Python NumPy Tutorial for Data Science

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In this NumPy Tutorial, we will learn what is **NumPy**. We will learn about its **uses**, **installation**, **operations** and many other features.

NumPy Introduction

NumPy stands for **'Numerical Python'**. It is a **package** in Python to work with **arrays**. It is a **basic scientific library**. Its most important feature is the **n-dimensional array object**. It has uses in **statistical functions**, **linear algebra**, **arithmetic operations**, **bitwise operations**, etc.

We perform all the **operations** on the **array elements**. We can **initialize** these **arrays** in several ways.

Prerequisite to Learn NumPy

The **two basic prerequisites** for NumPy are **Python** and **Mathematics**. We need to know the **python basics** to work with the **NumPy module**.

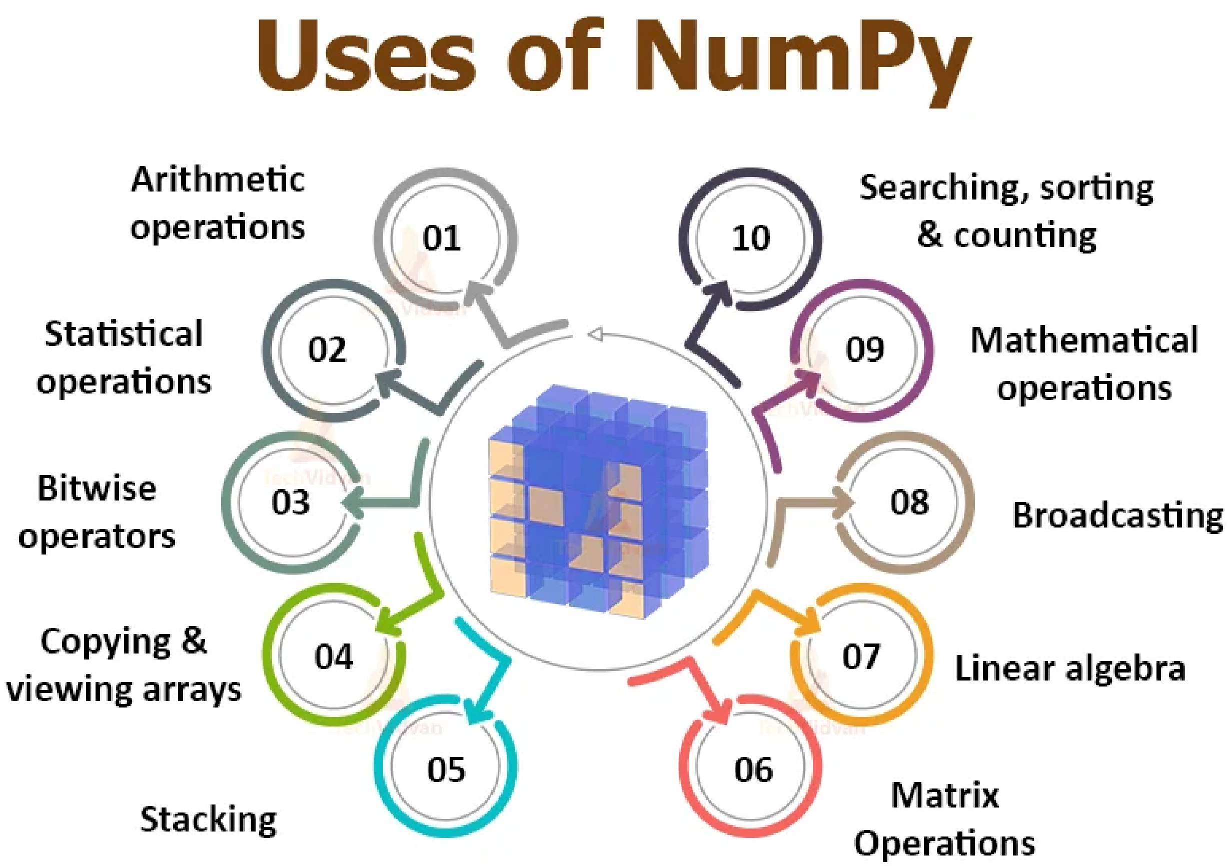
The functions available in **NumPy** are **built** on **python language**. We can hence combine the knowledge of **python arrays** and **list** for **array initialization** and **operations**.

NumPy Installation

We can install Python NumPy by going to the **command prompt** and **typing** a **simple command pip install NumPy**. Then go to the **IDE** and use the **import command import NumPy** as **np**.

We can now **access** all the **functionalities** of the **NumPy module**.

Uses of NumPy



NumPy is one of the most useful **external libraries** available in Python. It has a wide variety of **functions** to work with **arrays** and a **powerful multi-dimensional array object**. It has **operations** that are **applicable** to a **vast range** of **platforms**.

