Module 02

Numpy Indexing and Selection

Data Science Developer

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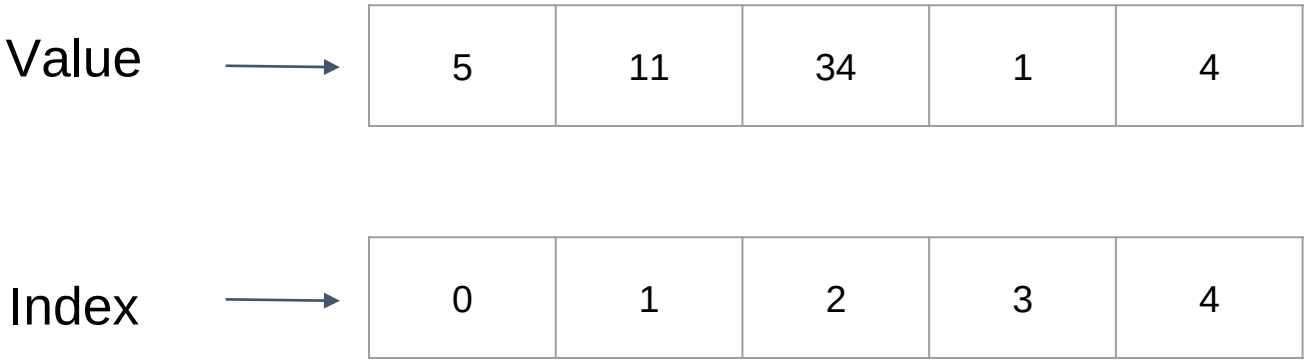
Outline

- Indexing in each array type (1D, 2D, 3D)
- Index and mutability in 1D Array
- Index and mutability in 2D Array
- Fancy Indexing
- Conditional Selection

Indexing for each Array Type

1D Array



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2D Array

1	5	-6	12
2	-23	23	-7
0	43	77	3
32	-22	88	2

0
1
2
3

0	1	2	3

Index

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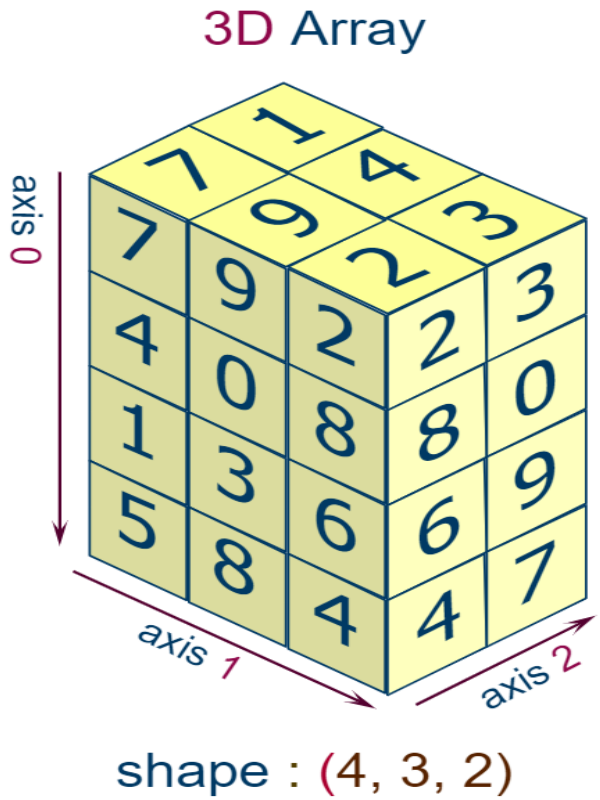
3D Array



0
1
2
3

0	1

0	1	2

Index

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Index and mutability in 1D Array

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New Array Arr

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

In [3]: #Creating sample array
        arr = np.arange(0,11)

In [4]: #Show
        arr

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

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Bracket Indexing and Selection

```
In [4]: #Show
        arr
Out[4]: array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10])

In [5]: #Get a value at an index
        arr[8]
Out[5]: 8

In [6]: #Get values in a range
        arr[1:5]
Out[6]: array([1, 2, 3, 4])

In [7]: #Get values in a range
        arr[0:5]
Out[7]: array([0, 1, 2, 3, 4])

In [8]: arr[0:10:2]
Out[8]: array([0, 2, 4, 6, 8])
```

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Slicing

In [4]:
```
#setting a value with an index range
arr[0:5]=100

#show
arr
```

Out[4]:
```
array([100, 100, 100, 100, 100,   5,   6,   7,   8,   9,  10])
```

In [5]:
```
# Reset array, we'll see why I had to reset in  a moment
arr = np.arange(0,11)

#Show
arr
```

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

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Slicing

In [6]:
```
#Important notes on Slices
slice_of_arr = arr[0:6]

#Show slice
slice_of_arr
```

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

In [7]:
```
#Change Slice
slice_of_arr[:]=99

#Show Slice again
slice_of_arr
```

Out[7]:
```
array([99, 99, 99, 99, 99, 99])
```

Now note the changes also occur in our original array!

