# Numerical Python

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# Contents

# Chapter 1

# Introduction

## 1.1 Introduction

NumPy is a Python library. NumPy is used for working with **arrays**.It also has functions for working in domain of

### 1.1.1 Why use NumPy

NumPy aims to provide an array object that is up to 50x faster than traditional Python lists. The array object in NumPy is called **ndarray**, it provides a lot of supporting functions that make working with **ndarray** very easy.

### 1.1.2 Why is NumPy Faster Than List?

NumPy arrays are **stored at one continuous place** in memory unlike lists, so processes can access and manipulate them very efficiently.

### 1.1.3 Which Language is NumPy Written in ?

NumPy is a Python library written partially in Python, but most of the parts that required fast computation are written in C or C++ . The source code for NumPy is located at this https://www.github.com/numpy/numpy github repository

Creating Arrays

# Chapter 2

# Creating Arrays

## 2.1 Create a ndarray Object

NumPy is used to work with arrays. The array object in NumPy is called *ndarray*We can create a Num

### 2.1.1 Dimensions in Arrays

A dimension in arrays is one level of array depth (nested arrays) .We have several types of array in NumPy. They are;

1. 0-D Arrays → Only one item in arroy
2. 1-D Arrays → Most basic and common arrays
3. 2-D Arrays → An array has 1-D arrays as its element. (Nested array in 1-D)
4. 3-D Arrays → An array has 2-D arrays as its element. (Nested array in 1-D)

**For multidimensional array, the number of elements in each nested array must be identical!** To return the dimension of the array → *ndim*

### 2.1.2 Higher dimensional Arrays

An array can have any number of dimensions.
When the array is created, we can define the number of dimensions bu using the ***ndim*** argument.

**Example**

arr = np.array([1,2,4,5], ndmin=8)

## 2.2 Array Indexing

Array indexing is the same as accessing an array element.
We can access an array element by referring to its index number.
The indexes in NumPy arrays start with 0, meaning that the index of first element is 0, and the 1 is for the second element and up to up...

### 2.2.1 Access Array Elements

1. To access 1-D Arrays → variable[n]
2. To access 2-D Arrays → variable[n,m]
3. To access 3-D Arrays → variable[n,m,l]
4. For negative Indexing → variable[n,-m]

To access 1-D Arrays → variable[n]

## 2.3 Array Slicing

Slicing means taking elements from one given index to another given index.
We pass slice instead of index like this : [start:end]
We can also define the step, like this: [start:end:step]
If we don't pass start its considered **0** If we don't pass end its considered **length of array** in that dimension.
If we don't pass step its considerde 1.
When we select a range such that [m:n] the result returns from index m to (n-1) index. But for nested array this rule is not fllowed. In that case, for [m:n, p:q] , it is taken ,for m:n from index **m to (n-1)** and for p:q **p to q**

### 2.3.1 1-D

variable[start:end]
arr = np.array([1,2,3,4,5,6])
print(arr[1:5])
It will return: 2 3 4
print(arr[1:]) (Slice elements from index 1 to the end of the array)
It will return: 2 3 4 5 6
print(arr[:4]) (Slice elements from the beginnig to index 4 (not included))
It will return: 1 2 3

### 2.3.2 Step

If we don't pass step its considered 1.

arr = np.array([1,2,3,4,5,6,7,8,9])
print(arr(1:6:2))
Result: 2 4 6

print(arr[::2])
Result: 1 3 5 7 9

### 2.3.3 2-D

arr = np.array([[1,2,3,4,5],[11,12,13,14,15]])

print(arr[0:2,3])

here,
arr[0:2,3] is saying that go throug the array of index 0 and 1 and slice the element of index 3 from each.
Hence, 0:2 indicating the index of main array and 3 is indicating the element of nested array and

Result : 4 14

Again, print(arr[0:2,1:4])

It is saying that go through the array of index 0 and 1 and then slice elements from index 1 to 4

Here, Result: [2 3 4] [12 13 14]

## 2.4 Array Copy vs View

The main difference between **copy** and **view** is that the **copy** is a new array, on the other hand **view** is just a view of original array!

Actually, the behaviour of **copy()** and **view** is as natural. The **copy** method just copy the original array and **view()** method just show us the original array. So if we make change in the original array the copied one will **not be affected** and will return the actual array what we copied. But for **view** we will show the changed array!

**copy()** method owns the array but **view()** don't.
Example:

```
import numpy as np
arr = np.array([1,2,3,4,5,0])

newarr = arr.copy()
view = arr.view()
arr[0] = 42

print(arr) → [42 2 3 4 5 0]
print(newarr) → [1 2 3 4 5 0]
print(view) → [42 2 3 4 5 0]
```

To check that an array owns the data from another one → variable.base → it will return **None** if it owns otherwise it will return the original object

# Chapter 3

# Data Types

## 3.1 Data Types in Python

By default Python have these data types;

1. string
2. integer
3. float
4. boolean
5. complex

## 3.2 Data Types in NumPy

**NumPy has some extra data types, and refer to data types with one character, like *i* for integer, *u* for unsigned integers etc.**

1. i → integer
2. b → boolean
3. u → unsigned integer
4. f → float
5. c → complex float
6. m → timedelta
7. M → datetime
8. O → object

9. S → string
10. U → unicode string
11. V → fixed chunk of memory for other type (void)

We can define or change the data-type of an array simply writing ***dtype='S'*** after the array
We also can define the size of this data type as well! simply writing ***dtype='S4'*** after the array
We know strings like 'hello, a, B etc.' cannot be converted to integer value. So, if we want cast them to integer, will rise an error called ValueError

Here the best way to change the data type of an existing array, is to make a copy of the array with the ***astype()*** method. It created a copy of data and allows to specify the data type as parameter.
e.g: arr = np.array([[1,2,3,4,5],[11,12,13,14,15]],dtype="S")
newarr = arr.astype("i")

# Chapter 4

# Array Shape

# Chapter 5

# In Brief

1. To check dimension/s → variable.ndim
2. To define the dimension of an Array → ndmin = n
3. To check the datatype of an array → variable.dtype
4. To copy,store and convert data type → newArray = prevArray.astype("i/S/bool...")
5. To access 1-D Arrays → variable[n]
6. To access 2-D Arrays → variable[n,m]
7. To access 3-D Arrays → variable[n,m,l]
8. For negative Indexing → variable[n,-m]
9. Slice 1-D Array → variable[n:m] (from n to m-1)
10. To use Step → variable[n:m:a] (a is step)
11. To use Step → variable[::a] (return element from begining to end after "a" number of step)
12. Slice 2-D Array → variable[n:m,p:q] (from n to m-1 and p to q)
13. To copy an array → variable.copy()
14. To show the original array → variable.view()
15. To check that an array owns the data from another one → variable.base → it will return **None** if it owns otherwise it will return the original object
16. To know the shape/size of an array → variable.shape

## 5.1 Rights

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