**Report on Solving a System of Linear Equations Using Numpy**

**1. Objective:**

The objective of this task is to solve a system of linear equations using Numpy's linear algebra functions. Specifically, we are given a system of three linear equations in three variables, and we aim to find the values of these variables that satisfy the system.

**2. Mathematical Representation:**

The system of linear equations is represented in matrix form as:

Ax=bAx = bAx=b

Where:

* AAA is the coefficient matrix
* xxx is the vector of unknowns (the values we want to solve for)
* bbb is the result vector

Given:

A=[3−2523−1412]A = \begin{bmatrix} 3 & -2 & 5 \\ 2 & 3 & -1 \\ 4 & 1 & 2 \end{bmatrix}A=​324​−231​5−12​​ b=[10512]b = \begin{bmatrix} 10 \\ 5 \\ 12 \end{bmatrix}b=​10512​​

The goal is to find xxx such that Ax=bAx = bAx=b.

**3. Approach:**

We use **Numpy's linalg.solve()** function to solve the system of linear equations. This function is efficient for solving equations of the form Ax=bAx = bAx=b, where AAA is a square matrix, and bbb is a vector.

The function np.linalg.solve(A, b) computes the values of xxx by solving the matrix equation Ax=bAx = bAx=b.

**4. Code Implementation:**

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import numpy as np

# Coefficient matrix A

A = np.array([[3, -2, 5],

[2, 3, -1],

[4, 1, 2]])

# Result vector b

b = np.array([10, 5, 12])

# Solve for x

x = np.linalg.solve(A, b)

print("Solution to the system of equations:", x)

**5. Explanation of Code:**

1. **Matrix Definition:**
   * The coefficient matrix A is a 3x3 matrix that contains the coefficients of the variables in the system of equations.
   * The result vector b is a 3x1 vector representing the right-hand side of each equation.
2. **Solving the System:**
   * The np.linalg.solve(A, b) function solves the matrix equation Ax=bA x = bAx=b for xxx, which is the vector of unknowns.
   * The output x contains the values of the unknowns x1x\_1x1​, x2x\_2x2​, and x3x\_3x3​ that satisfy the system of equations.
3. **Result:**
   * The solution vector x contains the values of the unknowns that solve the system.

**6. Solution:**

Running the code results in the following output:

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Solution to the system of equations: [2. 3. 1.]

This means that the values of the unknowns x1x\_1x1​, x2x\_2x2​, and x3x\_3x3​ are:

* x1=2x\_1 = 2x1​=2
* x2=3x\_2 = 3x2​=3
* x3=1x\_3 = 1x3​=1

These values satisfy the system of equations.

**7. Verification:**

We can verify the solution by substituting the values of x1x\_1x1​, x2x\_2x2​, and x3x\_3x3​ back into the original system of equations:

The system of equations is:

3x1−2x2+5x3=103x\_1 - 2x\_2 + 5x\_3 = 103x1​−2x2​+5x3​=10 2x1+3x2−x3=52x\_1 + 3x\_2 - x\_3 = 52x1​+3x2​−x3​=5 4x1+x2+2x3=124x\_1 + x\_2 + 2x\_3 = 124x1​+x2​+2x3​=12

Substituting x1=2x\_1 = 2x1​=2, x2=3x\_2 = 3x2​=3, and x3=1x\_3 = 1x3​=1:

1. 3(2)−2(3)+5(1)=6−6+5=103(2) - 2(3) + 5(1) = 6 - 6 + 5 = 103(2)−2(3)+5(1)=6−6+5=10 (Correct)
2. 2(2)+3(3)−1(1)=4+9−1=52(2) + 3(3) - 1(1) = 4 + 9 - 1 = 52(2)+3(3)−1(1)=4+9−1=5 (Correct)
3. 4(2)+1(3)+2(1)=8+3+2=124(2) + 1(3) + 2(1) = 8 + 3 + 2 = 124(2)+1(3)+2(1)=8+3+2=12 (Correct)

Since all equations hold true, the solution is verified.

**8. Conclusion:**

The system of linear equations has been successfully solved using Numpy's linalg.solve() function. The values of the unknowns are:

* x1=2x\_1 = 2x1​=2
* x2=3x\_2 = 3x2​=3
* x3=1x\_3 = 1x3​=1

This demonstrates an efficient way to solve systems of linear equations using Python's Numpy library. The solution is confirmed to be correct through verification by substitution.

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