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

```python
In [3]: arr = np.arange(0, 6)
        arr
```

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

```python
In [4]: nd = np.zeros((5,9), dtype = int)
        nd
```

```
Out[4]: 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]])
```

```python
In [5]: nd1 = np.ones((10,10), dtype = int)
        nd1
```

```
Out[5]: array([[1, 1, 1, 1, 1, 1, 1, 1, 1, 1],
               [1, 1, 1, 1, 1, 1, 1, 1, 1, 1],
               [1, 1, 1, 1, 1, 1, 1, 1, 1, 1],
               [1, 1, 1, 1, 1, 1, 1, 1, 1, 1],
               [1, 1, 1, 1, 1, 1, 1, 1, 1, 1],
               [1, 1, 1, 1, 1, 1, 1, 1, 1, 1],
               [1, 1, 1, 1, 1, 1, 1, 1, 1, 1],
               [1, 1, 1, 1, 1, 1, 1, 1, 1, 1],
               [1, 1, 1, 1, 1, 1, 1, 1, 1, 1],
               [1, 1, 1, 1, 1, 1, 1, 1, 1, 1]])
```

Numpy Funtions

```python
In [6]: np.random.rand(2)
```

```
Out[6]: array([0.38682048, 0.42365682])
```

```python
In [16]: np.random.rand(3)
```

```
Out[16]: array([0.67891626, 0.38604894, 0.21481586])
```

```python
In [17]: np.random.rand(2,3)
```

```
Out[17]: array([[0.45633393, 0.30916973, 0.94315794],
                [0.44526499, 0.17692997, 0.64329988]])
```

```python
In [23]: np.random.randint(3)
```

```
Out[23]: 2
```

```python
In [26]: np.random.randint(2,10)
```

```
Out[26]: 7
```

```python
In [29]: np.random.randint(2,10,4)
```

```
Out[29]: array([8, 2, 7, 3], dtype=int32)
```

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

```
Out[30]: array([  5,  -5,   3,  -7, -14, -22,  -3,  18,  -7, -28], dtype=int32)
```

```python
In [31]: np.random.randint(10,40,(10,10))
```

```
Out[31]: array([[33, 15, 36, 12, 11, 21, 21, 17, 31, 29],
                 [21, 31, 15, 20, 31, 32, 24, 20, 35, 19],
                 [38, 22, 21, 14, 36, 19, 32, 10, 29, 25],
                 [15, 11, 38, 36, 10, 38, 20, 25, 30, 17],
                 [20, 14, 22, 38, 33, 33, 25, 18, 38, 30],
                 [23, 25, 33, 11, 22, 13, 16, 33, 25, 12],
                 [25, 27, 13, 19, 20, 21, 14, 19, 18, 24],
                 [20, 21, 30, 27, 17, 15, 18, 28, 35, 20],
                 [14, 13, 32, 26, 29, 28, 37, 16, 19, 12],
                 [28, 18, 26, 35, 25, 18, 23, 25, 13, 38]], dtype=int32)
```

In [32]:
```python
m = np.random.randint(10,40,(10,10))
m
```

```
Out[32]: array([[39, 38, 27, 33, 15, 37, 30, 25, 24, 24],
                 [39, 30, 21, 26, 29, 23, 12, 16, 10, 12],
                 [10, 13, 12, 16, 32, 21, 30, 38, 13, 10],
                 [31, 33, 39, 32, 23, 13, 12, 11, 34, 31],
                 [21, 24, 16, 36, 20, 10, 11, 23, 15, 16],
                 [29, 11, 18, 35, 37, 27, 28, 16, 30, 18],
                 [23, 25, 23, 22, 32, 19, 12, 24, 10, 15],
                 [30, 29, 25, 32, 28, 37, 26, 25, 26, 14],
                 [11, 28, 37, 18, 30, 27, 31, 36, 12, 17],
                 [16, 38, 23, 11, 24, 32, 34, 10, 36, 31]], dtype=int32)
```

In [33]:
```python
arr
```

```
Out[33]: array([0, 1, 2, 3, 4, 5])
```

In [34]:
```python
arr.reshape(2,3)
```

```
Out[34]: array([[0, 1, 2],
                 [3, 4, 5]])
```

In [35]:
```python
arr.reshape(3,3)
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[35], line 1
----> 1 arr.reshape(3,3)

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

In [36]:
```python
arr.reshape(6,1)
```

```
Out[36]: array([[0],
                 [1],
                 [2],
                 [3],
                 [4],
                 [5]])
```

In [37]:
```python
arr.reshape(1,6)
```

