
 Marwadi University Marwadi Chandarana Group 	Marwadi University Faculty of Engineering & Technology Department of Information and Communication Technology	
Subject: Programming With Python (01CT1309)	Aim: Practical based on NumPy ndarray	
Experiment No: 07	Date:	Enrollment No:92510133011

Aim: Practical based on NumPy ndarray

IDE:

NumPy is a Python package created in 2005 that performs numerical calculations. It is generally used for working with arrays. NumPy also includes a wide range of mathematical functions, such as linear algebra, Fourier transforms, and random number generation, which can be applied to arrays.

Import NumPy in Python

We can import NumPy in Python using the import statement.

```
import numpy as np
```

The code above imports the numpy package in our program as an alias np. After this import statement, we can use NumPy functions and objects by calling them with np.

NumPy Array Creation

An array allows us to store a collection of multiple values in a single data structure. The NumPy array is similar to a list, but with added benefits such as being faster and more memory efficient. There are multiple techniques to generate arrays in NumPy.

Create Array Using Python List

We can create a NumPy array using a Python List. For example,

Example



```
import numpy as np
list1 = [2, 4, 6, 8]
array1 = np.array(list1)
```

Output:

```
PS C:\Users\trupa\OneDrive\Documents\PWP> & C:/Users/trupa/AppData/Local/Programs/Python/Python313/python.exe "c:/Users/trupa/OneDrive/Document
s/PWP/PWP_EXP_7"
[2, 4, 6, 8]
PS C:\Users\trupa\OneDrive\Documents\PWP>
```

Example

```
import numpy as np
```

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```
array1 = np.array([2, 4, 6, 8])
print(array1)
```

Output:

```
PS C:\Users\trupa\OneDrive\Documents\PWP> & C:/Users/trupa/AppData/Local/Programs/Python/Python313/python.exe "c:/Users/trupa/OneDrive/Document
s/PWP/PWP EXP 7"
[2 4 6 8]
```

Create an Array Using np.zeros()

The np.zeros() function allows us to create an array filled with all zeros. For example,

Example

```
import numpy as np
array1 = np.zeros(4)
print(array1)
```

Output:

```
PS C:\Users\trupa\OneDrive\Documents\PWP> & C:/Users/trupa/AppData/Local/Programs/Python/Python313/python.exe "c:/Users/trupa/OneDrive/Document
s/PWP/PWP EXP 7"
[0. 0. 0. 0.]
```

Create an Array With np.arange()

The np.arange() function returns an array with values within a specified interval. For example,



Example

```
import numpy as np
# create an array with values from 0 to 4
array1 = np.arange(5)
print("Using np.arange(5):", array1)
# create an array with values from 1 to 8 with a step of 2
array2 = np.arange(1, 9, 2)
print("Using np.arange(1, 9, 2):", array2)
```

Output:

```
PS C:\Users\trupa\OneDrive\Documents\PWP> & C:/Users/trupa/AppData/Local/Programs/Python/Python313/python.exe "c:/Users/trupa/OneDrive/Document
s/PWP/PWP EXP 7"
Using np.arange(5): [0 1 2 3 4]
Using np.arange(1, 9, 2): [1 3 5 7]
```

Create an Array With np.random.rand()

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The np.random.rand() function is used to create an array of random numbers. Let's see an example to create an array of 5 random numbers,

Example

```
import numpy as np
# generate an array of 5 random numbers
array1 = np.random.rand(5)
print(array1)
```

Output:

```
PS C:\Users\trupa\OneDrive\Documents\PWP> & C:/Users/trupa/AppData/Local/Programs/Python/Python313/python.exe "c:/Users/trupa/OneDrive/Document
s/PWP/PWP_EXP_7"
[0.57427841 0.23901639 0.2928608 0.11445309 0.72428432]
PS C:\Users\trupa\OneDrive\Documents\PWP>
```

Taks:

```
import numpy as np
# Example 1: Creation of 1D array
arr1=np.array([10,20,30])
print("My 1D array:\n",arr1)
```

Output:



```
PS C:\Users\trupa\OneDrive\Documents\PWP> & C:/Users/trupa/AppData/Local/Programs/Python/Python313/python.exe "c:/Users/trupa/OneDrive/Document
s/PWP/PWP_EXP_7"
My 1D array:
[10 20 30]
```

```
# Example 2: Create a 2D numpy array
arr2 = np.array([[10,20,30],[40,50,60]])
print("My 2D numpy array:\n", arr2)
```

Output:

```
PS C:\Users\trupa\OneDrive\Documents\PWP> & C:/Users/trupa/AppData/Local/Programs/Python/Python313/python.exe "c:/Users/trupa/OneDrive/Document
s/PWP/PWP_EXP_7"
My 2D numpy array:
[[10 20 30]
 [40 50 60]]
```

