

| **TIT Title :** NumPy library of Python |
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**AIM:** To explore the Numpy library of Python

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**Expected OUTCOME of Experiment:**

**CO2:** Use Numpy Library functions

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**Resource Needed: Python IDE**

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**Theory:**

**NumPy :A** 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.
* The array object in NumPy is called ndarray, it provides a lot of supporting functions that make working with ndarray very easy.

**For Installation of NumPy:**

* pip install numpy

Example

import numpy  
  
arr=numpy.array([1, 2, 3, 4, 5])  
  
print(arr)

output:?

**For Creatation of NumPy ndarray Object:**

* NumPy is used to work with arrays. The array object in NumPy is called ndarray.
* We can create a NumPy ndarray object by using the array() function.

Example:

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

**Creating ndarrays:**

array = np.array([[0,1,2],[2,3,4]])

output:

[[0 1 2]

[2 3 4]]

array = np.zeros((2,3))

[[0. 0. 0.]

[0. 0. 0.]]

array = np.ones((2,3))

[[1. 1. 1.]

[1. 1. 1.]]

array = np.eye(3)

[[1. 0. 0.]

[0. 1. 0.]

[0. 0. 1.]]

array = np.arange(0, 10, 2)

[0, 2, 4, 6, 8]

array = np.random.randint(0, 10, (3,3))

[[6 4 3]

[1 5 6]

[9 8 5]]

**Slicing arrays**

Slicing in python 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].

**Arithmatic with NumPy Arrays:**

**Any arithmetic operations between equal-size arrays applies the operation element-wise**

arr = np.array([[1., 2., 3.], [4., 5., 6.]])

print(arr)

[[1. 2. 3.]

[4. 5. 6.]]

print(arr \* arr)

[[ 1. 4. 9.]

[16. 25. 36.]]

print(arr - arr)

[[0. 0. 0.]

[0. 0. 0.]]

* **Shape of an Array**

The shape of an array is the number of elements in each dimension.

* **Reshaping arrays**

Reshaping means changing the shape of an array.

The shape of an array is the number of elements in each dimension.

By reshaping we can add or remove dimensions or change number of elements

in each dimension.

* **Iterating Arrays**

Iterating means going through elements one by one.

As we deal with multi-dimensional arrays in numpy, we can do this using basic

for loop of python. If we iterate on a 1-D array it will go through each element

one by one.

* **Joining NumPy Arrays**

Joining means putting contents of two or more arrays in a single array.

In SQL we join tables based on a key, whereas in NumPy we join arrays by axes.

We pass a sequence of arrays that we want to join to the concatenate() function,long with the axis. If axis is not explicitly passed, it is taken as 0.

* **Splitting NumPy Arrays**

Splitting is reverse operation of Joining.

Joining merges multiple arrays into one and Splitting breaks one array into multiple.

We use array\_split() for splitting arrays, we pass it the array we want to split and the number of splits.

* **NumPy Searching Arrays**

You can search an array for a certain value, and return the indexes that get a match.

To search an array, use the where() method.

* **Sorting Arrays**

Sorting means putting elements in an ordered sequence.

Ordered sequence is any sequence that has an order corresponding to elements, like numeric or alphabetical, ascending or descending.

The NumPy ndarray object has a function called sort(), that will sort a specified array.

* **NumPy Filter Array**

Getting some elements out of an existing array and creating a new array out of them is called filtering.In NumPy, you filter an array using a boolean index list.

1.Problem statement:

| **Python Code** | **Output** |
| --- | --- |
| import numpy as np  arr = np.array([[1, 2, 3, 4], [5, 6, 7, 8]])  print(arr.shape) | (2, 4) |
| import numpy as np  arr = np.array([1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12])  newarr = arr.reshape(4, 3)  print(newarr) | [[ 1 2 3]  [ 4 5 6]  [ 7 8 9]  [10 11 12]] |
| import numpy as np  arr = np.array([1, 2, 3])  for x in arr:  print(x) | 1  2  3 |
| import numpy as np  arr1 = np.array([1, 2, 3])  arr2 = np.array([4, 5, 6])  arr = np.concatenate((arr1, arr2))  print(arr) | [1 2 3 4 5 6] |
| import numpy as np  arr = np.array([1, 2, 3, 4, 5, 6])  newarr = np.array\_split(arr, 3)  print(newarr) | ? [array([1, 2]), array([3,  4]), array([5, 6])] |
| import numpy as np  arr = np.array([1, 2, 3, 4, 5, 4, 4])  x = np.where(arr == 4)  print(x) | (array([3, 5, 6], dtype=int64),) |
| import numpy as np  arr = np.array([3, 2, 0, 1])  print(np.sort(arr)) | [0 1 2 3] |
| import numpy as np  arr = np.array([41, 42, 43, 44])  x = [True, False, True, False]  newarr = arr[x]  print(newarr) | [41 43] |

