

Applied Data Science with Python



NumPy



Learning Objectives

By the end of this lesson, you will be able to:

- 🕒 Explain the fundamentals of NumPy
- 🕒 Explore the axes and shape properties of n-dimensional arrays
- 🕒 Perform arithmetic functions
- 🕒 Apply mathematical functions to an array
- 🕒 Explore array indexing and slicing
- 🕒 Use NumPy to handle files



Business Scenario

ABC is a company that operates as an incident ticket management system, handling a significant number of tickets on a daily basis. All of this information is saved in a database. ABC is responsible for analyzing this data and delivering daily reports to its clients.

However, it is having trouble executing operations on multi-dimensional arrays and matrices. In addition, the processing power being utilized is very high.

Data analysts at ABC decide to utilize NumPy, which allows them to construct applicable data types and integrate them with different databases. This will also lower the computational power, save time, and cut costs.





Fundamentals of NumPy

Discussion: Fundamentals of NumPy

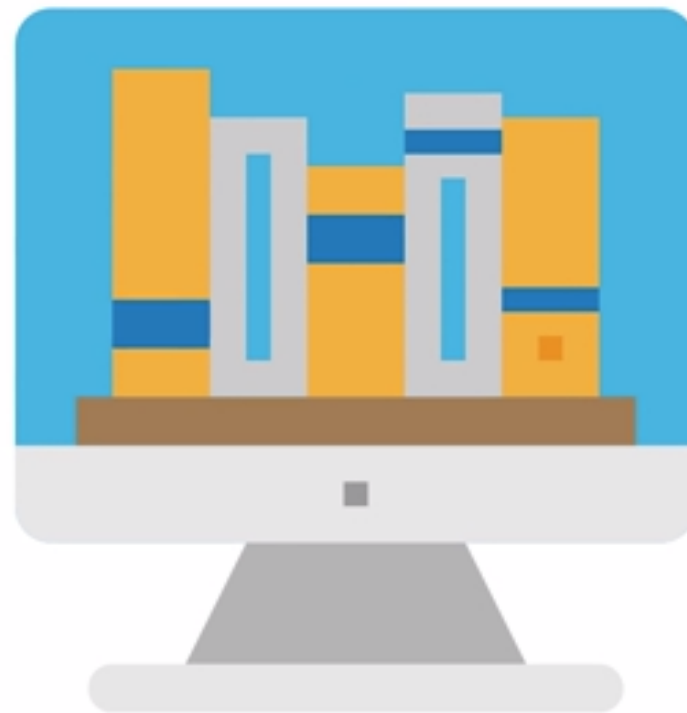
Duration: 10 minutes



- Why is NumPy essential?
- What are the significant attributes of NumPy?

Fundamentals of NumPy

NumPy (Numerical Python) is a free and open-source library that is mostly used for mathematical operations in scientific and engineering applications.



It is convenient for performing operations on multidimensional arrays and matrices.

Essentials of NumPy

NumPy is an efficient multidimensional container of generic data.



NumPy's ability to construct unique data types enables integration with a broad range of databases.

