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                  [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                  [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                  [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                  [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                  [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                  [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                  [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [461…
```
mat[0:11]
```

```
Out[461…   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],
                  [100, 101, 102, 103, 104, 105, 106, 107, 108, 109]])
```

In [454…
```
mat
```

```
Out[454…  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],
                 [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                 [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                 [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                 [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                 [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                 [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                 [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                 [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                 [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                 [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [455… `mat[0:10:3]`

```
Out[455…  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 [462… `mat[0:10:4]`

```
Out[462…  array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
                 [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
                 [80, 81, 82, 83, 84, 85, 86, 87, 88, 89]])
```

In [457… `mat[0:10:3]`

```
Out[457…  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 [458…   `mat`

Out[458…   ```
array([[0,   1,   2,   3,   4,   5,   6,   7,   8,   9],
       [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
       [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
       [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
       [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
       [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],
       [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
       [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
       [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
       [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
       [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
       [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
       [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
       [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
       [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
       [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [459…   `mat[4:]`

```
Out[459…  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],
                 [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                 [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                 [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                 [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                 [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                 [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                 [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                 [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                 [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                 [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

```
In [464…  mat
```

```
Out[464…  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],
                 [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                 [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                 [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                 [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                 [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                 [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                 [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                 [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                 [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                 [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [465…   `mat[:5]`

Out[465…   ```
            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 [466…   `mat`

Out[466…   ```
            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],
                   [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                   [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                   [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                   [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                   [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                   [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                   [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                   [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                   [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                   [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
            ```

In [468…     `mat[::-1,2]`

Out[468…    ```
            array([192, 182, 172, 162, 152, 142, 132, 122, 112, 102,  92,  82,  72,
                    62,  52,  42,  32,  22,  12,   2])
            ```

In [469…   `mat`

```
Out[469…   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],
                  [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                  [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                  [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                  [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                  [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                  [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                  [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                  [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                  [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                  [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [470…
```python
mat[::-3]
```

```
Out[470…   array([[190, 191, 192, 193, 194, 195, 196, 197, 198, 199],
                  [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                  [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                  [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                  [ 70,  71,  72,  73,  74,  75,  76,  77,  78,  79],
                  [ 40,  41,  42,  43,  44,  45,  46,  47,  48,  49],
                  [ 10,  11,  12,  13,  14,  15,  16,  17,  18,  19]])
```

In [471…
```python
mat
```

```
Out[471…  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],
                 [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                 [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                 [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                 [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                 [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                 [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                 [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                 [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                 [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                 [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [472…
```python
mat[::-3]
```

```
Out[472…  array([[190, 191, 192, 193, 194, 195, 196, 197, 198, 199],
                 [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                 [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                 [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                 [ 70,  71,  72,  73,  74,  75,  76,  77,  78,  79],
                 [ 40,  41,  42,  43,  44,  45,  46,  47,  48,  49],
                 [ 10,  11,  12,  13,  14,  15,  16,  17,  18,  19]])
```

In [473…
```python
mat
```

```
Out[473…   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],
                  [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                  [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                  [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                  [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                  [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                  [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                  [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                  [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                  [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                  [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [474…
```
mat[::-5]
```

Out[474…
```
array([[190, 191, 192, 193, 194, 195, 196, 197, 198, 199],
       [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
       [ 90,  91,  92,  93,  94,  95,  96,  97,  98,  99],
       [ 40,  41,  42,  43,  44,  45,  46,  47,  48,  49]])
```

In [475…
```
mat
```

```
Out[475…  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],
                [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [476… `mat[2:6]`

```
Out[476…  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 [477… `mat`

Out[477…

```
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],
       [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
       [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
       [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
       [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
       [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
       [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
       [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
       [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
       [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
       [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [478…

```
mat[2:5,2:6] # 1:5 --> only row part /// 1:3 -- it indicates only column parts
```

Out[478…

```
array([[22, 23, 24, 25],
       [32, 33, 34, 35],
       [42, 43, 44, 45]])
```

In [479…

```
mat
```

```
Out[479…   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],
                  [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                  [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                  [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                  [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                  [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                  [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                  [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                  [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                  [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                  [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [480…   `mat[0,1]`

Out[480…   np.int64(1)

In [481…   `mat[1,6]`

Out[481…   np.int64(16)

In [482…   `mat`

```
Out[482…   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],
                  [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                  [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                  [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                  [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                  [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                  [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                  [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                  [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                  [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                  [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [483…   `mat[1:6]`

```
Out[483…   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 [484…   `mat[1:]`

```
Out[484…   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],
                  [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                  [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                  [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                  [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                  [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                  [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                  [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                  [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                  [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                  [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [485…   mat

Out[485… 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],
               [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
               [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
               [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
               [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
               [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
               [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
               [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
               [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
               [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
               [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])

In [486… `mat[:6]`

Out[486… 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 [487… `mat[0:1]`

Out[487… array([[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]])

In [488… `mat`

```
Out[488…   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],
                  [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                  [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                  [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                  [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                  [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                  [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                  [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                  [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                  [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                  [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [489…   `mat[3:5]`

```
Out[489…   array([[30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
                  [40, 41, 42, 43, 44, 45, 46, 47, 48, 49]])
```

In [490…   `mat[3,5]`

Out[490…   `np.int64(35)`

In [491…   `mat`

```
Out[491…   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],
                  [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                  [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                  [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                  [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                  [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                  [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                  [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                  [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                  [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                  [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [492…   `mat[1:2,2:4]`

Out[492…   `array([[12, 13]])`

In [493…   `mat`