```
Out[37]: array([[0, 1, 2, 3, 4, 5]])
```

Slicing

In [38]:
```python
m
```

```
Out[38]: array([[39, 38, 27, 33, 15, 37, 30, 25, 24, 24],
                 [39, 30, 21, 26, 29, 23, 12, 16, 10, 12],
                 [10, 13, 12, 16, 32, 21, 30, 38, 13, 10],
                 [31, 33, 39, 32, 23, 13, 12, 11, 34, 31],
                 [21, 24, 16, 36, 20, 10, 11, 23, 15, 16],
                 [29, 11, 18, 35, 37, 27, 28, 16, 30, 18],
                 [23, 25, 23, 22, 32, 19, 12, 24, 10, 15],
                 [30, 29, 25, 32, 28, 37, 26, 25, 26, 14],
                 [11, 28, 37, 18, 30, 27, 31, 36, 12, 17],
                 [16, 38, 23, 11, 24, 32, 34, 10, 36, 31]], dtype=int32)
```

```
In [41]: b = np.random.randint(10,20,(5,4))
         b
```

```
Out[41]: array([[15, 18, 14, 15],
                 [10, 16, 18, 15],
                 [10, 15, 14, 16],
                 [11, 13, 12, 15],
                 [14, 14, 14, 18]], dtype=int32)
```

```
In [42]: b[:]
```

```
Out[42]: array([[15, 18, 14, 15],
                 [10, 16, 18, 15],
                 [10, 15, 14, 16],
                 [11, 13, 12, 15],
                 [14, 14, 14, 18]], dtype=int32)
```

```
In [43]: b[1:4]
```

```
Out[43]: array([[10, 16, 18, 15],
                 [10, 15, 14, 16],
                 [11, 13, 12, 15]], dtype=int32)
```

```
In [44]: b
```

```
Out[44]: array([[15, 18, 14, 15],
                 [10, 16, 18, 15],
                 [10, 15, 14, 16],
                 [11, 13, 12, 15],
                 [14, 14, 14, 18]], dtype=int32)
```

```
In [45]: b[-1:]
```

```
Out[45]: array([[14, 14, 14, 18]], dtype=int32)
```

```
In [46]: b[:-1]
```

```
Out[46]: array([[15, 18, 14, 15],
                 [10, 16, 18, 15],
                 [10, 15, 14, 16],
                 [11, 13, 12, 15]], dtype=int32)
```

```
In [47]: b[-5,-3]
```

```
Out[47]: np.int32(18)
```

```
In [48]: np.random.randint(10,20,(4,4))
```

```
Out[48]: array([[15, 12, 16, 15],
                 [12, 15, 12, 12],
                 [10, 15, 17, 18],
                 [14, 11, 11, 13]], dtype=int32)
```

```
In [49]: b
```

```
Out[49]:  array([[15, 18, 14, 15],
                 [10, 16, 18, 15],
                 [10, 15, 14, 16],
                 [11, 13, 12, 15],
                 [14, 14, 14, 18]], dtype=int32)
```

In [50]: `b[-4,-2]`

Out[50]: `np.int32(18)`

In [51]: `b[-4:2]`

Out[51]: `array([[10, 16, 18, 15]], dtype=int32)`

Operations

In [53]:
```
a = np.random.randint(10,20,10)
a
```

Out[53]: `array([10, 12, 13, 10, 18, 15, 15, 13, 16, 16], dtype=int32)`

In [54]: `id(a)`

Out[54]: `2432381672816`

In [55]: `arr`

Out[55]: `array([0, 1, 2, 3, 4, 5])`

In [56]: `arr2 = np.random.randint(0,100,(10,10))`

In [57]: `arr2`

```
Out[57]:  array([[93, 94, 29, 61, 95, 90, 96, 10, 72, 23],
                 [92, 76, 62, 25, 30, 47, 38, 13, 81, 91],
                 [33, 42, 48, 95, 17, 88, 16, 21, 48, 70],
                 [73, 57, 67, 22, 95, 26, 80, 16, 49, 42],
                 [23, 14, 50, 44,  7, 51, 55,  3, 35, 91],
                 [28,  4, 48, 18, 87, 42, 69, 23, 51, 31],
                 [21, 57, 33, 34, 97, 92, 25, 27, 37, 82],
                 [23, 73, 25, 94, 86, 85, 14, 36, 88, 34],
                 [21, 30, 50,  0, 49,  0, 51, 58, 85, 38],
                 [25, 39, 98, 27, 38, 18, 85, 89, 53, 72]], dtype=int32)
```

In [58]: `arr[:]`

Out[58]: `array([0, 1, 2, 3, 4, 5])`

In [59]: `arr[:4]`

Out[59]: `array([0, 1, 2, 3])`

In [60]: `arr2[:]`