Numpy can be put to use for **storing**, **manipulation**, and **deletion** of **array elements**. We can use it for **sorting**, **indexing**, and **stacking** of the **array elements**. It has modules regarding various operations:

- Arithmetic operations
- Statistical Operations
- Bitwise Operators
- Linear Algebra
- Copying and viewing arrays
- Stacking
- Searching, Sorting, and counting, etc.
- Mathematical Operations
- Broadcasting
- Matplotlib for graphical representations
- Matrix Operations, etc.

NumPy vs. Python arrays

The **NumPy library** is a great **alternative** to **python arrays**. The difference is that the NumPy arrays are **homogeneous** that makes it **easier** to work with. We can **initialize** the **array elements** in many ways, one being which is through the **python lists**.

The NumPy arrays are convenient as they have the following **three features**–

- **Less Memory Requirement**
- **Faster Processing**
- **Convenience of use**

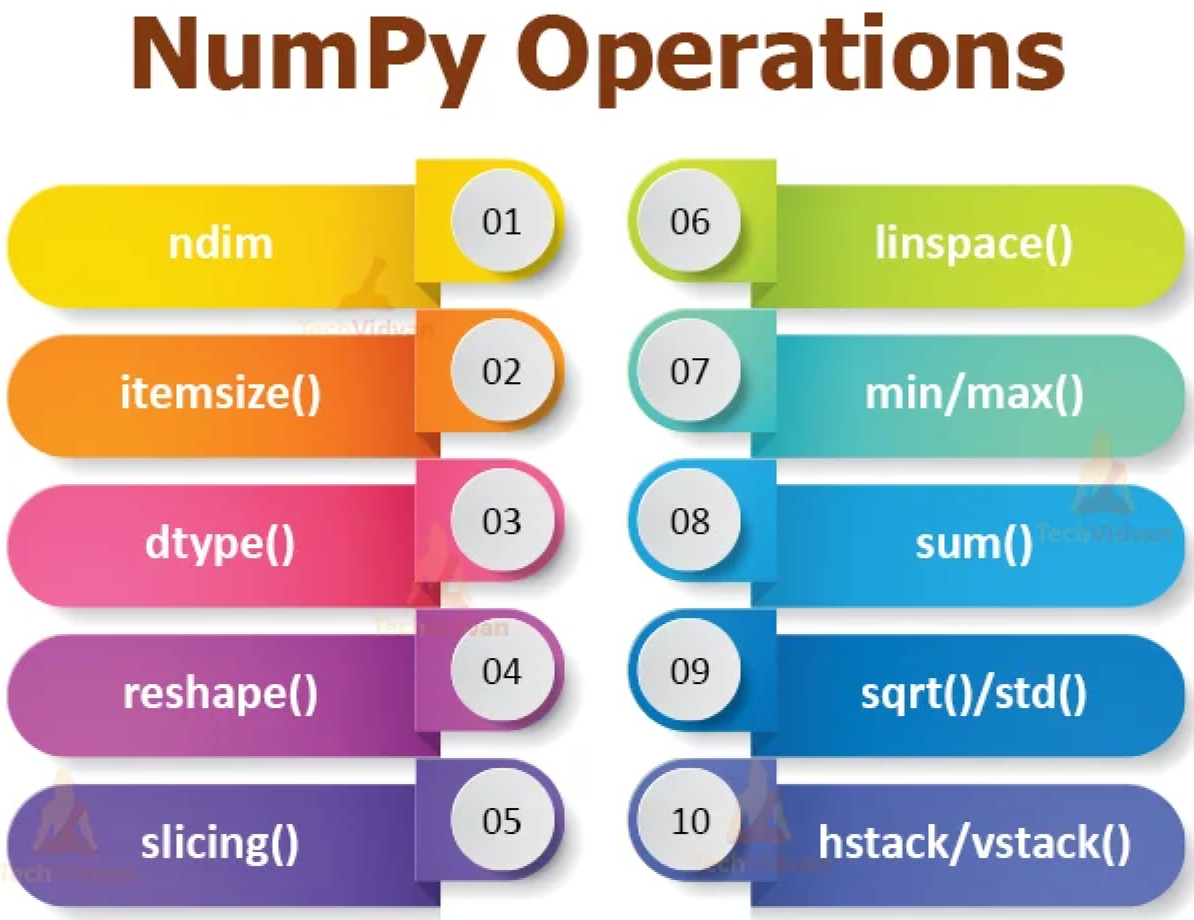
Data types in NumPy

Numpy **supports more data types** as compared to Python. These data types are instances of **dtype objects**. Some of the **scalar data types** are given in the table below.

Sr.No.	Data Types	Description
1.	bool_	Boolean True/False
2.	int_	Integer type
3.	intc	Same as C int
4.	intp	An integer used for indexing
5.	int8	Byte(-128 to 127)
6.	int16	Integer(-32768 to 32767)
7.	int32	Integer(-2147483648 to 2147483647)
8.	int64	Integer (-9223372036854775808 to 9223372036854775807)
9.	uint8	Unsigned integer(0 to 225)
10.	unit16	Unsigned integer(0 to 65535)
11.	unit32	Unsigned Integer(0 to 4294967295)
12.	unit64	Unsigned Integer(0 to 18446744073709551615)
13.	float_	Shorthand for float64
14.	float16	Half precision float
15.	float32	Single precision float
16.	float64	Double precision float
17.	complex_	Shorthand for comples128

18.	complex64	Two 32bit float complex number
19.	complex128	Two 64 bit float complex number

NumPy Operations



NumPy consists of a **wide range of functions** to work with **arrays**.