```
# Example 3: Create a sequence of integers
# from 0 to 20 with steps of 3
arr= np.arange(0, 20, 3)
```

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```
print ("A sequential array with steps of 3:\n", arr)
```

Output:

```
[48 51 54]
PS C:\Users\trupa\OneDrive\Documents\PWP> & C:/Users/trupa/AppData/Local/Programs/Python/Python313/python.exe "c:/Users/trupa/OneDrive/Document
s/PWP/PWP EXP 7"
A sequential array with steps of 3:
[ 0  3  6  9 12 15 18]
```

Example 4: Create a sequence of 5 values in range 0 to 3

```
arr= np.linspace(0, 3, 5)
```

```
print ("A sequential array with 5 values between 0 and 5:\n", arr)
```

Output:

```
PS C:\Users\trupa\OneDrive\Documents\PWP> & C:/Users/trupa/AppData/Local/Programs/Python/Python313/python.exe "c:/Users/trupa/OneDrive/Document
s/PWP/PWP EXP 7"
A sequential array with 5 values between 0 and 5:
[0.  0.75 1.5  2.25 3.  ]
```

Example 8: Use ones() create array

```
arr = np.ones((2,3))
```

```
print("numpy array:\n", arr)
```

```
print("Type:", type(arr))
```

Output:

```
PS C:\Users\trupa\OneDrive\Documents\PWP> & C:/Users/trupa/AppData/Local/Programs/Python/Python313/python.exe "c:/Users/trupa/OneDrive/Document
s/PWP/PWP EXP 7"
numpy array:
[[1.  1.  1.]
 [1.  1.  1.]]
Type: <class 'numpy.ndarray'>
```

NumPy Data Types


A data type is a way to specify the type of data that will be stored in an array. For example,

```
array1 = np.array([2, 4, 6])
```

NumPy Data Types

NumPy offers a wider range of numerical data types than what is available in Python. Here's the list of most commonly used numeric data types in NumPy:

1. int8, int16, int32, int64 - signed integer types with different bit sizes

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2. uint8, uint16, uint32, uint64 - unsigned integer types with different bit sizes
3. float32, float64 - floating-point types with different precision levels
4. complex64, complex128 - complex number types with different precision levels

Check Data Type of a NumPy Array

```
import numpy as np
```

```
# create an array of integers
```

```
int_array = np.array([-3, -1, 0, 1])
```

```
# create an array of floating-point numbers
```

```
float_array = np.array([0.1, 0.2, 0.3])
```

```
# create an array of complex numbers
```

```
complex_array = np.array([1+2j, 2+3j, 3+4j])
```

```
# check the data type of int_array
```

```
print(int_array.dtype) # prints int64
```

```
# check the data type of float_array
```

```
print(float_array.dtype) # prints float64
```

```
# check the data type of complex_array
```

```
print(complex_array.dtype) # prints complex128
```

Output:

```

Type: <class 'numpy.ndarray'>
PS C:\Users\trupa\OneDrive\Documents\PWP> & C:/Users/trupa/AppData/Local/Programs/Python/Python313/python.exe "c:/Users/trupa/OneDrive/Document
s/PWP/PWP_EXP_7"
int64
float64
complex128

```

Creating NumPy Arrays With a Defined Data Type

In NumPy, we can create an array with a defined data type by passing the dtype parameter while calling the np.array() function. For example,

```
import numpy as np
```

```
# create an array of 8-bit integers
```



```
array1 = np.array([1, 3, 7], dtype='int8')
```

```
# create an array of unsigned 16-bit integers
```

```
array2 = np.array([2, 4, 6], dtype='uint16')
```

```
# create an array of 32-bit floating-point numbers
```

```
array3 = np.array([1.2, 2.3, 3.4], dtype='float32')
```

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```
# create an array of 64-bit complex numbers
array4 = np.array([1+2j, 2+3j, 3+4j], dtype='complex64')
# print the arrays and their data types
print(array1, array1.dtype)
print(array2, array2.dtype)
print(array3, array3.dtype)
print(array4, array4.dtype)
```

Output:

```
PS C:\Users\trupa\OneDrive\Documents\PWP> & C:/Users/trupa/AppData/Local/Programs/Python/Python313/python.exe "c:/Users/trupa/OneDrive/Document
s/PWP/PWP EXP 7"
[1 3 7] int8
[2 4 6] uint16
[1.2 2.3 3.4] float32
[1.+2.j 2.+3.j 3.+4.j] complex64
```

NumPy Type Conversion

In NumPy, we can convert the data type of an array using the `astype()` method. For example,