Essentials of NumPy

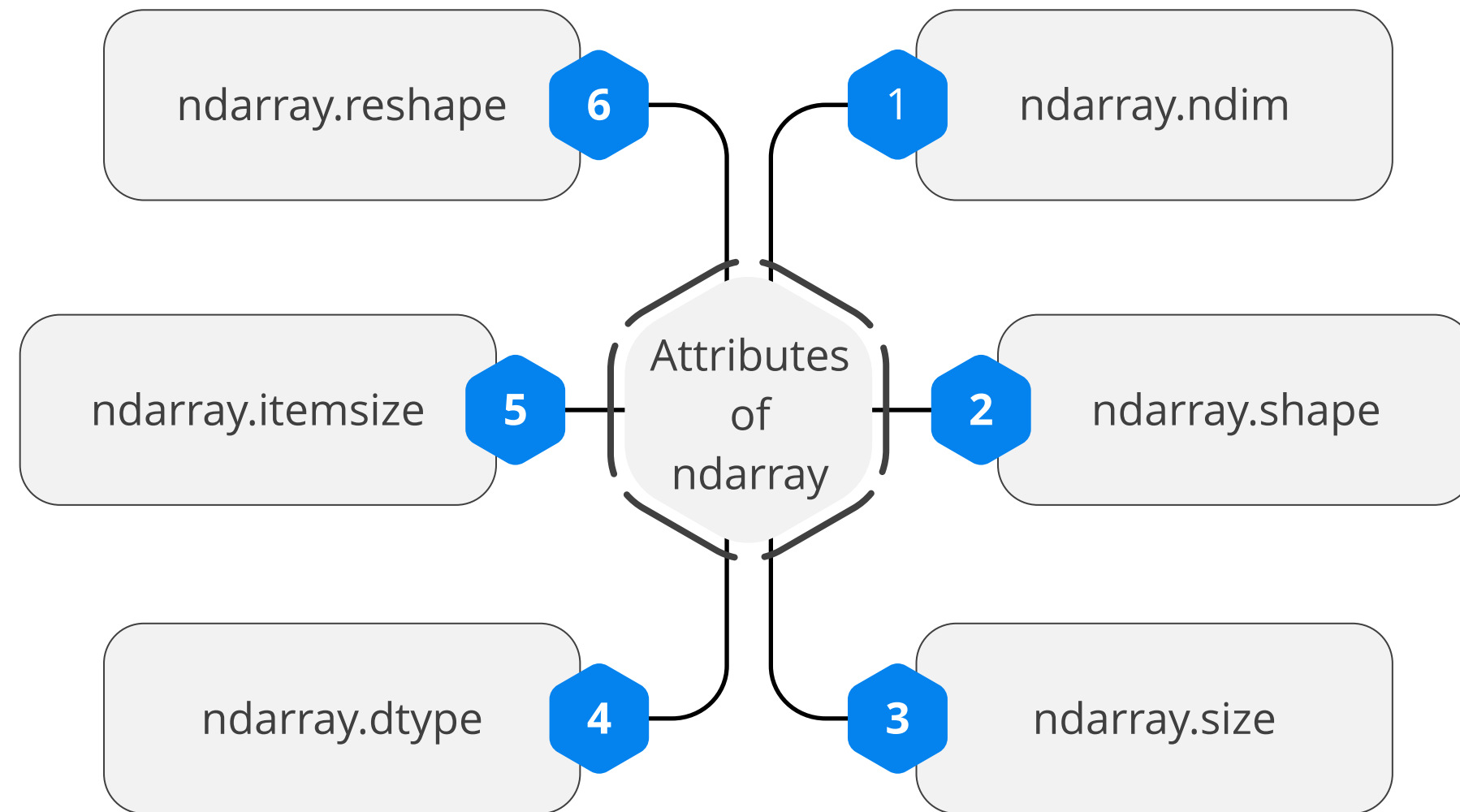
For example, a list cannot manage arithmetic operations whereas an array can.



- NumPy uses arrays instead of Python lists.
- Lists are much slower than arrays.
- It is difficult to apply mathematical operations on lists.

Important Attributes of ndarray

NumPy's arrays are called ndarray.



Important Attributes of ndarray

An example for each attribute is given below:

```
import numpy as np
arr = np.array( [[ 1, 2, 3], [ 4, 2, 5]] )
print("No. of dimensions: ", arr.ndim)
print("Shape of array: ", arr.shape)
print("Size of array: ", arr.size)
print("Array stores elements of type: ", arr.dtype)
print("Length of one array element in bytes. : ", arr.itemsize)
print("array's data. : ", arr.data)
```

Output:

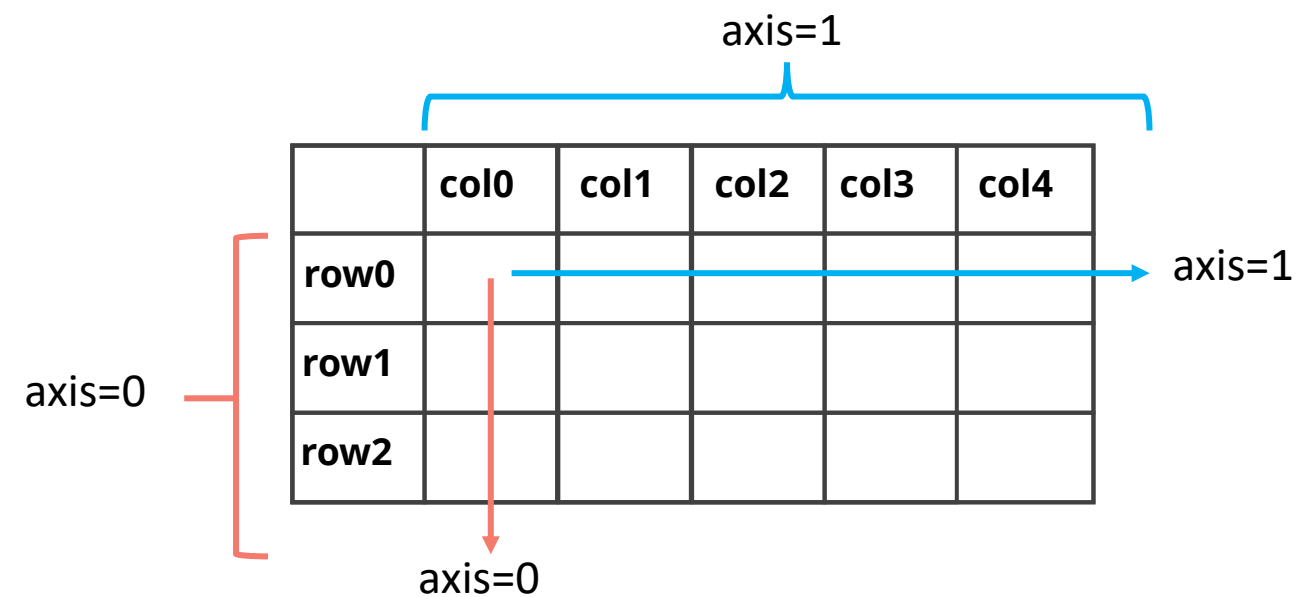
```
No. of dimensions:  2
Shape of array:  (2, 3)
Size of array:  6
Array stores elements of type:  int64
Length of one array element in bytes. :  8
array's data. :  <memory at 0x7f7e16a7d2f0>
```

Let us understand each one of these in detail.

Important Attributes of ndarray

ndarray.ndim

It is the number of axes (dimensions) of the array.



Example: A two-dimensional array (matrix) has two axes and contains elements arranged in rows and columns.

Important Attributes of ndarray

ndarray.shape

It provides the size of the array for each dimension. The output data type is a tuple.

(2,3)

(3,2)

For example, when shape output is (2,3), it means the matrix has 2 rows and 3 columns.

The length of the shape tuple is the number of axes, ndim.

Important Attributes of ndarray

ndarray.size

It is the total number of elements in the array.

It is equal to the product of the elements of the shape.

Size = 12

Important Attributes of ndarray

ndarray.dtype

It shows the data type of the elements in the array.

NumPy provides standard Python types of its own, like:

numpy.int32

numpy.int16

numpy.float64

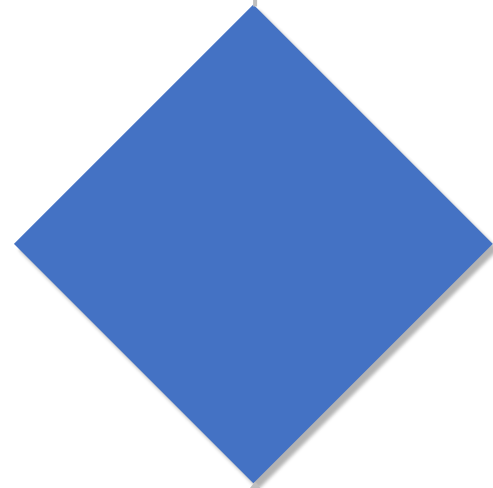


Important Attributes of ndarray

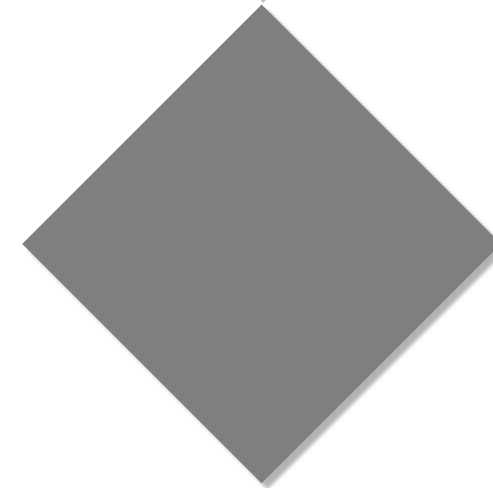
ndarray.itemsize

It shows the length of one array element in bytes.

