Unit - 2
Data Analysis Using NumPy

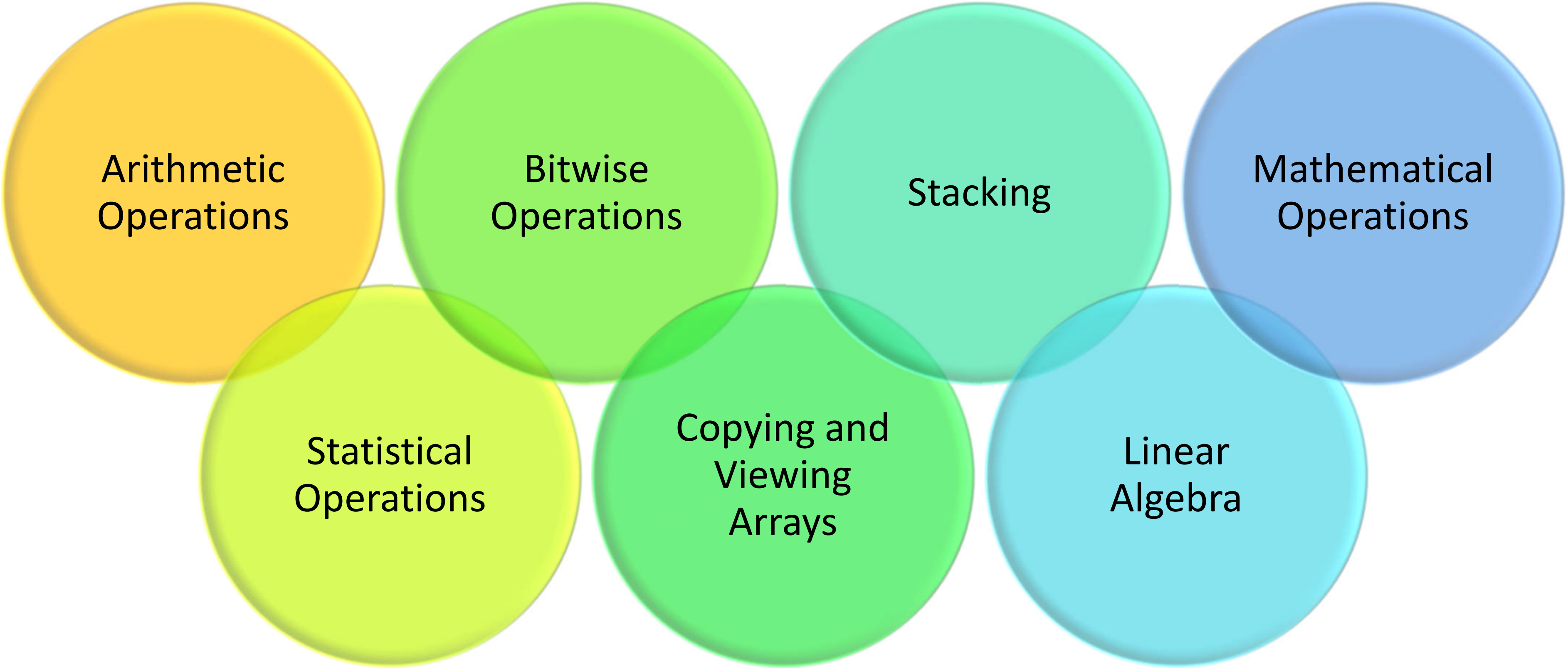
Objective

- Introduction to NumPy
- Installation of NumPy
- Statistical Functions of NumPy
- NumPy Array
- Case Study

Introduction

- NumPy is an open-source Python library used for working with arrays.
- It also has functions for working in domain of linear algebra, Fourier transform, and matrices.
- NumPy stands for Numerical Python.
- NumPy is a Python library and is written partially in Python, but most of the parts that require fast computation are written in C or C++.

Why NumPy?



Arithmetic Operations

Bitwise Operations

Stacking

Mathematical Operations

Statistical Operations

Copying and Viewing Arrays

Linear Algebra

Installing Numpy Module

- You may use Command Prompt/Terminal
- You need pip/conda to install various libraries

