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Work Sheet 4: NumPy Basics

Question 1: Array Creation

1.1 Create a 1D array of integers from 5 to 25 using NumPy.
1.2 Create a 2D array with 3 rows and 4 columns filled with random integers between 10 and 50.

Question 2: Array Attributes

2.1 For the 1D array created in Question 1.1, find, and print its:

- Shape
- Size
- Data type

2.2 For the 2D array created in Question 1.2, find, and print its:

- Shape
- Size
- Data type

Question 3: Array Operations

3.1 Create two 1D arrays:

- Array1: [2, 4, 6, 8, 10]
- Array2: [1, 3, 5, 7, 9]

3.2 Perform the following operations and print the results:

- Addition
- Subtraction
- Element-wise multiplication
- Element-wise division

Question 4: Broadcasting

4.1 Create a 2D array of shape (3, 3) with values starting from 1 to 9.
4.2 Using broadcasting, multiply this 2D array by a scalar value of 5. Print the result.

Question 5: Slicing and Indexing

5.1 Create a 2D array of shape (4, 4) with values ranging from 10 to 25.
5.2 Extract the second row and the last column of the array.
5.3 Replace the elements of the first row with zeros.

Question 6: Boolean Indexing

6.1 Create a 1D array with random integers between 20 and 40 (10 elements).
6.2 Use Boolean indexing to find all elements greater than 30.

Question 7: Reshaping

7.1 Create a 1D array with 12 elements starting from 11.
7.2 Reshape it into a 2D array of shape (3, 4). Print the reshaped array.

Question 8: Matrix Operations

8.1 Create two 2x2 matrices:

- Matrix A: [[1, 2], [3, 4]]

- Matrix B: [[5, 6], [7, 8]]

8.2 Perform and print the results of the following operations:

- Matrix multiplication
- Transpose of Matrix A

Question 9: Statistical Functions

9.1 Create a 1D array with random integers between 10 and 60 (15 elements).
9.2 Compute and print the following statistics:

- Mean
- Median
- Standard deviation

Question 10: Linear Algebra

10.1 Create a 3x3 matrix:

$$A = \begin{bmatrix} 2 & 1 & 3 \\ 0 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$$

10.2 Perform the following operations:

- Find the determinant of matrix A.
- Compute the inverse of matrix A.
- Find the eigenvalues and eigenvectors of matrix A.

Question 11: A mobile robot moves in a 2D environment, and its positions (x, y) are recorded at different time steps. The dataset of robot positions is stored in a NumPy array. Data → (x,y) → (0,0), (2,3), (4,7), (7,10), (10,15).

11.1 Which NumPy command will correctly compute the **Euclidean distance traveled** between the first and last recorded positions of the robot?
11.2 To compute the **total distance traveled** by the robot (step by step), which NumPy command is most appropriate?