Numpy

Index -

```
# SEQUENCE => ARRAY()
# 1D, 2D, 3D array
# ACCESS THE ELEMENTS : INDEX AND SLICING
# ATTRIBUTES : NDIM, SHAPE, SIZE ETC
# FUNCTIONS : SUM() MIN() MAX()    : ROWS : 1  COLUMNS : 0
# FUNCTION : RESHAPE()
# range() arange() linspace()
# Random Number Generator
# Trigonometric Functions: sin(), cos(), tan()
# Statistical Function : mean(), median()
# decimal function : ceil(), floor(), around()
# matrix functions : empty(), zeros(), ones(), identity(), matmul(),
multiply(),
```

Import the library

```
# import libraries
import numpy as nm
```

Convert the list to the array -

Using (np.array(x)) we convert any datatype into array.

```
# convert sequence into array
# array()
a = [10, 20, 30, 40, 50]
arr1 = nm.array(a)
print(arr1, type(arr1))

Output - [10, 20, 30, 40, 50] <class 'nump.ndarray'>
```

Arithmetic Operations -

- Addition (+)
- Substraction (-)
- Multiplication (*)
- Division (/)
- Floor Division (//)
- Mod (% remainder)
- Exponential (**)

Indexing & Slicing -

To access particular element from an array we use indexing.

```
# Indexing
a = [10, 20, 30, 40, 50, 0.1, 0.2, 0.3, 0.4, 0.5]    # List
# convert list into array
arr = nm.array(a)
arr

# To ascess elements : Indexing : 1. Positive    2. Negative
# Display : 20, 40
print(arr3[1],arr3[-9] )
print(arr3[3],arr3[-7] )
```

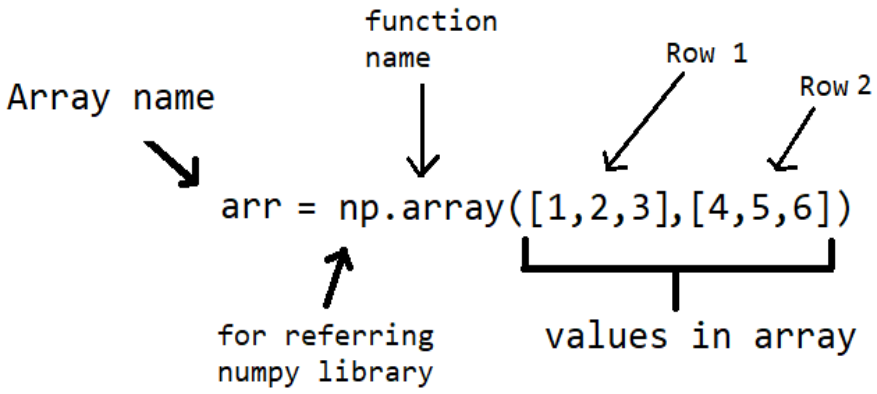
```
# Slicing : array_name[start=0 : end=-1 : steps=1]
arr = [10, 20, 30, 40, 50, 0.1, 0.2, 0.3, 0.4, 0.5]
# Display :
# 1. [10, 20, 30, 40, 50]
# 2. [0.3, 0.4, 0.5]
# 3. [10, 20, 30, 40, 50, 0.1, 0.2, 0.3, 0.4]
# 4. [10, , 40,  0.2,  0.5]

print(arr3[ : 5])
print(arr3[-3 :])
print(arr3[0 :9 ])
print(arr3[0 :  : 3])
```

2-D array -

2-D array is basically a matrix.

