
 <b>Marwadi University</b> Marwadi Chandarana Group 	<b>Marwadi University</b> <b>Faculty of Engineering &amp; Technology</b> <b>Department of Information and Communication Technology</b>	
<b>Subject: Programming With Python (01CT1309)</b>	<b>Aim:</b> Practical based on NumPy ndarray	
<b>Experiment No: 07</b>	<b>Date:18-8-2025</b>	<b>Enrollment No:92400133108</b>

**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.

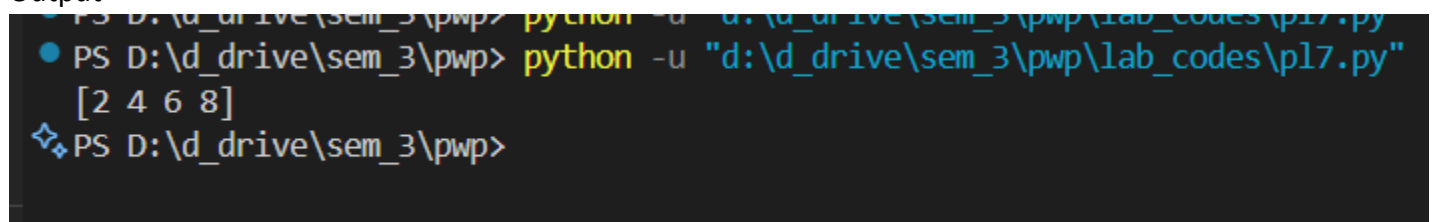
### **Create Array Using Python List**

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)
print(array1)
```

Output



```
PS D:\d_drive\sem_3\pwp> python -u "d:\d_drive\sem_3\pwp\lab_codes\pl7.py"
[ 2 4 6 8]
PS D:\d_drive\sem_3\pwp>
```

 <b>Marwadi University</b> Marwadi Chandarana Group 	<b>Marwadi University</b> <b>Faculty of Engineering &amp; Technology</b> <b>Department of Information and Communication Technology</b>	
<b>Subject: Programming With Python (01CT1309)</b>	<b>Aim:</b> Practical based on NumPy ndarray	
<b>Experiment No: 07</b>	<b>Date:18-8-2025</b>	<b>Enrollment No:92400133108</b>

Example

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

Output

```
PS D:\d_drive\sem_3\pwp> python -u "d:\d_drive\sem_3\pwp\lab_codes\pl7.py"
[2 4 6 8]
PS D:\d_drive\sem_3\pwp>
```

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 D:\d_drive\sem_3\pwp> python -u "d:\d_drive\sem_3\pwp\lab_codes\pl7.py"
[0. 0. 0. 0.]
PS D:\d_drive\sem_3\pwp>
```


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

 <b>Marwadi University</b> Marwadi Chandarana Group	<b>Marwadi University</b> <b>Faculty of Engineering &amp; Technology</b> <b>Department of Information and Communication Technology</b>	
<b>Subject: Programming With Python (01CT1309)</b>	<b>Aim:</b> Practical based on NumPy ndarray	
<b>Experiment No: 07</b>	<b>Date:18-8-2025</b>	<b>Enrollment No:92400133108</b>

```

PS D:\d_drive\sem_3\pwp> python -u "d:\d_drive\sem_3\pwp\lab_codes\pl7.py"
Using np.arange(5): [0 1 2 3 4]
Using np.arange(1, 9, 2): [1 3 5 7]
PS D:\d_drive\sem_3\pwp>

```

Create an Array With np.random.rand()

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 D:\d_drive\sem_3\pwp> python -u "d:\d_drive\sem_3\pwp\lab_codes\pl7.py"
[0.56237457 0.70468158 0.7935754 0.6042664 0.25780785]
PS D:\d_drive\sem_3\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 D:\d_drive\sem_3\pwp> python -u "d:\d_drive\sem_3\pwp\lab_codes\pl7.py"
My 1D array:
[10 20 30]
PS D:\d_drive\sem_3\pwp>

```

```
# Example 2: Create a 2D numpy array
```

```
arr2 = np.array([[10,20,30],[40,50,60]])
```

 <b>Marwadi University</b> Marwadi Chandarana Group	<b>Marwadi University</b> <b>Faculty of Engineering &amp; Technology</b> <b>Department of Information and Communication Technology</b>	
<b>Subject: Programming With Python (01CT1309)</b>	<b>Aim:</b> Practical based on NumPy ndarray	
<b>Experiment No: 07</b>	<b>Date:18-8-2025</b>	<b>Enrollment No:92400133108</b>