If element is **Float64**,
item size is $64/8 = 8$



If element is **Complex32**,
item size is $32/8 = 4$

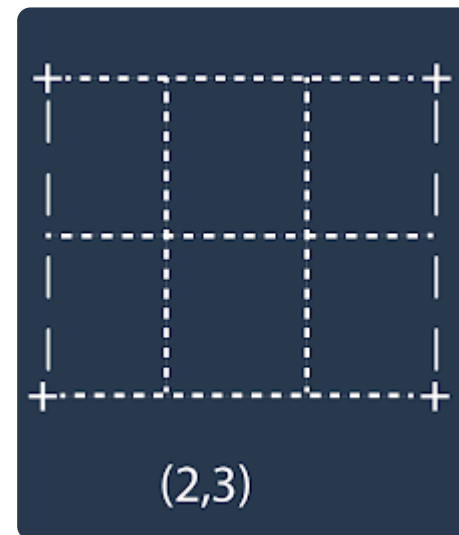


It is denoted by `ndarray.dtype.itemsize`.

Important Attributes of ndarray

ndarray.reshape

It is used to reshape the current elements of an array with a new shape.



Discussion: Fundamentals of NumPy

Duration: 10 minutes



- Why is NumPy essential?

Answer: NumPy is essential as it provides an efficient multidimensional container for generic data and enables the construction of unique data types, facilitating seamless integration with diverse databases.

- What are the significant attributes of NumPy?

Answer: The important attributes of NumPy include `ndarray.ndim`, `ndarray.shape`, `ndarray.size`, `ndarray.dtype`, `ndarray.itemsize`, and `ndarray.reshape`.

Assisted Practices



Let's understand the topics below using Jupyter Notebooks.

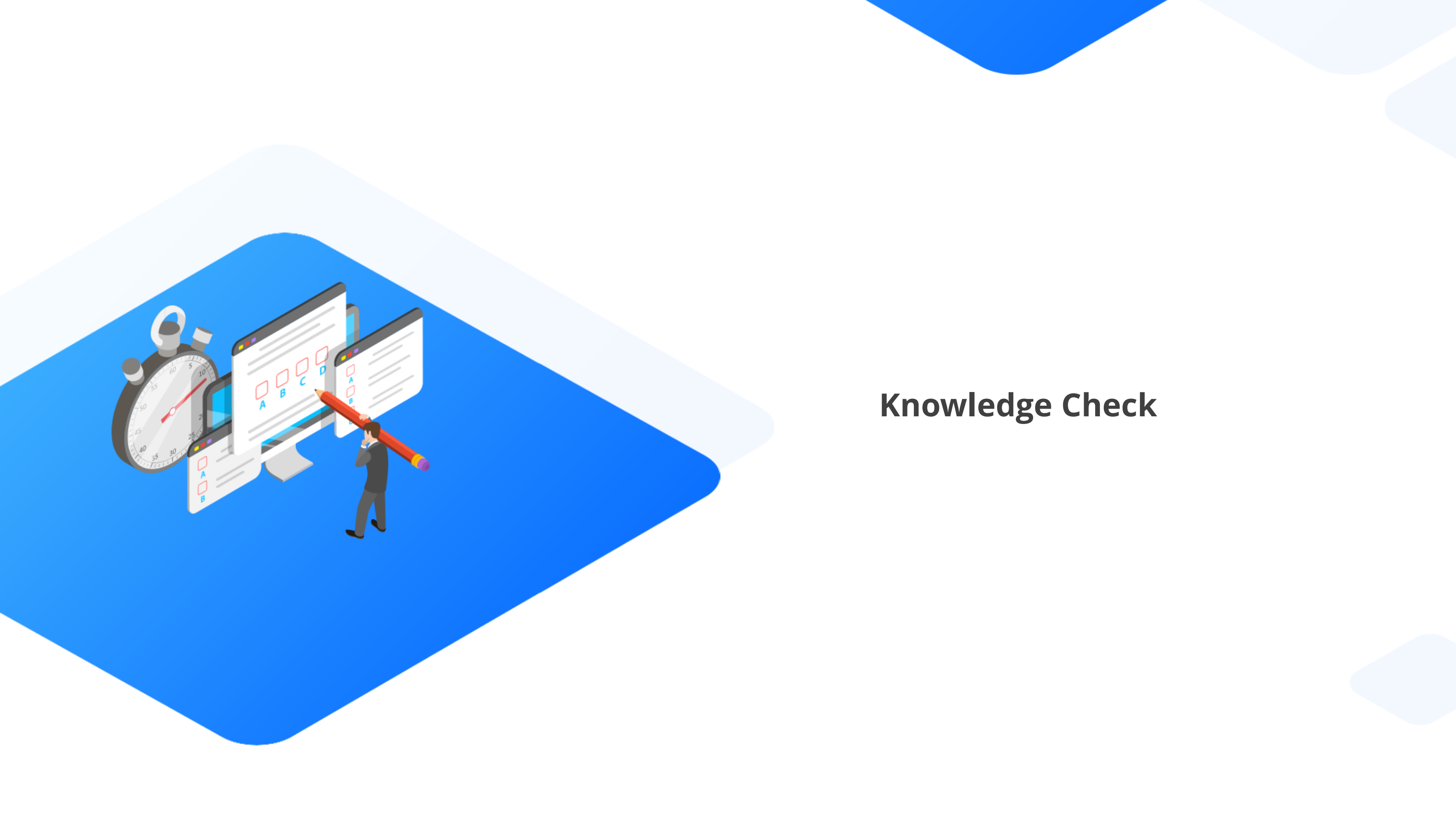
- 4.3_NumPy Array: Shapes and Axes: Part A
- 4.4_NumPy Array: Shapes and Axes: Part B
- 4.5_Arithmetic Operations in Python
- 4.6_Conditional Statements in Python
- 4.7_Common Mathematical and Statistical Functions in NumPy
- 4.8_Indexing and Slicing in Python: Part A
- 4.9_Indexing and Slicing in Python: Part B
- 4.10_File Handling in Python

