NUMPY

What is NumPy?
NumPy (Numerical Python) is a library used for working with arrays. It also provides functions for performing mathematical and logical operations on arrays.

Installing NumPy
You can install NumPy using pip:
```bash
pip install numpy
```

Importing NumPy
```python
import numpy as np
```

Creating Arrays
NumPy provides several ways to create arrays:

1. From a Python List
   ```python
   my_list = [1, 2, 3, 4, 5]
   np_array = np.array(my_list)
   print(np_array)
   ```

2. Using Built-in Functions
   - `np.zeros`: Creates an array of zeros
   - `np.ones`: Creates an array of ones
   - `np.arange`: Creates an array with a range of values
   - `np.linspace`: Creates an array with evenly spaced values over a specified interval

   ```python
   zeros_array = np.zeros((2, 3))  # 2x3 array of zeros
   ones_array = np.ones((2, 3))    # 2x3 array of ones
   range_array = np.arange(0, 10, 2)  # Array: [0, 2, 4, 6, 8]
```

```
   linspace_array = np.linspace(0, 1, 5)  # Array: [0. , 0.25, 0.5 , 0.75, 1. ]
   ```

Array Attributes
NumPy arrays have attributes that provide information about the array:

```python
array = np.array([[1, 2, 3], [4, 5, 6]])
print(array.shape)  # Shape of the array (rows, columns)
print(array.size)   # Total number of elements
print(array.ndim)   # Number of dimensions
print(array.dtype)  # Data type of elements
```

Reshaping Arrays
You can change the shape of an array using the `reshape` method:

```python
array = np.arange(1, 13)
reshaped_array = array.reshape((3, 4))  # Reshape to 3x4 array
print(reshaped_array)
```

Indexing and Slicing
NumPy arrays can be indexed and sliced similarly to Python lists:

```python
array = np.array([1, 2, 3, 4, 5])
print(array[0])     # First element
print(array[1:4])   # Elements from index 1 to 3
print(array[:3])    # First three elements
print(array[-1])    # Last element
```

For multidimensional arrays:
```python
array = np.array([[1, 2, 3], [4, 5, 6], [7, 8, 9]])
print(array[0, 0])     # Element at (0, 0)
print(array[0:2, 1:3]) # Subarray from rows 0 to 1 and columns 1 to 2
```

Basic Operations
NumPy supports element-wise operations:

```python
array1 = np.array([1, 2, 3])
array2 = np.array([4, 5, 6])

print(array1 + array2)  # Element-wise addition
print(array1 - array2)  # Element-wise subtraction
print(array1 * array2)  # Element-wise multiplication
print(array1 / array2)  # Element-wise division
```

You can also perform operations like dot product, sum, min, max, etc.:
```python
dot_product = np.dot(array1, array2)
sum_array = np.sum(array1)
min_value = np.min(array1)
max_value = np.max(array1)
```

Useful Functions
- np.mean: Compute the mean
- np.std: Compute the standard deviation
- np.var: Compute the variance

```python
array = np.array([1, 2, 3, 4, 5])
mean_value = np.mean(array)
std_value = np.std(array)
var_value = np.var(array)
```