```
Out[60]:  array([[93, 94, 29, 61, 95, 90, 96, 10, 72, 23],
                 [92, 76, 62, 25, 30, 47, 38, 13, 81, 91],
                 [33, 42, 48, 95, 17, 88, 16, 21, 48, 70],
                 [73, 57, 67, 22, 95, 26, 80, 16, 49, 42],
                 [23, 14, 50, 44,  7, 51, 55,  3, 35, 91],
                 [28,  4, 48, 18, 87, 42, 69, 23, 51, 31],
                 [21, 57, 33, 34, 97, 92, 25, 27, 37, 82],
                 [23, 73, 25, 94, 86, 85, 14, 36, 88, 34],
                 [21, 30, 50,  0, 49,  0, 51, 58, 85, 38],
                 [25, 39, 98, 27, 38, 18, 85, 89, 53, 72]], dtype=int32)
```

In [61]: `arr2[0:5]`

```
Out[61]:  array([[93, 94, 29, 61, 95, 90, 96, 10, 72, 23],
                 [92, 76, 62, 25, 30, 47, 38, 13, 81, 91],
                 [33, 42, 48, 95, 17, 88, 16, 21, 48, 70],
                 [73, 57, 67, 22, 95, 26, 80, 16, 49, 42],
                 [23, 14, 50, 44,  7, 51, 55,  3, 35, 91]], dtype=int32)
```

In [62]: `arr2[1,4]`

Out[62]: np.int32(30)

In [67]: `arr2[1,3]`

Out[67]: np.int32(25)

In [68]: `arr2`

```
Out[68]:  array([[93, 94, 29, 61, 95, 90, 96, 10, 72, 23],
                 [92, 76, 62, 25, 30, 47, 38, 13, 81, 91],
                 [33, 42, 48, 95, 17, 88, 16, 21, 48, 70],
                 [73, 57, 67, 22, 95, 26, 80, 16, 49, 42],
                 [23, 14, 50, 44,  7, 51, 55,  3, 35, 91],
                 [28,  4, 48, 18, 87, 42, 69, 23, 51, 31],
                 [21, 57, 33, 34, 97, 92, 25, 27, 37, 82],
                 [23, 73, 25, 94, 86, 85, 14, 36, 88, 34],
                 [21, 30, 50,  0, 49,  0, 51, 58, 85, 38],
                 [25, 39, 98, 27, 38, 18, 85, 89, 53, 72]], dtype=int32)
```

In [69]: `arr2[-5,5]`

Out[69]: np.int32(42)

In [72]: `arr2[-1,-2]`

Out[72]: np.int32(53)

In [76]: `print(arr2)`

```
[[93 94 29 61 95 90 96 10 72 23]
 [92 76 62 25 30 47 38 13 81 91]
 [33 42 48 95 17 88 16 21 48 70]
 [73 57 67 22 95 26 80 16 49 42]
 [23 14 50 44  7 51 55  3 35 91]
 [28  4 48 18 87 42 69 23 51 31]
 [21 57 33 34 97 92 25 27 37 82]
 [23 73 25 94 86 85 14 36 88 34]
 [21 30 50  0 49  0 51 58 85 38]
 [25 39 98 27 38 18 85 89 53 72]]
```

In [77]: `print(arr2[::-1]) # This reverses the rows of the matrix — last row comes first, first row comes`

```
[[25 39 98 27 38 18 85 89 53 72]
 [21 30 50  0 49  0 51 58 85 38]
 [23 73 25 94 86 85 14 36 88 34]
 [21 57 33 34 97 92 25 27 37 82]
 [28  4 48 18 87 42 69 23 51 31]
 [23 14 50 44  7 51 55  3 35 91]
 [73 57 67 22 95 26 80 16 49 42]
 [33 42 48 95 17 88 16 21 48 70]
 [92 76 62 25 30 47 38 13 81 91]
 [93 94 29 61 95 90 96 10 72 23]]
```

In [79]:
```
# This reverses the rows and takes every 2nd row — from bottom to top, skipping one row in betwe
print(arr2[::-2])
```

```
[[25 39 98 27 38 18 85 89 53 72]
 [23 73 25 94 86 85 14 36 88 34]
 [28  4 48 18 87 42 69 23 51 31]
 [73 57 67 22 95 26 80 16 49 42]
 [92 76 62 25 30 47 38 13 81 91]]
```