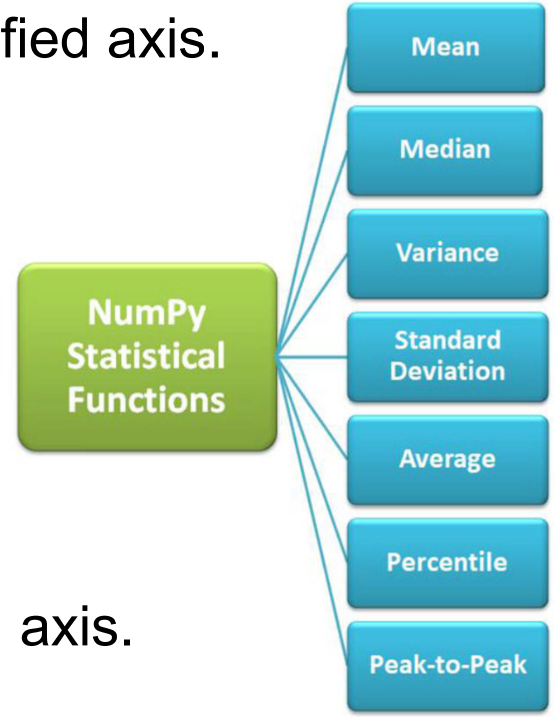
```
pip install numpy

conda install numpy
```

Note: It is pre-installed if Anaconda Software is used

NumPy Statistical Functions

- np.amin()- Minimum value of the element along a specified axis.
- np.amax()- Maximum value of the element along a specified axis.
- np.mean()- Mean value of the data set.
- np.median()- Median value of the data set.
- np.ptp()- Range of values along an axis(peak to peak).
- np.std()- Standard deviation
- np.var() – Variance.
- np.average()- Weighted average
- np.percentile()- nth percentile of data along the specified axis.



Statistics – Mean, Median and Range

- Mean - Compute the arithmetic mean along the specified axis.

  np.mean([1,2,3,4,5])

- Median - Compute the median along the specified axis.

  np.median([1,5,2,3,4])

- Range - Compute the median along the specified axis.

  np.ptp([1,5,2,3,4])

***Ptp – Point to Point**

Statistics – Standard Deviation and Variance

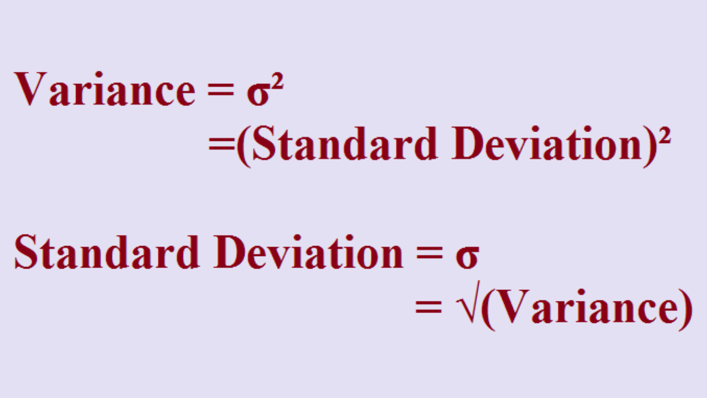
Standard deviation is the square root of the average of squared deviations from mean. The function used for this is np.std().

```
np.std([1,2,3,4])
```

Variance is the average of squared deviations, i.e., **mean(abs(x - x.mean())**2).**

Or, standard deviation is the square root of variance.

```
np.var([1,2,3,4])
```



Variance = σ^2

=(Standard Deviation)^2

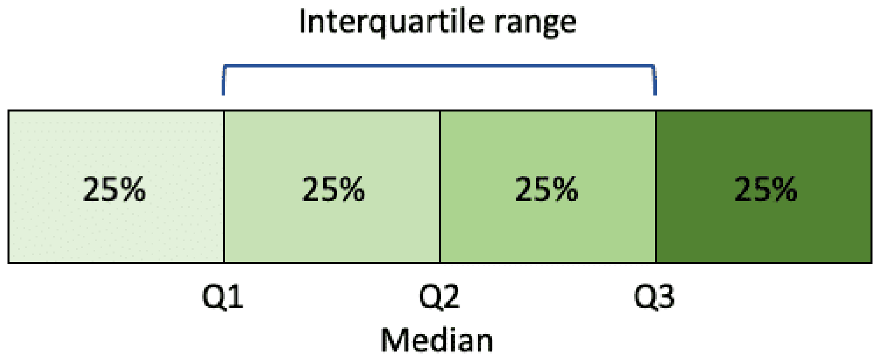
Standard Deviation = σ

= √(Variance)

Practical on Statistical Functions

- Random Generator Number
- Importance of Random Seed
- Descriptive Statistics using Numpy
- Interquartile Range

