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°4
Subject: NumPy – Arrays

SESSION 4
NumPy – Arrays, Creation and Indexing

LEARNING GOALS

- Understand a NumPy array as a numerical data structure.
- Create one-dimensional and two-dimensional arrays.
- Access elements using indices.
- Use simple array constructors.

SHORT THEORY

NumPy is a Python library for numerical work. The syllabus focuses here on arrays, their creation and indexing. Indices start at 0.

1. Create arrays

LET'S TRY

```
import numpy as np

x = np.array([2, 4, 6, 8])
A = np.array([[1,2,3],[4,5,6]])

print(x)
print(A)

```

2. Useful constructors

GUIDED PRACTICE

```
print(np.zeros(5))
print(np.ones(4))
print(np.arange(0, 10, 2))
print(np.linspace(0, 1, 6))

```

3. Indexing

LET'S TRY

```
print(x[0])
print(x[2])
print(A[0,1])
print(A[1,2])

```

SHORT THEORY

Indexing reminder
For a vector, `x[i]` selects one element. For a matrix, `A[i,j]` selects one element; `:` can select a complete row or column.

PHYSICS CONNECTION

A vector can represent sampled values:

$$x = (x_0, x_1, \ldots, x_n).$$

For example, `np.linspace(0,1,11)` creates 11 equally spaced points between 0 and 1.

Guided practice – vectors and matrices

GUIDED PRACTICE

```
        x = np.arange(0, 10, 2)
        print(x)
        print(x[1:4])

        A = np.array([[1,2,3],
        [4,5,6],
        [7,8,9]])

        print(A[1,:])     # second row
        print(A[:,2])     # third column

```

TRY IT YOURSELF – NO SOLUTION

1. Create an array containing the even numbers from 2 to 20.
2. Create 11 equally spaced values between 0 and 1.
3. Create a 4×4 matrix containing 1 to 16.
4. Extract its second row and fourth column.
5. Extract the upper-left 2×2 block.