```
print("My 2D numpy array:\n", arr2)
```

Output

```

PS D:\d_drive\sem_3\pwp> python -u "d:\d_drive\sem_3\pwp\lab_codes\pl7.py"
My 2D numpy array:
[[10 20 30]
 [40 50 60]]
❖PS D:\d_drive\sem_3\pwp>

```

# Example 3: Create a sequence of integers

# from 0 to 20 with steps of 3

```
arr= np.arange(0, 20, 3)
```

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

Output

```

PS D:\d_drive\sem_3\pwp> python -u "d:\d_drive\sem_3\pwp\lab_codes\pl7.py"
• A sequential array with steps of 3:
[ 0  3  6  9 12 15 18]
❖PS D:\d_drive\sem_3\pwp>

```

# 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 3:\n", arr)
```

Output

```

• A sequential array with 5 values between 0 and 3:
[0.  0.75 1.5  2.25 3.  ]
❖PS D:\d_drive\sem_3\pwp>


```

# Example 8: Use ones() create array

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

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

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

 <b>Marwadi University</b> Marwadi Chandarana Group	<b>Marwadi University</b> <b>Faculty of Engineering &amp; Technology</b> <b>Department of Information and Communication Technology</b>	
<b>Subject: Programming With Python (01CT1309)</b>	<b>Aim:</b> Practical based on NumPy ndarray	
<b>Experiment No: 07</b>	<b>Date:18-8-2025</b>	<b>Enrollment No:92400133108</b>

## Output

```

PS D:\d_drive\sem_3\pwp> python -u "d:\d_drive\sem_3\pwp\lab_codes\pl7.py"
numpy array:
[[1. 1. 1.]
 [1. 1. 1.]]
Type: <class 'numpy.ndarray'>
PS D:\d_drive\sem_3\pwp>

```

## 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
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

 <b>Marwadi University</b> Marwadi Chandarana Group 	<b>Marwadi University</b> <b>Faculty of Engineering &amp; Technology</b> <b>Department of Information and Communication Technology</b>	
<b>Subject: Programming With Python (01CT1309)</b>	<b>Aim:</b> Practical based on NumPy ndarray	
<b>Experiment No: 07</b>	<b>Date:18-8-2025</b>	<b>Enrollment No:92400133108</b>

```

• PS D:\d_drive\sem_3\pwp> python -u "d:\d_drive\sem_3\pwp\lab_codes\pl7.py"
int64
float64
complex128
❖ PS D:\d_drive\sem_3\pwp>

```

### 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')
# 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

```

[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
❖ PS D:\d_drive\sem_3\pwp>

```

 <b>Marwadi University</b> Marwadi Chandarana Group	<b>Marwadi University</b> <b>Faculty of Engineering &amp; Technology</b> <b>Department of Information and Communication Technology</b>	
<b>Subject: Programming With Python (01CT1309)</b>	<b>Aim:</b> Practical based on NumPy ndarray	
<b>Experiment No: 07</b>	<b>Date:18-8-2025</b>	<b>Enrollment No:92400133108</b>

## 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 D:\d_drive\sem_3\pwp> python -u "d:\d_drive\sem_3\pwp\lab_codes\pl7.py"
[1 3 5 7] int64
[1. 3. 5. 7.] float64
PS D:\d_drive\sem_3\pwp>
```

## 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.



## Common NumPy Attributes

Here are some of the commonly used NumPy attributes:

Attributes	Description
<b>ndim</b>	returns number of dimension of the array
<b>size</b>	returns number of elements in the array
<b>dtype</b>	returns data type of elements in the array
<b>shape</b>	returns the size of the array in each dimension.
<b>itemsize</b>	returns the size (in bytes) of each elements in the array
<b>data</b>	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
```

 <b>Marwadi University</b> Marwadi Chandarana Group 	<b>Marwadi University</b> <b>Faculty of Engineering &amp; Technology</b> <b>Department of Information and Communication Technology</b>	
<b>Subject: Programming With Python (01CT1309)</b>	<b>Aim:</b> Practical based on NumPy ndarray	
<b>Experiment No: 07</b>	<b>Date:18-8-2025</b>	<b>Enrollment No:92400133108</b>

```
array1 = np.array([[2, 4, 6],
                  [1, 3, 5]])
# check the dimension of array1
print(array1.ndim)
```

Output

```
PS D:\d_drive\sem_3\pwp> python -u "d:\d_drive\sem_3\pwp\lab_codes\pl7.py"
2
PS D:\d_drive\sem_3\pwp>
```

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 D:\d_drive\sem_3\pwp> python -u "d:\d_drive\sem_3\pwp\lab_codes\pl7.py"
6
PS D:\d_drive\sem_3\pwp>
```



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



 <b>Marwadi University</b> Marwadi Chandarana Group 	<b>Marwadi University</b> <b>Faculty of Engineering &amp; Technology</b> <b>Department of Information and Communication Technology</b>	
<b>Subject: Programming With Python (01CT1309)</b>	<b>Aim:</b> Practical based on NumPy ndarray	
<b>Experiment No: 07</b>	<b>Date:18-8-2025</b>	<b>Enrollment No:92400133108</b>