Note: Please download the pdf files for each topics mentioned above from the Reference Material section.

Key Takeaways

- NumPy is an open-source library used primarily for mathematical operations in science and engineering applications.
- `ndarray.shape` is a tuple of integers that gives the size of the array in each dimension.
- `ndarray.itemsize` determines the size in bytes of each element of the array.
- `ndarray.data` is a buffer that contains the actual elements of the array.





Knowledge Check

Knowledge Check

1

What is NumPy and what is it used for?

- A. NumPy is used for building dynamic websites.
- B. NumPy is used primarily for mathematical operations in science and engineering applications.
- C. NumPy is used for image and speech recognition.
- D. NumPy is used for building mobile applications.



Knowledge Check

1

What is NumPy and what is it used for?

- A. NumPy is used for building dynamic websites.
- B. NumPy is used primarily for mathematical operations in science and engineering applications.
- C. NumPy is used for image and speech recognition.
- D. NumPy is used for building mobile applications.

The correct answer is **B**

NumPy is used for mathematical operations in science and engineering applications.



Knowledge Check

2

What are the attributes of ndarray?

- A. ndim, shape, size, dtype, itemsize
- B. ndim, shape, dtype, data, index
- C. ndim, size, dtype, itemsize, data
- D. ndim, index, dtype, itemsize, shape



Knowledge Check

2

What are the attributes of ndarray?

- A. ndim, shape, size, dtype, itemsize
- B. ndim, shape, dtype, data, index
- C. ndim, size, dtype, itemsize, data
- D. ndim, index, dtype, itemsize, shape

The correct answer is **A**

The attributes of ndarray are ndim, shape, size, dtype, itemsize.



Knowledge Check

3

Which of the following is used to change the dimension of an array?

- A. `ndarray.shape`
- B. `ndarray.size`
- C. `ndarray.data`
- D. `ndarray.itemsize`



Knowledge Check

3

Which of the following is used to change the dimension of an array?

- A. `ndarray.shape`
- B. `ndarray.size`
- C. `ndarray.data`
- D. `ndarray.itemsize`

The correct answer is **A**

`ndarray.shape` is used to change the dimension of an array.





Thank You