Introduction to NumPy

- NumPy is a Python package and it stands for Numerical Python.
- It was created in 2005 by Travis Oliphant. It is an open source project.
- It is a core Python library used for working with arrays and for scientific computing.
- It also has inbuilt functions for working with linear algebra, Fourier transform, matrices, and data science.
- It has an N-dimensional array object (ndarray) which is in the form of rows and columns.

Lists and Numpy arrays

- Python has lists similar to arrays and they serve the purpose, but they are slow to process.
- To work with large data sets, Python provides Numpy arrays, and it provides much faster access to data, than the Python List.
- Numpy arrays are stored at one continuous place in memory unlike the case of Python List, so it provides the fast access and processing. This Numpy follows the Locality of Reference.

Installation of Numpy

- Numpy is not available as a bundled package in Python.
- We can install it using PIP. PIP is a package management system to install and manage software packages written in Python. PIP stands for Pip Installs Packages.
- Steps to install Numpy in Python.
- Go to command prompt
  - Type cmd on RUN or click the command prompt
- Change the folder to location where Python is installed.
  - cd c:\Python38-32
- Move to the folder Scripts in C:\python38-32.
  - c:\Python38-32> cd scripts
  - c:\Python38-32\Scripts>
- Type the PIP install Numpy and press the enter key. Keep the internet connection active during this process. It will download the package and install it automatically.
  - c:\Python38-32\Scripts> pip install numpy
Using NumPy

- To use the NumPy package, it is required to import the library NumPy.
- NumPy is used to work with arrays. It has functions to manipulate the arrays.
- The array object in NumPy is called ndarray.

Example

```python
import numpy
arr1=numpy.array(1)
arr2=numpy.array([1,2,3,4,5])
print('Numpy Version : ',  numpy.__version__)
print('Array 1 Values : ', arr1)
print('Array 2 Values : ', arr2)
print('Array 1 Data Type : ', type(arr1))
print('Array 2 Data Type : ', type(arr2))
```

Output

```
Numpy Version : 1.18.4
Array 1 Values : 1
Array 2 Values : [1 2 3 4 5]
Array 1 Data Type : <class 'numpy.ndarray'>
Array 2 Data Type : <class 'numpy.ndarray'>
```
Dimension of arrays in Numpy

- A dimension in arrays is one level of array depth.
- Types of Arrays
  1. 0-D arrays: It has a scalar element in an array. Each value in an array is a 0-D array.
     - e.g. `numpy.array(10)`
  2. 1-D arrays: An array that has 0-D arrays as its elements is called uni-dimensional or 1-D array.
     - e.g. `numpy.array([30, 40])`
  3. 2-D arrays: An array that has 1-D arrays as its elements is called a 2-D array.
     - e.g. `numpy.array([[30, 40], [50, 60]])`
  4. 3-D arrays: An array that has 2-D arrays (matrices) as its elements is called 3-D array.
     - e.g. `numpy.array([[[30, 40], [50, 60]],
                        [[70, 80], [90, 10]]])`

- `<array_name>.ndim` used to know the dimension of the array.

Example

```python
import numpy
arr1 = numpy.array(1)
arr2 = numpy.array([1, 2, 3, 4, 5])
arr3 = numpy.array([[1, 2, 3], [4, 5, 6]])
arr4 = numpy.array([[[1, 2, 3], [4, 5, 6]],
                    [[1, 2, 3], [4, 5, 6]]])

print('Array -1')
print(arr1)
print('Array Dim :', arr1.ndim)

print('Array -2')
print(arr2)
print('Array Dim :', arr2.ndim)

print('Array -3')
print(arr3)
print('Array Dim :', arr3.ndim)

print('Array -4')
print(arr4)
print('Array Dim :', arr4.ndim)
```
Output

Array -1
1
Array Dim : 0

Array -2
[1 2 3 4 5]
Array Dim : 1

Array -3
[[1 2 3]
[4 5 6]]
Array Dim : 2

Array -4
[[[1 2 3]
[4 5 6]]
[[1 2 3]
[4 5 6]]]
Array Dim : 3