Python For Data Science Cheat Sheet

NumPy Basics

Learn Python for Data Science Interactively

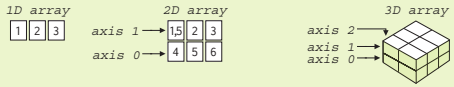
NumPy

The NumPy library is the core library for scientific computing in Python. It provides a high-performance multidimensional array object, and tools for working with these arrays.

Use the following import convention:

```
>>> import numpy as np
```

NumPy Arrays



Creating Arrays

```
>>> a = np.array([1,2,3])
>>> b = np.array([(1.5,2,3), (4,5,6)], dtype = float)
>>> c = np.array([[(1.5,2,3), (4,5,6)], [(3,2,1), (4,5,6)]],
                 dtype = float)
```

Initial Placeholders

```
>>> np.zeros((3,4))                  Create an array of zeros
>>> np.ones((2,3,4),dtype=np.int16)  Create an array of ones
>>> d = np.arange(10,25,5)           Create an array of evenly
                                     spaced values (step value)
>>> np.linspace(0,2,9)               Create an array of evenly
                                     spaced values (number of
                                     samples)
>>> e = np.full((2,2),7)             Create a constant array
>>> f = np.eye(2)                    Create a 2X2 identity matrix
>>> np.random.random((2,2))          Create an array with random
                                     values
>>> np.empty((3,2))                  Create an empty array
```

I/O

Saving & Loading On Disk

```
>>> np.save('my_array', a)
>>> np.savez('array.npz', a, b)
>>> np.load('my_array.npy')
```

Saving & Loading Text Files

```
>>> np.loadtxt("myfile.txt")
>>> np.genfromtxt("my_file.csv", delimiter=',')
>>> np.savetxt("myarray.txt", a, delimiter=" ")
```

Data Types

```
>>> np.int64      Signed 64-bit integer types
>>> np.float32    Standard double-precision floating point
>>> np.complex    Complex numbers represented by 128 floats
>>> np.bool       Boolean type storing TRUE and FALSE values
>>> np.object     Python object type
>>> np.string_    Fixed-length string type
>>> np.unicode_   Fixed-length unicode type
```

Inspecting Your Array

```
>>> a.shape       Array dimensions
>>> len(a)        Length of array
>>> b.ndim        Number of array dimensions
>>> e.size        Number of array elements
>>> b.dtype       Data type of array elements
>>> b.dtype.name  Name of data type
>>> b.astype(int) Convert an array to a different type
```

Asking For Help

```
>>> np.info(np.ndarray.dtype)
```

Array Mathematics

Arithmetic Operations

```
>>> g = a - b                        Subtraction
    array([[-0.5, 0. , 0. ],
           [-3. , -3. , -3. ]])
>>> np.subtract(a,b)                 Subtraction
>>> b + a                            Addition
    array([[ 2.5, 4. , 6. ],
           [ 5. , 7. , 9. ]])
>>> np.add(b,a)                      Addition
>>> a / b                            Division
    array([[ 0.66666667, 1. , 1. ],
           [ 0.25 , 0.4 , 0.5 ]])
>>> np.divide(a,b)                   Division
>>> a * b                            Multiplication
    array([[ 1.5, 4. , 9. ],
           [ 4. , 10. , 18. ]])
>>> np.multiply(a,b)                 Multiplication
>>> np.exp(b)                        Exponentiation
>>> np.sqrt(b)                       Square root
>>> np.sin(a)                        Print sines of an array
>>> np.cos(b)                        Element-wise cosine
>>> np.log(a)                        Element-wise natural logarithm
>>> e.dot(f)                         Dot product
    array([[ 7., 7.],
           [ 7., 7.]])
```

Comparison

```
>>> a == b                           Element-wise comparison
    array([[False, True, True],
           [False, False, False]], dtype=bool)
>>> a < 2                            Element-wise comparison
    array([True, False, False], dtype=bool)
>>> np.array_equal(a, b)             Array-wise comparison
```