```
import numpy as np
# create an array of integers
int_array = np.array([1, 3, 5, 7])
# convert data type of int_array to float
float_array = int_array.astype('float')
# print the arrays and their data types
print(int_array, int_array.dtype)
print(float_array, float_array.dtype)
```

Output:

```
PS C:\Users\trupa\OneDrive\Documents\PWP> & C:/Users/trupa/AppData/Local/Programs/Python/Python313/python.exe "c:/Users/trupa/OneDrive/Document
s/PWP/PWP EXP 7"
[1 3 5 7] int64
[1. 3. 5. 7.] float64
```

NumPy Array Attributes

In NumPy, attributes are properties of NumPy arrays that provide information about the array's shape, size, data type, dimension, and so on.

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Common NumPy Attributes

Here are some of the commonly used NumPy attributes:

Attributes	Description
ndim	returns number of dimension of the array
size	returns number of elements in the array
dtype	returns data type of elements in the array
shape	returns the size of the array in each dimension.
itemsize	returns the size (in bytes) of each elements in the array
data	returns the buffer containing actual elements of the array in memory

The ndim attribute returns the number of dimensions in the numpy array. For example,

```
import numpy as np
# create a 2-D array
array1 = np.array([[2, 4, 6],
                   [1, 3, 5]])
# check the dimension of array1
print(array1.ndim)
```

Output:

```
PS C:\Users\trupa\OneDrive\Documents\PWP> & C:/Users/trupa/AppData/Local/Programs/Python/Python313/python.exe "c:/Users/trupa/OneDrive/Document
s/PWP/PWP EXP 7"
2
```



NumPy Array size Attribute

The size attribute returns the total number of elements in the given array.

```
import numpy as np
array1 = np.array([[1, 2, 3],
                   [6, 7, 8]])
# return total number of elements in array1
print(array1.size)
```

Output:

```
PS C:\Users\trupa\OneDrive\Documents\PWP> & C:/Users/trupa/AppData/Local/Programs/Python/Python313/python.exe "c:/Users/trupa/OneDrive/Document
s/PWP/PWP EXP 7"
6
PS C:\Users\trupa\OneDrive\Documents\PWP>
```

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NumPy Array shape Attribute

In NumPy, the shape attribute returns a tuple of integers that gives the size of the array in each dimension. For example,

```
import numpy as np
array1 = np.array([[1, 2, 3],
                   [6, 7, 8]])
# return a tuple that gives size of array in each dimension
print(array1.shape)
```

Output:

```
PS C:\Users\trupa\OneDrive\Documents\PWP> & C:/Users/trupa/AppData/Local/Programs/Python/Python313/python.exe "c:/Users/trupa/OneDrive/Document
s/PWP/PWP EXP 7"
(2, 3)
```

NumPy Array dtype Attribute

We can use the dtype attribute to check the datatype of a NumPy array. For example,

```
import numpy as np
# create an array of integers
array1 = np.array([6, 7, 8])
# check the data type of array1
print(array1.dtype)
```



Output:

```
PS C:\Users\trupa\OneDrive\Documents\PWP> & C:/Users/trupa/AppData/Local/Programs/Python/Python313/python.exe "c:/Users/trupa/OneDrive/Document
s/PWP/PWP EXP 7"
int64
```

NumPy Array itemsize Attribute

In NumPy, the itemsize attribute determines size (in bytes) of each element in the array. For example,

```
import numpy as np
# create a default 1-D array of integers
array1 = np.array([6, 7, 8, 10, 13])
# create a 1-D array of 32-bit integers
array2 = np.array([6, 7, 8, 10, 13], dtype=np.int32)
```


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use of itemsize to determine size of each array element of array1 and array2

```
print(array1.itemsize) # prints 8
```

```
print(array2.itemsize) # prints 4
```

Output:

```
PS C:\Users\trupa\OneDrive\Documents\PWP> & C:/Users/trupa/AppData/Local/Programs/Python/Python313/python.exe "c:/Users/trupa/OneDrive/Document
s/PWP/PWP EXP 7"
8
4
```

NumPy Array data Attribute

In NumPy, we can get a buffer containing actual elements of the array in memory using the data attribute.

In simpler terms, the data attribute is like a pointer to the memory location where the array's data is stored in the computer's memory.