```

• PS D:\d_drive\sem_3\pwp> python -u "d:\d_drive\sem_3\pwp\lab_codes\pl7.py"
(2, 3)
❖ PS D:\d_drive\sem_3\pwp>

```

#### 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 D:\d_drive\sem_3\pwp> python -u "d:\d_drive\sem_3\pwp\lab_codes\pl7.py"
int64
❖ PS D:\d_drive\sem_3\pwp>

```

#### 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)
```

```
# 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 D:\d_drive\sem_3\pwp> python -u "d:\d_drive\sem_3\pwp\lab_codes\pl7.py"
8
4
❖ PS D:\d_drive\sem_3\pwp>

```

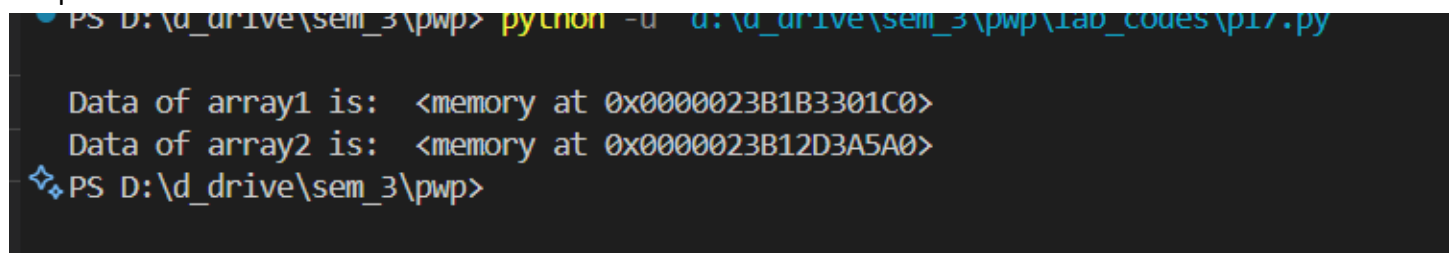
#### NumPy Array data Attribute

<div><div><div>Marwadi University</div><div>Marwadi Chandarana Group</div></div><div><div>NAAC</div><div>A+</div></div></div>		<div>Marwadi University</div> <div>Faculty of Engineering &amp; Technology</div> <div>Department of Information and Communication Technology</div>	
<div>Subject: Programming With Python (01CT1309)</div>		<div>Aim: Practical based on NumPy ndarray</div>	
<div>Experiment No: 07</div>		<div>Date:18-8-2025</div>	<div>Enrollment No:92400133108</div>

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 D:\d_drive\sem_3\pwp> python -u d:\d_drive\sem_3\pwp\lab_codes\p17.py
Data of array1 is: <memory at 0x0000023B1B3301C0>
Data of array2 is: <memory at 0x0000023B12D3A5A0>
PS D:\d_drive\sem_3\pwp>
```

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

 <b>Marwadi University</b> Marwadi Chandarana Group 	<b>Marwadi University</b> <b>Faculty of Engineering &amp; Technology</b> <b>Department of Information and Communication Technology</b>	
<b>Subject: Programming With Python (01CT1309)</b>	<b>Aim:</b> Practical based on NumPy ndarray	
<b>Experiment No: 07</b>	<b>Date:18-8-2025</b>	<b>Enrollment No:92400133108</b>

```

• PS D:\d_drive\sem_3\pwp> python -u "d:\d_drive\sem_3\pwp\lab_codes\pl7.py"
Original matrices:
[[1, 0], [0, 1]]
[[1, 2], [3, 4]]
Result of the matrix multiplication:
[[1 2]
 [3 4]]
❖ PS D:\d_drive\sem_3\pwp>

```

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

```

Original 2-d array
[[1 0]
 [1 2]]
Determinant of the said 2-D array:
2.0
❖ PS D:\d_drive\sem_3\pwp>

```

 <b>Marwadi University</b> Marwadi Chandarana Group 	<b>Marwadi University</b> <b>Faculty of Engineering &amp; Technology</b> <b>Department of Information and Communication Technology</b>	
<b>Subject: Programming With Python (01CT1309)</b>	<b>Aim:</b> Practical based on NumPy ndarray	
<b>Experiment No: 07</b>	<b>Date:18-8-2025</b>	<b>Enrollment No:92400133108</b>

### Post Lab Exercise:

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

Code :

```
import numpy as np

mat = np.arange(2,11)
matrix = mat.reshape(3,3)

print(matrix)
```