Aggregate Functions

```
>>> a.sum()                          Array-wise sum
>>> a.min()                          Array-wise minimum value
>>> b.max(axis=0)                    Maximum value of an array row
>>> b.cumsum(axis=1)                 Cumulative sum of the elements
>>> a.mean()                         Mean
>>> b.median()                       Median
>>> a.corrcoef()                     Correlation coefficient
>>> np.std(b)                        Standard deviation
```

Copying Arrays

```
>>> h = a.view()     Create a view of the array with the same data
>>> np.copy(a)       Create a copy of the array
>>> h = a.copy()     Create a deep copy of the array
```

Sorting Arrays

```
>>> a.sort()         Sort an array
>>> c.sort(axis=0)   Sort the elements of an array's axis
```

Subsetting, Slicing, Indexing

Also see Lists

Subsetting

```
>>> a[2]                             Select the element at the 2nd index
    3
>>> b[1,2]                           Select the element at row 1 column 2
    6.0                              (equivalent to b[1][2])
```

Slicing

```
>>> a[0:2]                           Select items at index 0 and 1
    array([1, 2])
>>> b[0:2,1]                         Select items at rows 0 and 1 in column 1
    array([ 2., 5.])
>>> b[:1]                            Select all items at row 0
    array([[1.5, 2., 3.]])           (equivalent to b[0:1, :])
>>> c[1,...]                         Same as [1,:,:]
    array([[[ 3., 2., 1.],
            [ 4., 5., 6.]]])
>>> a[ : :-1]                        Reversed array a
    array([3, 2, 1])
```

Boolean Indexing

```
>>> a[a<2]                           Select elements from a less than 2
    array([1])
```

Fancy Indexing

```
>>> b[[1, 0, 1, 0],[0, 1, 2, 0]]    Select elements (1,0),(0,1),(1,2) and (0,0)
    array([ 4. , 2. , 6. , 1.5])
>>> b[[1, 0, 1, 0]][:,[0,1,2,0]]    Select a subset of the matrix's rows
    array([[4. , 5., 6., 4.],        and columns
           [1.5, 2., 3., 1.5],
           [4., 5,. 6,. 4. ],
           [1.5, 2., 3., 1.5]])
```

Array Manipulation

Transposing Array

```
>>> i = np.transpose(b)              Permute array dimensions
>>> i.T                              Permute array dimensions
```

Changing Array Shape

```
>>> b.ravel()                        Flatten the array
>>> g.reshape(3,-2)                  Reshape, but don't change data
```

Adding/Removing Elements

```
>>> h.resize((2,6))                  Return a new array with shape (2,6)
>>> np.append(h,g)                   Append items to an array
>>> np.insert(a, 1, 5)               Insert items in an array
>>> np.delete(a,[1])                 Delete items from an array
```

Combining Arrays

```
>>> np.concatenate((a,d),axis=0)     Concatenate arrays
    array([ 1, 2, 3, 10, 15, 20])
>>> np.vstack((a,b))                 Stack arrays vertically (row-wise)
    array([[ 1. , 2. , 3. ],
           [ 1.5, 2. , 3. ],
           [ 4. , 5. , 6. ]])
>>> np.r_[e,f]                       Stack arrays vertically (row-wise)
>>> np.hstack((e,f))                 Stack arrays horizontally (column-wise)
    array([[ 7., 7., 1., 0.],
           [ 7., 7., 0., 1.]])
>>> np.column_stack((a,d))           Create stacked column-wise arrays
    array([[ 1, 10],
           [ 2, 15],
           [ 3, 20]])
>>> np.c_[a,d] C                     reate stacked column-wise arrays
```

Splitting Arrays

```
>>> np.hsplit(a,3)                   Split the array horizontally at the 3rd
    [array([1]),array([2]),array([3])] index
>>> np.vsplit(c,2)                   Split the array vertically at the 2nd
    [array([[[ 1.5, 2. , 1. ],       index
            [ 4. , 5. , 6. ]]]),
     array([[[ 3., 2., 3.],
             [ 4., 5., 6.]]])]
```