



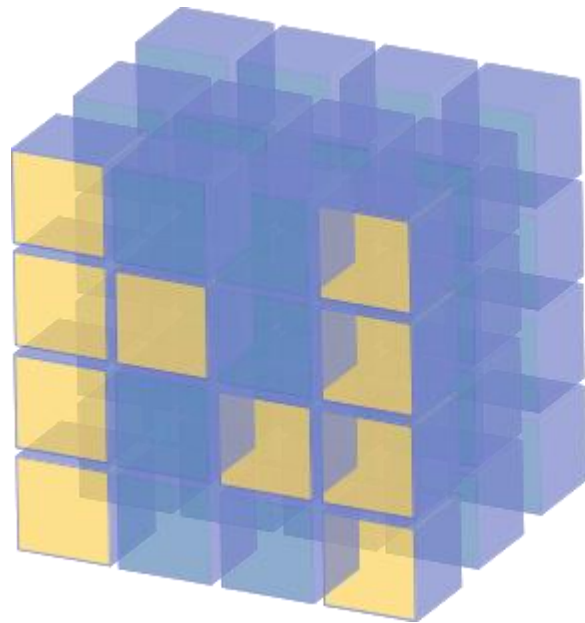
Basic Programming

Lesson 11

Numpy

Numpy

NumPy is the fundamental package for array and matrix computing with Python



NumPy

Install Numpy library

Install via pip:

- `pip install numpy`

Import Numpy

```
import numpy as np
```

Initial array

1D:

```
arr = np.array([1, 3, 4, 5, 6])
```

2D:

```
arr = np.array([[4, 5, 6], [1, 2, 3]], dtype=int)
```

3D:

```
arr = np.array([[[2, 4, 0, 6], [4, 7, 5, 6]],  
                [[0, 3, 2, 1], [9, 4, 5, 6]],  
                [[5, 8, 6, 4], [1, 4, 6, 8]]], dtype=int)
```

Initial array with built-in functions

zeros:

```
arr = np.zeros((3, 4), dtype=int)
```

ones:

```
arr = np.ones((2, 3, 4), dtype=int)
```

arange:

```
arr = np.arange(1, 7, 2)
```

full:

```
arr = np.full((2, 3), 5)
```

eye:

```
arr = np.eye(4, dtype=int)
```

random:

```
arr = np.random.random((2, 3))
```

Array information

dtype:

```
print(arr.dtype)
```

shape:

```
print(arr.shape)
```

size:

```
print(arr.size)
```

ndim:

```
print(arr.ndim)
```

Array indexing

Slicing:

```
arr = np.array([[1, 2, 3, 4],  
                [5, 6, 7, 8],  
                [9, 10, 11, 12]])  
print(arr[:2, 1:3])  
print(arr[0, 1])  
print(arr[1, :])  
print(arr[1:2, :])  
print(arr[:, 1])  
print(arr[:, 1:2])
```


Array indexing

Integer array indexing:

```
arr = np.array([[1, 2, 3, 4],  
                [5, 6, 7, 8],  
                [9, 10, 11, 12]])  
print(arr[[0, 1, 2], [0, 1, 0]])  
print(arr[[0, 0], [1, 1]])
```

Array indexing

Boolean array indexing:

```
arr = np.array([[1, 2, 3, 4],  
                [5, 6, 7, 8],  
                [9, 10, 11, 12]])  
print(arr[arr > 5])
```

Array Math

Add:

```
x = np.array([[1, 2], [3, 4]], dtype=np.float64)
y = np.array([[5, 6], [7, 8]], dtype=np.float64)
print(x + y)
print(np.add(x, y))
```

Subtract:

```
x = np.array([[1, 2], [3, 4]], dtype=np.float64)
y = np.array([[5, 6], [7, 8]], dtype=np.float64)
print(x - y)
print(np.subtract(x, y))
```