```
Out[493…   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],
                  [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                  [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                  [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                  [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                  [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                  [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                  [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                  [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                  [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                  [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [494…
```
mat[2:3,2:3]
```

Out[494…
```
array([[22]])
```

In [495…
```
mat
```

```
Out[495…   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],
                  [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                  [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                  [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                  [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                  [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                  [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                  [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                  [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                  [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                  [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [496…   `mat[2:4,3:5]`

```
Out[496…   array([[23, 24],
                  [33, 34]])
```

In [497…   `mat[3:5,2:4]`

```
Out[497…   array([[32, 33],
                  [42, 43]])
```

In [498…   `mat`

```
Out[498…  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],
                [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [499… `mat[2:5,4:6]`

```
Out[499…  array([[24, 25],
                [34, 35],
                [44, 45]])
```

Masking

In [500… `mat # we also called as filter`

```
Out[500…   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],
                  [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                  [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                  [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                  [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                  [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                  [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                  [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                  [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                  [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                  [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [501…
```
id(mat)
```

Out[501…   1760002323728

In [502…
```
mat
```

```
Out[502…   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],
                  [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                  [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                  [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                  [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                  [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                  [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                  [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                  [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                  [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                  [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [503…
```
mat[mat<50]
```

Out[503…
```
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 [504…
```
mat[mat<=50]
```

Out[504…
```
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 [505…
```
mat > 50
```

```
Out[505…   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],
                   [ True,  True,  True,  True,  True,  True,  True,  True,  True,
                     True],
                   [ True,  True,  True,  True,  True,  True,  True,  True,  True,
                     True],
                   [ True,  True,  True,  True,  True,  True,  True,  True,  True,
                     True],
                   [ True,  True,  True,  True,  True,  True,  True,  True,  True,
                     True],
                   [ True,  True,  True,  True,  True,  True,  True,  True,  True,
                     True],
                   [ True,  True,  True,  True,  True,  True,  True,  True,  True,
                     True],
                   [ True,  True,  True,  True,  True,  True,  True,  True,  True,
                     True],
                   [ True,  True,  True,  True,  True,  True,  True,  True,  True,
                     True],
                   [ True,  True,  True,  True,  True,  True,  True,  True,  True,
                     True]])
```

In [506… `mat[mat==50]`

Out[506… `array([50])`

In [507… `mat`

Out[507…
```
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],
       [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
       [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
       [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
       [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
       [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
       [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
       [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
       [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
       [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
       [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [508… `mat == 50`

```
Out[508…   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],
                 [False, False, False, False, False, False, False, False, False,
                  False],
                 [False, False, False, False, False, False, False, False, False,
                  False],
                 [False, False, False, False, False, False, False, False, False,
                  False],
                 [False, False, False, False, False, False, False, False, False,
                  False],
                 [False, False, False, False, False, False, False, False, False,
                  False],
                 [False, False, False, False, False, False, False, False, False,
                  False],
                 [False, False, False, False, False, False, 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 [509… `mat`

Out[509…
```
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],
       [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
       [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
       [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
       [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
       [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
       [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
       [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
       [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
       [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
       [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

In [510…
```
a1 = mat[mat<50]
a1
```

Out[510…
```
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 [511… `mat`

```
Out[511…    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],
                   [100, 101, 102, 103, 104, 105, 106, 107, 108, 109],
                   [110, 111, 112, 113, 114, 115, 116, 117, 118, 119],
                   [120, 121, 122, 123, 124, 125, 126, 127, 128, 129],
                   [130, 131, 132, 133, 134, 135, 136, 137, 138, 139],
                   [140, 141, 142, 143, 144, 145, 146, 147, 148, 149],
                   [150, 151, 152, 153, 154, 155, 156, 157, 158, 159],
                   [160, 161, 162, 163, 164, 165, 166, 167, 168, 169],
                   [170, 171, 172, 173, 174, 175, 176, 177, 178, 179],
                   [180, 181, 182, 183, 184, 185, 186, 187, 188, 189],
                   [190, 191, 192, 193, 194, 195, 196, 197, 198, 199]])
```

```
In [512…    a2 = mat[mat>50]
            a2
```

```
Out[512…    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, 100, 101, 102,
                   103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115,
                   116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128,
                   129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141,
                   142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154,
                   155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167,
                   168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180,
                   181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193,
                   194, 195, 196, 197, 198, 199])
```

```
In [513…    a3 = mat[mat<=50]
            a3
```

```
Out[513...    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 [514...
```
a4 = mat[mat==50]
a4
```

Out[514...   array([50])

python program to generat otp

In [515...
```python
import random

def generate_otp(length=4):
    """Generate a numeric OTP of a specified length."""
    digits = '01112131415'
    otp = ''.join(random.choice(digits) for _ in range(length))
    return otp

# Example usage
otp_length = 4  # You can change this to any length you prefer
otp = generate_otp(otp_length)
print(f"Your OTP is: {otp}")
```

Your OTP is: 1111

In [516...
```python
def wish():
    print('congrutlations')
wish()

def wish():
    print('congrutlations')
wish()

def wish():
    print('congrutlations')
wish()
```

```
    congrutlations
    congrutlations
    congrutlations
```

In [517…
```
def wish():
    print('congrutlations')
wish()

wish()

wish()
```

```
    congrutlations
    congrutlations
    congrutlations
```

In [518…
```
list1=['a','b','g',1,5]
print(list1.pop)
```

```
<built-in method pop of list object at 0x00000199C7E8C6C0>
```

In [520…
```
x = [4, 5, 6]
y = x.copy()
x.append(4)
print(x)
```

```
[4, 5, 6, 4]
```

In [ ]: