Introduction to NumPy

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What is NumPy?

- NumPy (Numerical Python) is a powerful library for numerical computing in Python.
- It provides support for large, multi-dimensional arrays and matrices.
- Offers a collection of mathematical functions to operate efficiently on arrays.

Why Use NumPy?

- Faster computations compared to Python lists.
- Optimized memory usage.
- Broad functionality including linear algebra, statistics, and random number generation.

Installing NumPy

- Using pip: `pip install numpy`
- Importing NumPy: `import numpy as np`

Creating NumPy Arrays

```python
import numpy as np

# Creating a 1D array
arr1 = np.array([1, 2, 3, 4, 5])
print(arr1)

# Creating a 2D array
arr2 = np.array([[1, 2, 3], [4, 5, 6]])
print(arr2)
```

Listing 1: Creating Arrays

Basic Operations on Arrays

```python
import numpy as np

arr = np.array([1, 2, 3, 4])
print(arr + 2)   # Add 2 to each element
print(arr * 3)   # Multiply each element by 3
print(arr ** 2)  # Square each element
```

Listing 2: Basic Operations

Indexing and Slicing

```python
import numpy as np

arr = np.array([10, 20, 30, 40, 50])
print(arr[0])      # First element
print(arr[-1])     # Last element
print(arr[1:4])    # Elements from index 1 to 3
```

Listing 3: Indexing & Slicing

Shape and Reshape

```python
import numpy as np

arr = np.array([[1, 2, 3], [4, 5, 6]])
print(arr.shape)  # Output: (2, 3)

reshaped = arr.reshape(3, 2)
print(reshaped)   # Reshape to 3x2
```

Listing 4: Shape & Reshape

Useful NumPy Functions

```
import numpy as np

arr = np.array([1, 2, 3, 4, 5])
print(np.sum(arr))       # Sum of all elements
print(np.mean(arr))      # Mean value
print(np.max(arr))       # Maximum value
print(np.min(arr))       # Minimum value
```

Listing 5: Common Functions

Random Number Generation

```
1 import numpy as np
2
3 random_numbers = np.random.rand(3, 3)  # 3x3 matrix of
      random numbers
4 print(random_numbers)
```

Listing 6: Generating Random Numbers

Conclusion

- NumPy is an essential tool for scientific computing.
- Provides efficient and fast operations on large datasets.
- Supports a wide range of mathematical functions and operations.