```python
In [80]:  # This reverses the rows and takes every 3rd row — from bottom to top, skipping two rows in betw
          print(arr2[::-3])
```

```
[[25 39 98 27 38 18 85 89 53 72]
 [21 57 33 34 97 92 25 27 37 82]
 [73 57 67 22 95 26 80 16 49 42]
 [93 94 29 61 95 90 96 10 72 23]]
```

```python
In [81]:  # This slices rows from index 0 to 9 (inclusive), taking every 3rd row — normal order.
          print(arr2[0:10:3])
```

```
[[93 94 29 61 95 90 96 10 72 23]
 [73 57 67 22 95 26 80 16 49 42]
 [21 57 33 34 97 92 25 27 37 82]
 [25 39 98 27 38 18 85 89 53 72]]
```

```python
In [82]:  arr
```

```
Out[82]:  array([0, 1, 2, 3, 4, 5])
```

```python
In [83]:  arr.max()
```

```
Out[83]:  np.int64(5)
```

```python
In [84]:  arr.min()
```

```
Out[84]:  np.int64(0)
```

```python
In [85]:  arr.mean()
```

```
Out[85]:  np.float64(2.5)
```

```python
In [86]:  print(arr.reshape(3,2))
```

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

```python
In [87]:  arr.reshape(2,3,order='C')
```

```
Out[87]:  array([[0, 1, 2],
                 [3, 4, 5]])
```

```python
In [88]:  arr.reshape(2,3,order='F')
```

```
Out[88]:  array([[0, 2, 4],
                 [1, 3, 5]])
```

```python
In [89]:  arr.reshape(2,3,order='A')
```

```
Out[89]:  array([[0, 1, 2],
                 [3, 4, 5]])
```

Indexing

```python
In [90]:  mat = np.arange(0,100).reshape(10,10)
```

```python
In [91]:  mat
```

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

In [92]:
```
row=4
col=5
```

In [93]:
```
col
```

Out[93]: 5

In [94]:
```
row
```

Out[94]: 4

In [95]:
```
mat
```

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

In [96]:
```
mat[row,col]
```

Out[96]: np.int64(45)

In [97]:
```
mat[:]
```

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

In [98]:
```
col=6
```

In [99]:
```
mat
```

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

In [100…]:
```
mat[6]
```

```
Out[100…  array([60, 61, 62, 63, 64, 65, 66, 67, 68, 69])

In [101…  mat

Out[101…  array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
                 [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
                 [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
                 [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
                 [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
                 [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
                 [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
                 [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
                 [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
                 [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])

In [102…  mat[:,col]

Out[102…  array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])

In [103…  mat[row,:]

Out[103…  array([40, 41, 42, 43, 44, 45, 46, 47, 48, 49])

In [104…  mat[:,8]

Out[104…  array([ 8, 18, 28, 38, 48, 58, 68, 78, 88, 98])

In [105…  mat[:col]

Out[105…  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 [106…  mat[:6]

Out[106…  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 [107…  row

Out[107…  4

In [108…  mat

Out[108…  array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
                 [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
                 [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
                 [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
                 [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
                 [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
                 [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
                 [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
                 [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
                 [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])

In [109…  mat[:row]

Out[109…  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]])
```

```python
In [110...  mat[row:]
```

```
Out[110...  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]])
```

```python
In [111...  mat[:]
```

```
Out[111...  array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
               [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
               [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
               [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
               [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
               [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
               [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
               [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
               [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
               [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```python
In [112...  mat[:,8]
```

```
Out[112...  array([ 8, 18, 28, 38, 48, 58, 68, 78, 88, 98])
```

```python
In [113...  mat[:,-1]
```

```
Out[113...  array([ 9, 19, 29, 39, 49, 59, 69, 79, 89, 99])
```

```python
In [114...  mat[:,col]
```

```
Out[114...  array([ 6, 16, 26, 36, 46, 56, 66, 76, 86, 96])
```

```python
In [115...  mat[1:4]
```

```
Out[115...  array([[10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
               [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
               [30, 31, 32, 33, 34, 35, 36, 37, 38, 39]])
```

```python
In [116...  mat[3:-3]
```

```
Out[116...  array([[30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
               [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
               [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
               [60, 61, 62, 63, 64, 65, 66, 67, 68, 69]])
```

```python
In [117...  mat[0]
```

```
Out[117...  array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])
```

```python
In [118...  mat[6]
```

```
Out[118...  array([60, 61, 62, 63, 64, 65, 66, 67, 68, 69])
```

```python
In [119...  mat[6:]
```

```
Out[119...  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]])
```

```python
In [120...  mat[:6]
```

```
Out[120…  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 [121… `mat[::-1]`

```
Out[121…  array([[90, 91, 92, 93, 94, 95, 96, 97, 98, 99],
              [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
              [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
              [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
              [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
              [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
              [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
              [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
              [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
              [ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9]])
```