2. Write a python program to calculate the sum of all columns in a 2D NumPy array.

3. Create two NumPy arrays representing monthly high and low temperatures for a year. Calculate the monthly average temperatures, the overall average high and low temperatures, and identify the months with the highest and lowest average temperatures.

Not completed: P1 ON SCREEN TEST 12 MARKS 19 OCT 23. Select to mark as complete.

**Books/ Journals/ Websites referred:**

1. Reema Thareja, *Python Programming: Using Problem Solving Approach*, Oxford University Press, First Edition 2017, India
2. Sheetal Taneja and Naveen Kumar, *Python Programming: A modular Approach*, Pearson India, Second Edition 2018,India

**Implementation details:**

**2)**

import numpy as np

#function definition

def sumfn(arr2d):

    colsum = np.sum(arr2d,axis=0)

    return colsum

#input

arr = np.array([[1, 2, 3],

                [4, 5, 6],

                [7, 8, 9]])

#calculation

result = sumfn(arr)

#print

print("Original array :\n",arr)

print("\nArray of the sum of columns : \n",result)

**3)**

import numpy as np

highs = np.array([80, 85, 90, 75, 70, 78, 88, 92, 79, 83, 88, 87])

lows = np.array([65, 70, 75, 60, 55, 62, 70, 75, 58, 63, 70, 68])

#monthly average temp

monthlyavg = (highs + lows) / 2

#average high and low temp

avghigh = np.mean(highs)

avglow = np.mean(lows)

#Highest and lowest temp month identification(adding 1 to overcome 0-index)

maxavgmonth = np.argmax(monthlyavg) + 1

minavgmonth = np.argmin(monthlyavg) + 1

#print

print("\nMonthly highs in temperature : ",highs)

print("\nMonthly lows in temperature : ",lows)

print("\nMonthly Average Temperatures:",monthlyavg)

print(f"\nOverall average of the high temperatures: {avghigh}")

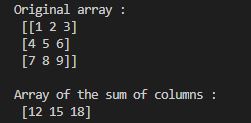
print(f"Overall average of the low temperatures: {avglow}")

print(f"\nMonth with the Highest Average Temperature: {maxavgmonth}")

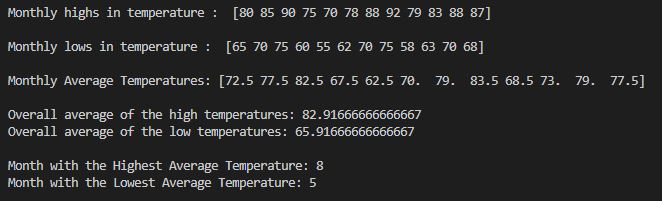
print(f"Month with the Lowest Average Temperature: {minavgmonth}\n")

**Output(s):**

1)



2)



**Conclusion:**

Used Numpy library of Python and used various in-built functions of Numpy to create Arrays and perform array operations which can be useful in various fields such as Data Science, Machine Learning, Image Processing, Finance, Bioformatrics and Signal Processing.

**Post Lab Descriptive Questions**

1. **Generate a random integer from 0 to 100 using NumPy random function?**
2. import numpy as np
3. intrandom = np.random.randint(0, 101)
4. print("Random Integer:", intrandom)

**Output:**

**OP3.1.JPG OP3.2.JPG OP3.3.JPG**

**2. Explain the slicing of 2-D Array**

The basic syntax for slicing a 2-D Array is given by:

array[start\_row:end\_row, start\_column:end\_column]

import numpy as np

arr = np.array([[1, 2, 3],

                [4, 5, 6],

                [7, 8, 9]])

#Slice specific rows and columns

slice1 = arr[0:2, 1:3]

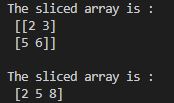
print("The sliced array is : \n",slice1)

#Slice all rows but specific columns

slice2 = arr[:, 1]

print("\nThe sliced array is : \n",slice2)

**Output:**

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**Date: \_\_\_\_\_\_\_\_\_\_\_\_\_ Signature of faculty in-charge**