University: Mohamed Khider University of Biskra
Faculty: Faculty of Exact Sciences
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Module: Scientific Programming
Level: 2nd Year LMD
Specialty: Physics/MCPC
Session: Practical Work N°5
Subject: Basic Arithmetic and Comparisons

SESSION 5
NumPy – Basic Arithmetic and Comparisons

LEARNING GOALS

- Perform simple arithmetic on arrays.
- Understand element-wise operations.
- Use basic comparisons.
- Apply simple NumPy functions required in the syllabus.

SHORT THEORY

NumPy allows arithmetic to be performed element by element. Common functions include `sum`, `mean`, `min`, `max`, `sqrt` and `abs`.

1. Element-wise arithmetic

LET'S TRY

```
import numpy as np

x = np.array([1., 2., 3., 4.])
y = 2*x + 1

print(y)
print(x**2)

```

2. Comparisons

GUIDED PRACTICE

```
x = np.array([1, 4, 7, 10])

print(x > 5)
print(x == 4)

```

A comparison produces a Boolean result for each element.

3. Simple functions

LET'S TRY

```
print(np.sum(x))
print(np.mean(x))
print(np.min(x))
print(np.max(x))
print(np.sqrt(x))

```

Guided example – approximate data

GUIDED PRACTICE

```
        exact = np.array([1.0, 2.0, 3.0, 4.0])
        approx = np.array([0.9, 2.1, 2.8, 4.2])

        error = np.abs(exact - approx)

        print(error)
        print(np.max(error))
        print(np.mean(error))

```

PHYSICS CONNECTION

The same operations are useful when a physical quantity is stored as a collection of measured or calculated values. We keep the example simple: arrays, arithmetic, comparisons and basic functions only.

TRY IT YOURSELF – NO SOLUTION

1. Create $x = 0, 0.1, \ldots, 1$ and calculate x^2.
2. Create a second array by adding a small value to each element.
3. Calculate the maximum absolute difference between the two arrays.

TRY IT YOURSELF – NO SOLUTION

1. Create a NumPy array of 10 equally spaced values in $[0, 1]$.
2. Perform an element-wise calculation using powers and square roots.
3. Extract a specified row and column from a matrix.
4. Compute the maximum absolute difference between two arrays.