2-D array contains rows and columns.




```
a = [10,20,30]
b = [40,50,60]
c = [70,80,90]

arr = nm.array([a,b,c])
```

```
print(arr4, type(arr4))
Output - <class 'numpy.ndarray'>
```

```
# dimensions : dim
print(arr.ndim)
O/P - 2
```

```
# size
print(arr.size)
O/P - 12
```

```
# shape
print(arr.shape)        # O/P : (Rows, Columns ) => (3, 3)
O/P - (3,3)
```

Accessing Elements in 2-D array -

```
# Accessing elements :
print(arr4[0])
print(arr4[0,0])
print(arr4[0,1])

O/P -
[10, 20, 30]
10
20
```

Exercise -

```
# create a 5, 7 matrix

arr=np.array([range(1,8),range(11,18),range(21,28),range(31,38),range(4
1,48) ])

arr

O/P -
array([
[1, 2, 3, 4, 5, 6, 7],
[11, 12, 13, 14, 15, 16, 17],
[21, 22, 23, 24, 25, 26, 27],
[31, 32, 33, 34, 35, 36, 37,]
[41,42, 43, 44, 45, 46, 47]
])
```

```
# attributes :

print(arr.ndim)
print(arr.size)
print(arr.shape)

O/P -
2
35
(5, 7)
```

```
arr = ([
[1, 2, 3, 4, 5, 6, 7],
[11, 12, 13, 14, 15, 16, 17],
[21, 22, 23, 24, 25, 26, 27],
[31, 32, 33, 34, 35, 36, 37,]
```

```
[41,42, 43, 44, 45, 46, 47]
])
# To select columns we did slicing
# Display :
[13, 14, 15, 16, 17]
print(arr[1, 2:])

# Display Column Values : 1, 11, 21
print(arr[ 0:3 , 0])  # here, (0:3) is used to select the rows and (,
0) is used to select the columns.
O/P - [1, 11, 21]

# Display
# 13, 14, 15,
# 23, 24, 25,
# 33, 34, 35,
print(arr[1:4,  2:5]) # here, (1:4) is used to select the rows and
(1:5) is used to select the columns.

'''
  0    [ 1,  2,  3,  4,  5,  6,  7],
  2     [21, 22, 23, 24, 25, 26, 27],
  4     [41, 42, 43, 44, 45, 46, 47]
'''
#  here, [0:5:2] = [start, stop, step], : = columns
print(arr5[0 : 5 : 2    ,  : ])
```

3-D array -

A three dimensional means we can use nested levels of array for each dimension.

```
# create a 3D array :

arr = nm.array([[[12, 15, 17], [21,34,12], [23, 33,13]],
                [[45,56, 67], [44,76,89], [54,67,78]],
                [[100,102,103], [121,133,145], [143,134,122]]])


# attributes :
print(arr.ndim)
print(arr.size)
print(arr.shape)

O/P -
```

```
3
27
(3, 3, 3)

# Indexing :
# display : 100 , 76, 134, 33
print(arr6[2,0,0])
print(arr6[1,1,1])
print(arr6[2,2,1])
print(arr6[0,2,1])
```

Arithmetic Functions -

- min()
- max()
- sum()

```
# Note : Columns : axis = 0                Rows : axis = 1

arr = nm.array([[11,22,33,44], [-10, -50, 60, 70], [15, 67, -89, 54]])
arr

# Display row wise min values
print(arr.min(axis = 1))

# Display row wise max values
print(arr.max(axis = 1))

# Display row wise sum
print(arr.sum(axis = 1))

# Display column wise min values
print(arr7.min(axis = 0)

# min() max() sum() + rows : '1', columns : '0'   + index/slicing

# Find min value in 3rd row.
print(arr7.min(axis = 1)[2])

# Find max value in 2nd column
print(arr7.max(0)[1])

# Find sum of all elements of 1st row.
print(arr7.sum(1)[0])
```

```
# reshape()

arr = nm.array([[11,22,33,44], [-10, -50, 60, 70], [15, 67, -89, 54]])

print(arr)
print(" Dimensions : {} \t Size : {} \t Shape : {}".format(arr.ndim,
arr.size, arr.shape ))
O/P - Dimensions: 2 Size:12 Shape:(3, 4)


# row = 3    columns = 4          =>      row = 2    column = 6

arr1 = arr.reshape(2,6)
print(arr1)
print(" Dimensions : {} \t Size : {} \t Shape : {}".format(arr1.ndim,
arr1.size, arr1.shape ))
O/P - Dimensions: 2 Size:12 Shape:(2, 6)
```