```
import numpy as np
```

```
array1 = np.array([6, 7, 8])
```

```
array2 = np.array([[1, 2, 3],
                  [6, 7, 8]])
```

print memory address of array1's and array2's data

```
print("\nData of array1 is: ",array1.data)
```

```
print("Data of array2 is: ",array2.data)
```

output:

```
PS C:\Users\trupa\OneDrive\Documents\PWP> & C:/Users/trupa/AppData/Local/Programs/Python/Python313/python.exe "c:/Users/trupa/OneDrive/Document
s/PWP/PWP EXP 7"

Data of array1 is: <memory at 0x000001C34CFD0100>
Data of array2 is: <memory at 0x000001C33C84A670>
```

Task

Multiplication of two given matrixes

```
import numpy as np
```

```
p = [[1, 0], [0, 1]]
```



```
q = [[1, 2], [3, 4]]
```

```
print("Original matrices:")
```

```
print(p)
```

```
print(q)
```

Perform matrix multiplication using np.dot

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```
result1 = np.dot(p, q)
print("Result of the matrix multiplication:")
print(result1)
```

Output:

```
PS C:\Users\trupa\OneDrive\Documents\PWP> & C:/Users/trupa/AppData/Local/Programs/Python/Python313/python.exe "c:/Users/trupa/OneDrive/Document
s/PWP/PWP EXP 7"
Original matrices:
[[1, 0], [0, 1]]
[[1, 2], [3, 4]]
Result of the matrix multiplication:
[[1 2]
 [3 4]]
PS C:\Users\trupa\OneDrive\Documents\PWP> & C:/Users/trupa/AppData/Local/Programs/Python/Python313/python.exe "c:/Users/trupa/OneDrive/Document
```

Compute the determinant of a given square array.


```
import numpy as np
from numpy import linalg as LA
a = np.array([[1, 0], [1, 2]])
# Display the original 2x2 array 'a'
print("Original 2-d array")
print(a)
print("Determinant of the said 2-D array:")
print(np.linalg.det(a))
```

Output:

```
PS C:\Users\trupa\OneDrive\Documents\PWP> & C:/Users/trupa/AppData/Local/Programs/Python/Python313/python.exe "c:/Users/trupa/OneDrive/Document
s/PWP/PWP EXP 7"
Original 2-d array
[[1 0]
 [1 2]]
Determinant of the said 2-D array:
2.0
PS C:\Users\trupa\OneDrive\Documents\PWP>
```

Post Lab Exercise:

- Write a NumPy program to create a 3x3 matrix with values ranging from 2 to 10.

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```
PS C:\Users\trupa\OneDrive\Documents\PWP> & C:/Users/trupa/AppData/Local/Programs/Python/Python313/python.exe "c:/Users/trupa/OneDrive/Document
s/PWP/PWP EXP 7"
a:
[[ 2  3  4]
 [ 5  6  7]
 [ 8  9 10]]
```

- b. Write a NumPy program to reverse an array (the first element becomes the last).

```
PS C:\Users\trupa\OneDrive\Documents\PWP> & C:/Users/trupa/AppData/Local/Programs/Python/Python313/python.exe "c:/Users/trupa/OneDrive/Document
s/PWP/PWP EXP 7"
b (Reversed): [5 4 3 2 1]
```

- c. Write a NumPy program to find common values between two arrays.

```
PS C:\Users\trupa\OneDrive\Documents\PWP> & C:/Users/trupa/AppData/Local/Programs/Python/Python313/python.exe "c:/Users/trupa/OneDrive/Document
s/PWP/PWP EXP 7"
Common values: [4 5]
```

- d. Write a NumPy program to repeat array elements.

```
PS C:\Users\trupa\OneDrive\Documents\PWP> & C:/Users/trupa/AppData/Local/Programs/Python/Python313/python.exe "c:/Users/trupa/OneDrive/Document
s/PWP/PWP EXP 7"
Repeated elements: [10 10 10 20 20 20 30 30 30]
```

- e. Write a NumPy program to find the memory size of a NumPy array.

```
PS C:\Users\trupa\OneDrive\Documents\PWP> & C:/Users/trupa/AppData/Local/Programs/Python/Python313/python.exe "c:/Users/trupa/OneDrive/Document
s/PWP/PWP EXP 7"
Memory size: 40 bytes
```

- f. Write a NumPy program to create an array of ones and zeros.

```
PS C:\Users\trupa\OneDrive\Documents\PWP> & C:/Users/trupa/AppData/Local/Programs/Python/Python313/python.exe "c:/Users/trupa/OneDrive/Document
s/PWP/PWP EXP 7"
Zeros array:
[[0. 0. 0.]
 [0. 0. 0.]]
Ones array:
[[1. 1. 1.]
 [1. 1. 1.]]
```

- g. Write a NumPy program to find the 4th element of a specified array.

```
PS C:\Users\trupa\OneDrive\Documents\PWP> & C:/Users/trupa/AppData/Local/Programs/Python/Python313/python.exe "c:/Users/trupa/OneDrive/Document
s/PWP/PWP EXP 7"
4th element: 40
```