Array Math

Multiply:

```
x = np.array([[1, 2], [3, 4]], dtype=np.float64)
y = np.array([[5, 6], [7, 8]], dtype=np.float64)
print(x * y)
print(np.multiply(x, y))
```

Divide:

```
x = np.array([[1, 2], [3, 4]], dtype=np.float64)
y = np.array([[5, 6], [7, 8]], dtype=np.float64)
print(x / y)
print(np.divide(x, y))
```

Array Math

Square:

```
x = np.array([[1, 2], [3, 4]], dtype=np.float64)
y = np.array([[5, 6], [7, 8]], dtype=np.float64)
print(np.sqrt(x))
```

Dot:

```
x = np.array([[1, 2], [3, 4]], dtype=np.float64)
y = np.array([[5, 6], [7, 8]], dtype=np.float64)
print(x.dot(y))
print(np.dot(x, y))
```

Array Math

Sum:

```
x = np.array([[1, 2], [3, 4]], dtype=np.float64)
y = np.array([[5, 6], [7, 8]], dtype=np.float64)
print(x.sum())
print(np.sum(x))
print(x.sum(axis=0))
print(np.sum(x, axis=0))
print(x.sum(axis=1))
print(np.sum(x, axis=1))
```

Array Math

Max:

```
x = np.array([[1, 2], [3, 4]], dtype=np.float64)
print(x.max())
print(np.max(x))
print(x.max(axis=0))
print(np.max(x, axis=0))
print(x.max(axis=1))
print(np.max(x, axis=1))
```

Array Math

Min:

```
x = np.array([[1, 2], [3, 4]], dtype=np.float64)
print(x.min())
print(np.min(x))
print(x.min(axis=0))
print(np.min(x, axis=0))
print(x.min(axis=1))
print(np.min(x, axis=1))
```


Array Math

Mean:

```
x = np.array([[1, 2], [3, 4]], dtype=np.float64)
print(x.mean())
print(np.mean(x))
print(x.mean(axis=0))
print(np.mean(x, axis=0))
print(x.mean(axis=1))
print(np.mean(x, axis=1))
```

Array Math

Median:

```
x = np.array([[1, 2], [3, 4]], dtype=np.float64)
print(np.median(x))
print(np.median(x, axis=0))
print(np.median(x, axis=1))
```

Transposition:

```
x = np.array([1, 2, 3, 4], dtype=np.float64)
y = np.array([[5, 6], [7, 8]], dtype=np.float64)
print(x.T)
print(y.T)
```

Array Math

Absolute:

```
x = np.array([[10, 2, 50],  
              [-3, 0, 9],  
              [11, 6, -20]], dtype=np.int64)  
print(np.abs(x))  
print(np.absolute(x))
```

Other functions

Concatenation:

```
x = np.array([[1, 2], [3, 4]], dtype=np.float64)
y = np.array([[5, 6], [7, 8]], dtype=np.float64)
print(np.concatenate([x, y], axis=0))
print(np.concatenate([x, y], axis=1))
```

Split:

```
x = np.array([10, 2, 50, -3, 0, 9, 11, 6], dtype=np.int64)
print(np.split(x, [2, 5]))
```

Other functions

Sort:

```
x = np.array([[10, 2, 50],  
              [-3, 0, 9],  
              [11, 6, -20]], dtype=np.int64)  
print(np.sort(x, axis=0))  
print(np.sort(x, axis=1))  
print(np.sort(x, axis=None))
```

Count:

```
x = np.array([10, 2, 50, -3, 0, 9, 11, 6], dtype=np.int64)  
print(np.count_nonzero(x))  
print(np.count_nonzero(x > 3))
```

Other functions

Sort:

```
x = np.array([[10, 2, 50],  
              [-3, 0, 9],  
              [11, 6, -20]], dtype=np.int64)  
print(np.sort(x, axis=0))  
print(np.sort(x, axis=1))  
print(np.sort(x, axis=None))
```

Sin, Cosin, Logarit, Reduce, Variance, Standard deviation

Bitwise: and, or, xor, not