Sequence Generator -

arrange()

linespace()

```
# 1. arange(start , end, steps )

b = nm.arange(1,101)
print(b)
print(type(b))

O/P -
[1, 2, 3, 4, 5, …… 100]
<class 'numpy.ndarray'>
```

```
# 2. linspace(start , end, interval)

c = nm.linspace(1,10, 5)
print(c)

O/P - [1. 3.75 5.5 7.5 10.]

9/4 = 2.5
1 + 2.5 + 2.5 + 2.5 + 2.5  = 10.0
```

Trigonometric Functions -

Sin, cos, Tan

```
# sin, cos, tan

angles_degree = nm.array([0 , 30, 45, 60, 90, 180])
angles_radians = (nm.pi / 180) * angles_degree

# Trigonometric sin

a_sin = nm.sin(angles_radians)
print(a_sin)

# Trigonometric cos

a_cos = nm.cos(angles_radians)
print(a_cos)

# Trigonometric tan

a_tan = nm.tan(angles_radians)
print(a_tan)
```

Decimal Functions -

floor() - Removes all the decimals

ceil() - Returns nearest integer

around(2) - Returns 2 decimal numbers after point eg.(10.00)

```
arr1 = nm.linspace(1,5, 7)
print(arr1)
```

```
print("Output of Floor : ", nm.floor(arr1))
print("Output of ceil : ", nm.ceil(arr1))
print("Output of Around : ", nm.around(arr1, 3))
```

Statistical Functions -

mean() -

median() -

```
# mean() , median()

arr2 =
nm.array([2,4,10,46,54,5,7,643,24,11,76,54,43,4,57,65,3,6,76,543,4,57,6
5,44,6,5,4,4,6,56,4,6,65,4,57,6,76,5,45,4], order = 'F')
```

```
print(" Mean of arr2 : ", nm.floor(nm.mean(arr2)))

print("Median of arr2 : ", nm.median(arr2))
```

Generate random numbers -

```
nm.random.randint(1, 10, 5)  # start value, stop value, total random
numbers required
```

Matrix functions -

- empty() -
- zeros() -
- ones() -
- identity() -
- matmul() -
- multiply () -
- det() -
- inv() -
- dot() -
- linalg() -

```
# Matrix :

# empty() : Creating empty matrix
# Create a 5X5 empty matrix
a = numpy.matlib.empty((5,5))
print(a)



# zeros() : create a matrix of zeros.
# create a matrix of 5X5.
a = numpy.matlib.zeros((5,5))
print(a)

# ones() : create a matrix of ones.
# create a matrix of 5X3.
b = numpy.matlib.ones((5,3))
print(b)

# identity() : create an Identity matrix.
c = numpy.matlib.identity(6)
print(c)

# Matrix Multiplication :
# matmul() :
a = nm.array([[1,2,3], [4,5,6], [7,8,9]])
```

```
b = nm.array([[10,20,30], [6,5,8], [1,2,4]])
print(a)
print(b)
c = nm.matmul(a,b)
print(c)

# multiply()  : Element wise multiplication
d = nm.multiply(a,b)
print(d)

# Determinant of Matrix : det()
a = nm.array([[1,2], [3,4]])
# 1   2
# 3   4     = (1 * 4) - (2 * 3) = 4-6 = -2
det = nm.linalg.det(a)
print("Determinant of Matrix : ",det)


# Inverse of a Matrix : inv()
# 1. determinant        2. co-factors        3. Inverse
# A * [INV]  = [1]
a = nm.array([[1,2], [3,4]])
inv = nm.linalg.inv(a)
print(inv)

# vector :
# 1. dot() : dot product
a = nm.array([1,2,3,4,5])
b = nm.array([10,20,30,40,50])
#dot_product = a1* b1 + a2+b2 + a3*b3 + ... = 1*10 + 2*20 + 3*30 + 4*40
+ 5 * 50 = 10+40 + 90+160+250 = 550
c = nm.dot(a,b)
print(c)
```

If you have an array of shape (2,4) then reshaping it with (-1, 1), then the array will get reshaped in such a way that the resulting array has only 1 column and this is only possible by having 8 rows, hence, (8,1).