In [122… `mat[::-3]`

```
Out[122…  array([[90, 91, 92, 93, 94, 95, 96, 97, 98, 99],
              [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
              [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
              [ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9]])
```

In [123… `mat[::-5]`

```
Out[123…  array([[90, 91, 92, 93, 94, 95, 96, 97, 98, 99],
              [40, 41, 42, 43, 44, 45, 46, 47, 48, 49]])
```

In [124… `mat[2:6,2:4]`

```
Out[124…  array([[22, 23],
              [32, 33],
              [42, 43],
              [52, 53]])
```

In [125… `mat[2:4,3:5]`

```
Out[125…  array([[23, 24],
              [33, 34]])
```

In [126… `mat[3:5,2:4]`

```
Out[126…  array([[32, 33],
              [42, 43]])
```

Masking

Masking means applying a condition to a NumPy array to filter/select elements based on True/False values.

How does it work?

- Create a condition: mat > 50 → returns a Boolean mask of the same shape as mat
- Apply mask: mat[mat > 50] → returns only the values where the condition is True

In [127… `mat`

```
Out[127... array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
              [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
              [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
              [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
              [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
              [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
              [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
              [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
              [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
              [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

```
In [128... id(mat)
```

```
Out[128... 2432381672240
```

```
In [129... mat[mat<50]
```

```
Out[129... 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 [130... mat[mat<40]
```

```
Out[130... 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 [131... mat[mat<=50]
```

```
Out[131... 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 [132... mat>50
```

```
Out[132... array([[False, False, False, False, False, False, False, False, False,
              False],
             [False, False, False, False, False, False, False, False, False,
              False],
             [False, False, False, False, False, False, False, False, False,
              False],
             [False, False, False, False, False, False, False, False, False,
              False],
             [False, False, False, False, False, False, False, False, False,
              False],
             [False,  True,  True,  True,  True,  True,  True,  True,  True,
               True],
             [ True,  True,  True,  True,  True,  True,  True,  True,  True,
               True],
             [ True,  True,  True,  True,  True,  True,  True,  True,  True,
               True],
             [ True,  True,  True,  True,  True,  True,  True,  True,  True,
               True],
             [ True,  True,  True,  True,  True,  True,  True,  True,  True,
               True]])
```

```
In [133... mat[mat==50]
```

```
Out[133... array([50])
```

```
In [134... mat
```

```
Out[134...   array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
                    [10, 11, 12, 13, 14, 15, 16, 17, 18, 19],
                    [20, 21, 22, 23, 24, 25, 26, 27, 28, 29],
                    [30, 31, 32, 33, 34, 35, 36, 37, 38, 39],
                    [40, 41, 42, 43, 44, 45, 46, 47, 48, 49],
                    [50, 51, 52, 53, 54, 55, 56, 57, 58, 59],
                    [60, 61, 62, 63, 64, 65, 66, 67, 68, 69],
                    [70, 71, 72, 73, 74, 75, 76, 77, 78, 79],
                    [80, 81, 82, 83, 84, 85, 86, 87, 88, 89],
                    [90, 91, 92, 93, 94, 95, 96, 97, 98, 99]])
```

In [135...
```
mat == 50
```

```
Out[135...   array([[False, False, False, False, False, False, False, False, False,
                     False],
                    [False, False, False, False, False, False, False, False, False,
                     False],
                    [False, False, False, False, False, False, False, False, False,
                     False],
                    [False, False, False, False, False, False, False, False, False,
                     False],
                    [False, False, False, False, False, False, False, False, False,
                     False],
                    [ True, False, False, False, False, False, False, False, False,
                     False],
                    [False, False, False, False, False, False, False, False, False,
                     False],
                    [False, False, False, False, False, False, False, False, False,
                     False],
                    [False, False, False, False, False, False, False, False, False,
                     False],
                    [False, False, False, False, False, False, False, False, False,
                     False]])
```

In [136...
```
a1 = mat[mat<50]
a1
```

```
Out[136...   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 [137...
```
a2 = mat[mat>50]
a2
```

```
Out[137...   array([51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67,
                    68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84,
                    85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99])
```

In [139...
```
a3 = mat[mat<=50]
a3
```

```
Out[139...   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 [142...
```
a4 = mat[mat==50]
a4
```

```
Out[142...   array([50])
```