In [8]:
```
arr
```

Out[8]:
```
array([99, 99, 99, 99, 99, 99,  6,  7,  8,  9, 10])
```

Data is not copied, it's a view of the original array! This avoids memory problems!

In [9]:
```
#To get a copy, need to be explicit
arr_copy = arr.copy()

arr_copy
```

Out[9]:
```
array([99, 99, 99, 99, 99, 99,  6,  7,  8,  9, 10])
```

Indexing a 2D array

In [14]:
```
arr_2d = np.array(([5,10,15],[20,25,30],[35,40,45]))

#Show
arr_2d
```

Out[14]:
```
array([[ 5, 10, 15],
       [20, 25, 30],
       [35, 40, 45]])
```

In [15]:
```
#Indexing row
arr_2d[1]
```

Out[15]:
```
array([20, 25, 30])
```

In [16]:
```
# Format is arr_2d[row][col] or arr_2d[row,col]

# Getting individual element value
arr_2d[1][0]
```

Out[16]:
```
20
```

In [17]:
```
# Getting individual element value
arr_2d[1,0]
```

Out[17]:
```
20
```

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Indexing a 2D array

```
In [14]: arr_2d = np.array(([5,10,15],[20,25,30],[35,40,45]))

         #Show
         arr_2d
```

```
Out[14]: array([[ 5, 10, 15],
                [20, 25, 30],
                [35, 40, 45]])
```

```
In [18]: # 2D array slicing

         #Shape (2,2) from top right corner
         arr_2d[:2,1:]
```

```
Out[18]: array([[10, 15],
                [25, 30]])
```

```
In [51]: arr_2d[:,2]
```

```
Out[51]: array([15, 30, 45])
```

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Fancy Indexing

Fancy Indexing

```
In [4]: #Show
        arr
```

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

```
In [54]: #normal indexing

         [arr[2], arr[5], arr[9]]
```

```
Out[54]: [2, 5, 9]
```

```
In [56]: #fancy indexing
         arr[[2,5,9]]
```

```
Out[56]: array([2, 5, 9])
```

```
In [57]: #can be in any order
         arr[[5,9,2]]
```

```
Out[57]: array([5, 9, 2])
```

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Fancy Indexing

In [14]:
```
arr_2d = np.array(([5,10,15],[20,25,30],[35,40,45]))

#Show
arr_2d
```

Out[14]:
```
array([[ 5, 10, 15],
       [20, 25, 30],
       [35, 40, 45]])
```

In [60]:
```
arr_2d[[0,2]]
```

Out[60]:
```
array([[ 5, 10, 15],
       [35, 40, 45]])
```

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Conditional Selection

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Conditional Selection

```
In [28]: arr = np.arange(1,11)
         arr
Out[28]: array([ 1,  2,  3,  4,  5,  6,  7,  8,  9, 10])

In [30]: arr > 4
Out[30]: array([False, False, False, False,  True,  True,  True,  True,  True,  True], dtype=bool)

In [31]: bool_arr = arr>4

In [32]: bool_arr
Out[32]: array([False, False, False, False,  True,  True,  True,  True,  True,  True], dtype=bool)

In [33]: arr[bool_arr]
Out[33]: array([ 5,  6,  7,  8,  9, 10])
```

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Conditional Selection

```
In [34]: arr[arr>2]

Out[34]: array([ 3,  4,  5,  6,  7,  8,  9, 10])

In [37]: x = 2
         arr[arr>x]

Out[37]: array([ 3,  4,  5,  6,  7,  8,  9, 10])
```

Reference

- Numpy Indexing. https://numpy.org/doc/stable/reference/arrays.indexing.html
- Fancy Indexing. https://jakevdp.github.io/PythonDataScienceHandbook/02.07-fancy-indexing.html
- Glosarry. https://numpy.org/doc/stable/glossary.html

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