Statistics – Interquartile Range

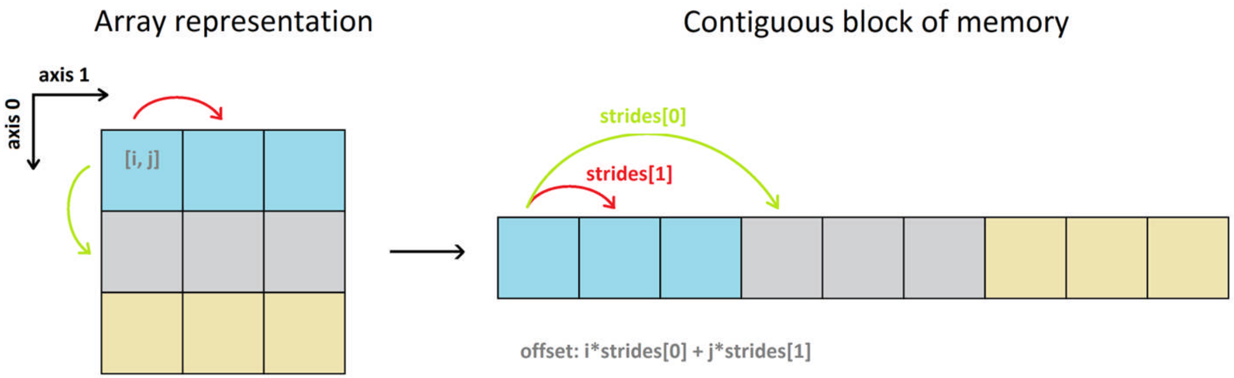


The **first quartile (Q1)**, is defined as the middle number between the smallest number and the median of the data set, the **second quartile (Q2)** – **median** of the given data set while the **third quartile (Q3)**, is the middle number between the median and the largest value of the data set.

In numpy, use np.percentile()

NumPy Array

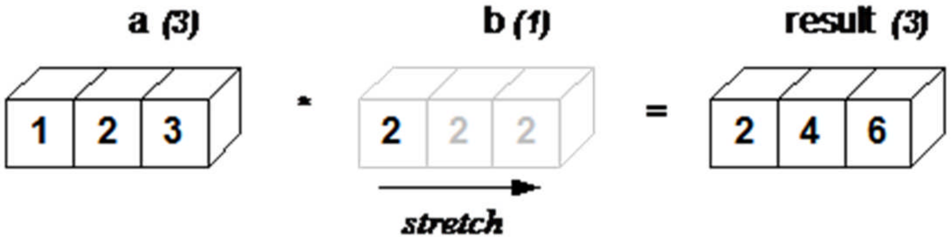
- NumPy aims to provide an array object that is up to 50x faster than traditional Python lists
- Numpy array is a contiguous block of memory used to store the same type of data. When the type of data you store is determined, your memory stride is determined.


Array representation
Contiguous block of memory
axis 1
axis 0
[i, j]
strides[0]
strides[1]
offset: i*strides[0] + j*strides[1]

https://i.stack.imgur.com/oQQVI.png

Broadcasting of an Array

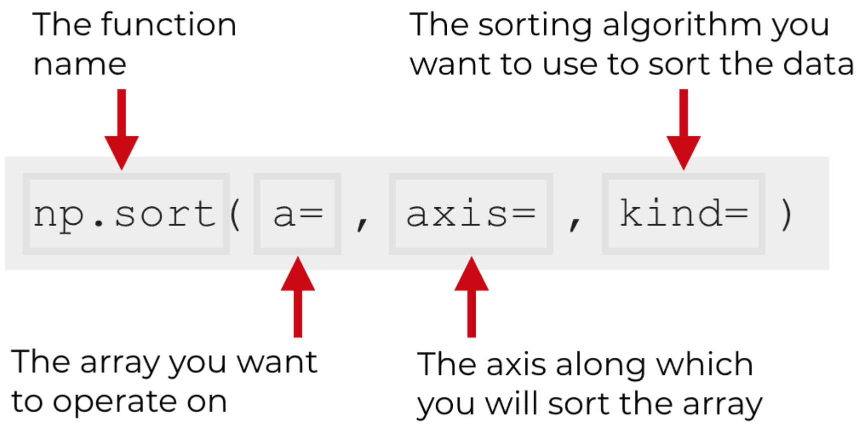
- Broadcasting describes how numpy treats arrays with different shapes during arithmetic operations.
- The smaller array is “broadcast” across the larger array so that they have compatible shapes.



https://numpy.org/doc/stable/_images/theory.broadcast_1.gif

Sorting an Array

- Return a sorted copy of an array.



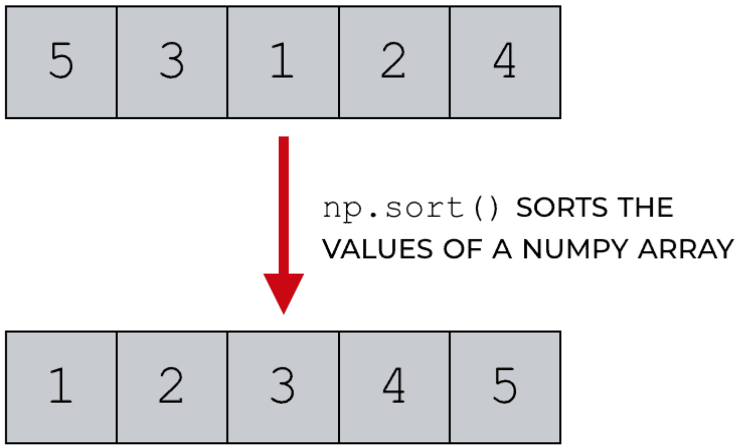
The function name

The sorting algorithm you want to use to sort the data

```
np.sort( a= , axis= , kind= )
```