1. Numpy ndim

It is the **function** which **determines** the **dimensions** of the **input array**

```
import numpy as np
a = np.array([(1,1,1),(2,2,2)])
print(a.ndim)
```

Output

```
2
```

2. Numpy itemsize()

We use this function to determine the **size of** the **array elements**.

```
import numpy as np
a = np.array([(1,1)])
print(a.itemsize)
```

Output

```
8
```

3. Numpy dtype()

We use this function to determine the **data type** of the **array elements**.

```
import numpy as np
a = np.array([(1,1)])
print(a.dtype)
```

Output

```
int64
```

4. Numpy reshape()

We use this function to **reassign** the **array** a **new shape**.

```
import numpy as np
a = np.array([(1,1,1),(2,2,2)])
print(a)
a=a.reshape(3,2)
print(a)
```

Output

```
[[1 1 1]
[2 2 2]]
[[1 1]
[1 2]
[2 2]]
```

5. Numpy slicing()

It is for **extracting** a **particular set** of **elements** from the **array**.

```
import numpy as np
a=np.array([(1,1),(2,2),(3,3)])
print(a[0:2,1])
```

Output

[1 2]

6. Numpy linspace()

This is for array generation of **evenly spread elements**.

```
import numpy as np
a=np.linspace(1,5,10)
print(a)
```

Output

```
[1. 1.44444444 1.88888889 2.33333333 2.77777778 3.22222222
3.66666667 4.11111111 4.55555556 5. ]
```

7. Numpy min() / Numpy max()

We can find the **minimum** and **maximum values** from the **array**.

```
import numpy as np
arr= np.array([10,20,30])
print(arr.min())
print(arr.max())
```

Output

```
10
30
```

8. Numpy sum()

This is to **return** the **sum** of all the **array elements**

```
import numpy as np
arr= np.array([10,50,100])
print(arr.sum())
```

Output

```
160
```

9. Numpy sqrt()/ Numpy std()

We can determine the **square root** and **standard deviation** of the **array elements**.

```
import numpy as np
a=np.array([(1,2,3),(4,5,6)])
print(np.sqrt(a))
print(np.std(a))
```

Output

[[1. 1.41421356 1.73205081]
[2. 2.23606798 2.44948974]]
1.707825127659933

10. +,-,/, *

We can determine the **sum**, **difference**, **division**, and **multiplication** of the **array elements** with the use of these **operators**.

```
import numpy as np
x= np.array([(1,1,1),(2,2,2)])
y= np.array([(3,3,3),(4,4,4)])
print(x+y)
print(x-y)
print(x*y)
print(x/y)
```

Output

```
[[4 4 4]
[6 6 6]]
[[-2 -2 -2]
[-2 -2 -2]]
[[3 3 3]
[8 8 8]]
[[0.33333333 0.33333333 0.33333333]
[0.5 0.5 0.5 ]]
```

11. Numpy hstack/ Numpy vstack()

These are **stacking functions**, we can perform **horizontal** and **vertical stacking** of **arrays**.

```
import numpy as np
x= np.array([(1,1,1),(2,2,2)])
y= np.array([(3,3,3),(4,4,4)])
print(np.vstack((x,y)))
print(np.hstack((x,y)))
```

Output

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

[[1 1 1 3 3 3]
[2 2 2 4 4 4]]

12. Numpy ravel()

This function concerts the **entire array** into a **single column**.

```
import numpy as np
arr= np.array([(1,1,1),(2,2,2)])
print(arr.ravel())
```

Output

[1 1 1 2 2 2]

There are a **few special functions** available in **NumPy**. We can plot the **sine**, **cos,** and **tan curves** using the **matplotlib module.** It is an **alternative** to other **plotting software** like **MatLab**.

It is a great alternative when working with **graphical representations**.

```
import numpy as np
import matplotlib.pyplot as plt
arr1= np.arange(0,2*np.pi,0.5)
arr2=np.sin(arr1)
arr3=np.cos(arr1)
arr4=np.tan(arr1)
plt.plot(arr1,arr2)
plt.plot(arr1,arr3)
plt.plot(arr1,arr4)
plt.show()
```

Summary

Here we come to the end of **Numpy Tutorial**.

NumPy is the **basic library** for **mathematical operations** in **Machine Learning**. It has a **vast range of functions** to **manipulate arrays** and **matrices**. It is a very **convenient** and **user-friendly library**. It has made to work with an **array element** a much easier task.

Working with arrays has turned out to be a much **faster** and **time-efficient process**. It is very easy to **install** and **implement**.

There are many **modules** in **NumPy** that are specific to **various complex functions**. It can also **extend functionalities** by **combining** with **other python libraries**.