Output :

```
PS D:\d_drive\sem_3\pwp> python -u "d:\d_drive\sem_3\pwp\lab_codes\pl7.py"
[[ 2  3  4]
 [ 5  6  7]
 [ 8  9 10]]
PS D:\d_drive\sem_3\pwp>
```

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



Code :

```
import numpy as np

arr = np.arange(1,11)
print(arr)
arr1 = arr[::-1]
print(arr1)
```

Output :

```
PS D:\d_drive\sem_3\pwp> python -u "d:\d_drive\sem_3\pwp\lab_codes\pl7.py"
[ 1  2  3  4  5  6  7  8  9 10]
[10  9  8  7  6  5  4  3  2  1]
PS D:\d_drive\sem_3\pwp>
```

 <b>Marwadi University</b> Marwadi Chandarana Group 	<b>Marwadi University</b> <b>Faculty of Engineering &amp; Technology</b> <b>Department of Information and Communication Technology</b>	
<b>Subject: Programming With Python (01CT1309)</b>	<b>Aim:</b> Practical based on NumPy ndarray	
<b>Experiment No: 07</b>	<b>Date:18-8-2025</b>	<b>Enrollment No:92400133108</b>

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

Code :

```
import numpy as np
```

```
array1 = np.array([1, 2, 3, 4, 5])
```

```
array2 = np.array([4, 5, 6, 7, 8])
```

```
common_values = np.intersect1d(array1, array2)
```

```
print("Array 1:", array1)
```

```
print("Array 2:", array2)
```

```
print("Common values:", common_values)
```

Output :

```
PS D:\d_drive\sem_3\pwp> python -u "d:\d_drive\sem_3\pwp\lab_codes\pl7.py"
Array 1: [1 2 3 4 5]
Array 2: [4 5 6 7 8]
Common values: [4 5]
PS D:\d_drive\sem_3\pwp>
```

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

Code :

```
import numpy as np
```

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



```
repeated_array = np.repeat(array, 3)
```

```
print("Original array:", array)
```

```
print("Repeated array:", repeated_array)
```

Output :

```
PS D:\d_drive\sem_3\pwp> python -u "d:\d_drive\sem_3\pwp\lab_codes\pl7.py"
Original array: [1 2 3]
Repeated array: [1 1 1 2 2 2 3 3 3]
PS D:\d_drive\sem_3\pwp>
```

 <b>Marwadi University</b> Marwadi Chandarana Group 	<b>Marwadi University</b> <b>Faculty of Engineering &amp; Technology</b> <b>Department of Information and Communication Technology</b>	
<b>Subject: Programming With Python (01CT1309)</b>	<b>Aim:</b> Practical based on NumPy ndarray	
<b>Experiment No: 07</b>	<b>Date:18-8-2025</b>	<b>Enrollment No:92400133108</b>

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

Code :

```
import numpy as np
```

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

```
memory_size = array.nbytes
```

```
print("Array:", array)
```

```
print("Memory size in bytes:", memory_size)
```

Output :

```

• PS D:\d_drive\sem_3\pwp> python -u "d:\d_drive\sem_3\pwp\lab_codes\pl7.py"
  Array: [1 2 3 4 5]
  Memory size in bytes: 40
❖ PS D:\d_drive\sem_3\pwp>

```

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

Code :

```
import numpy as np
```

```
zeros_array = np.zeros((3, 3))
```

```
ones_array = np.ones((3, 3))
```



```
print("Array of Zeros:")
```

```
print(zeros_array)
```

```
print("\nArray of Ones:")
```

```
print(ones_array)
```

Output :

 <b>Marwadi University</b> Marwadi Chandarana Group 	<b>Marwadi University</b> <b>Faculty of Engineering &amp; Technology</b> <b>Department of Information and Communication Technology</b>	
<b>Subject: Programming With Python (01CT1309)</b>	<b>Aim:</b> Practical based on NumPy ndarray	
<b>Experiment No: 07</b>	<b>Date:18-8-2025</b>	<b>Enrollment No:92400133108</b>

```

PS D:\d_drive\sem_3\pwp> python -u "d:\d_drive\sem_3\pwp\lab_codes\pl7.py"
Array of Zeros:
[[0. 0. 0.]
 [0. 0. 0.]
 [0. 0. 0.]]

Array of Ones:
[[1. 1. 1.]
 [1. 1. 1.]
 [1. 1. 1.]]
❖ PS D:\d_drive\sem_3\pwp>

```

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

Code :

```
import numpy as np
```

```
array = np.array([10, 20, 30, 40, 50, 60])
```

```
print("Array:", array)
```

```
print("4th element:", array[3])
```

Output :

```

Array: [10 20 30 40 50 60]
4th element: 40
❖ PS D:\d_drive\sem_3\pwp>

```