The array you want to operate on

The axis along which you will sort the array

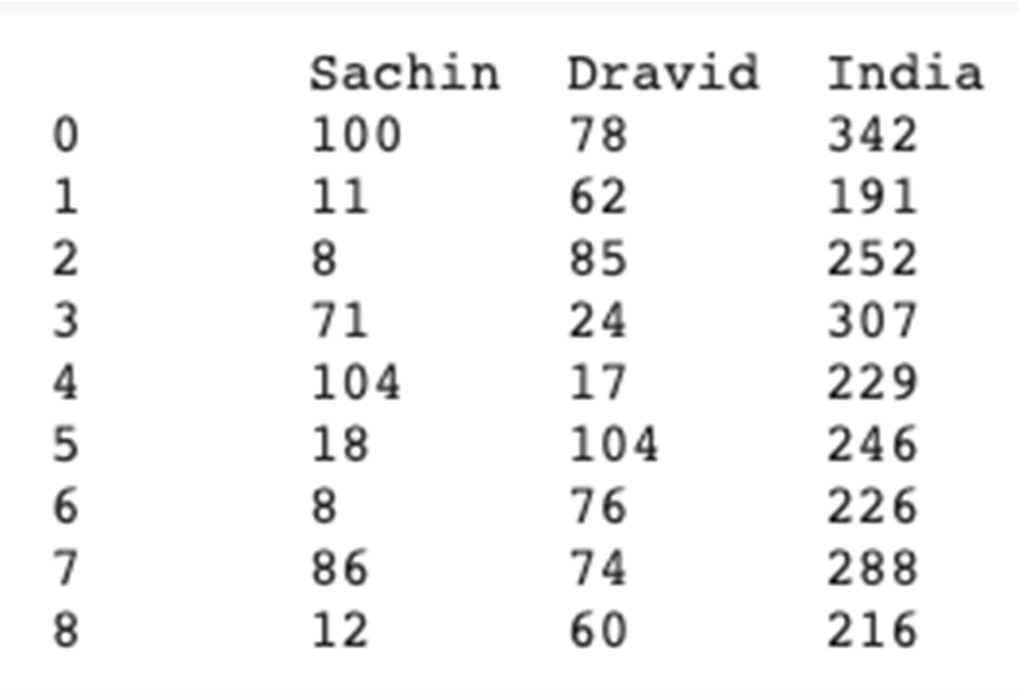


`np.sort()` SORTS THE VALUES OF A NUMPY ARRAY

https://vrzkj25a871bpq7t1ugcgmn9-wpengine.netdna-ssl.com/wp-content/uploads/2019/05/numpy-sort-simple-example.png

Case Study

- Let us consider a dataset consisting of runs scored by Sachin and Dravid and team India across a subset of matches. The data set covers 15 matches. Let us try and answer a few questions



```
      Sachin  Dravid  India
0     100     78      342
1     11      62      191
2     8       85      252
3     71      24      307
4     104     17      229
5     18      104     246
6     8       76      226
7     86      74      288
8     12      60      216
```

Data Set Source - https://github.com/goradbj/MachineLearning/blob/main/cric.tsv

Case Study

- Firstly, let us load the dataset using the command —

```
cric_data = np.loadtxt("cric_data.tsv", skiprows=1)
cric_data.shape()
Output: (225,4) Indicates 225 matches.
```

Case Study

- Let us first divide the n-d array into individual components.

Sachin = cric_data[:,1]

Dravid = cric_data[:,2]

India = cric_data[:,3]

(Note - ':' indicates all values along that dimension)

Example Output:

Sachin = [100, 11, 8, 71.......]

Case Study

Find the Mean and Median of Sachin, Dravid and India.

We can use NumPy library functions **np.mean()** and **np.median()** to achieve the desired results. We will create a function named stats, which will return us the mean and median of the data passed to the function.

Case Study

```
>>def stats(col):
    print('Mean', np.mean(col))
    print('Median', np.median(col))

>>stats(Sachin)
Output: Mean 39.87  Median 27.0

>>stats(Dravid)
Output: Mean 32.06  Median 22.0

>>stats(India)
Output: Mean
220.79  Median 216.0
```

REFERENCES

- https://en.wikipedia.org/wiki/Anaconda_(Python_distribution)
- https://docs.python.org/3/library/
- https://www.tutorialspoint.com/numpy
- https://numpy.org/
- https://towardsdatascience.com/
- https://realpython.com/

THANK YOU