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Module: Scientific Programming
Level: 2nd Year LMD
Specialty: Physics/MCPC
Session: Practical Work N°10
Subject: Mathematical Functions and Basic Search

SESSION 10
Mathematical Functions and Basic Search

LEARNING GOALS

- Use the `math` module for common mathematical functions.
- Evaluate `sin`, `cos`, `log`, `exp` and `sqrt`.
- Understand the idea of linear search.
- Recognize the basic idea of binary search.

SHORT THEORY

Python's `math` module provides common mathematical functions. The syllabus includes: `sin`, `cos`, `log`, `exp`, `sqrt`. Angles for `sin` and `cos` are given in radians.

1. Mathematical functions

LET'S TRY

```
        import math

        x = math.pi / 4

        print(math.sin(x))
        print(math.cos(x))
        print(math.sqrt(16))
        print(math.exp(1))
        print(math.log(10))

```

2. Linear search

GUIDED PRACTICE

Linear search checks elements one after another until the target is found or the list ends.

```
        values = [4, 8, 2, 9, 5]
        target = 9

        for i in range(len(values)):
        if values[i] == target:
        print("Found at index", i)

```

3. Binary search – introduction only

SHORT THEORY

Binary search requires a **sorted** list. It repeatedly compares the target with the middle element and keeps only the half where the target can still be located.

LET'S TRY

For the sorted list

$$[2, 4, 7, 9, 12, 15, 20],$$

to search for 12, first inspect the middle value 9. Since $12 > 9$, continue in the right half. Then inspect the middle of the remaining part.

PHYSICS CONNECTION

Mathematical functions are directly useful when a physical model contains trigonometric, exponential or logarithmic expressions. Search algorithms are introduced as basic algorithmic tools, without going into advanced complexity analysis.

TRY IT YOURSELF – NO SOLUTION

1. Calculate $\sin(\pi/6)$, $\cos(\pi/3)$, $\sqrt{25}$, e^2 and $\log(10)$ using `math`.
2. Write a simple linear search for the value 15 in a list.
3. For a sorted list, explain the first comparison made by binary search when looking for a chosen value.