SCALER

NUMPY CHEAT-SHEET

1 IMPORT CONVENTION

```
import numpy as np
```

2 WHY NUMPY ?

- supports element wise **operation + vectorization**

`arr = np.array ([1, 2, 3, 4])`
  - output: *array([1, 2, 3, 4])*

`arr*2`
  - output: *array([2,4,6,8])*

- faster execution speed

python list (took **300 milli sec** for squaring elements)

```
l = range(1000000)
```

```
%timeit [i**2 for i in l]
```

```
339 ms ± 14.8 ms per loop (mean ± std. dev. of 7 runs, 1 loop each)
```

Numpy array (took **2 ms**)

- Numpy internally uses C arrays

```
l = np.array(range(1000000))
```

```
%timeit l**2
```

```
2.92 ms ± 418 µs per loop (mean ± std. dev. of 7 runs, 100 loops each)
```

3 INITIALIZING ARRAY

Initializing array using python list	`arr1= np.array ([4,11,53,2,9])`
	`type(arr1)`
	`> numpy.ndarray`

Creates 2-D array of float data type array	`arr2 = np.array([[2,7,11],[4,8,2]]`
	`,type= float)`
	`# array([1.,2.,3.], [4.,5.,6.]])`

Initializing numpy array range. Similar to python range().
 	
Step size can be float.
	`arr3 = np.arange(stop= 5)`
	`# array([0,1,2,3,4])`
	
	`arr4 = np.arange(start = 2,`
	`stop = 10,step = 1.5)`
	`# array([2.,3.5,5.,6.5,8.,9.5])`

Returns evenly spaced numbers over specified interval	`np.linspace(start = 0,`
	`stop = 100,num =5)`
	`# array([0,25.,50.,75.,100.])`
	
	`np.linspace(0, 10, 5)`
	`# array([0.,2.5,5.,7.5,10.])`

Creates an array with all elements as 0
 	
similar func: **np.ones()**
	`zero_arr = np.zeros(3)`
	`# array([0., 0., 0.])`
	
	`zero_arr_2d= np.zeros((2,3))`
	`# array([[0., 0., 0.],`
	`[0., 0., 0.]])`

Generates array with elements belonging to continuous uniform distribution Range: [0, 1]	`np.random.rand(3, 2)`
	
	`# array([[0.81595852,0.59222987],`
	`[0.30536743,0.27175429],`
	`[0.03835455,0.27976716]])`

4 PROPERTIES OF ARRAY

number of dimensions of the array.	`arr.ndim`
	`arr1.ndim  # returns 1`
	`arr2.ndim  # returns 2`

shape of Array	`arr.shape`
	`arr1.shape  # returns (5, )`
	`arr2.shape  # returns (2, 3)`

datatype of array	`arr.dtype` `arr1.dtype  # returns int64`

5 ACCESSING ELEMENTS

· Accessing Single element (Indexing)

access element present at that index. Index start from 0	`arr1[2]  # returns 53` `arr2[1, 2] # returns 6`
Negative index based indexing	`arr1[-1]` `# returns 6`

· Accessing Sequence(Slicing)

Slice out and get part of the numpy array. Can use negative indexes for slicing as well.
 	
Slicing returns View not copy.
	`arr1[3:] # returns [2,9]`
	`arr1[:4] # returns [4,11,53,2]`
	`arr[1: 4: 2]`
	`#returns array([11,2])`
	`arr1[-4: -1] # returns [11,53,2]`

	`arr2[:, 1]`
	`# fetches first row`
	`# [[2., 7. , 11.]]`
	`arr2[:, 2:]`
	`# fetches third column`
	`# [[11.],[2. ]]`

· Accessing based on condition (Masking)

Indexing based on condition.Masking creates a copy of the array not a view.	`arr1[arr1 > 8]`
	`# returns [11, 53, 9]`
	`arr1[(arr1 >5) & (arr1 <=11)]`
	`# returns [11, 9]`

6 OPERATIONS

· Arithmetic

```
a = np.array([1, 2, 3, 4])
b = np.array([1, 1, 2, 2])
```

Element wise Addition	`a + b [or np.add (a,b)]` `# [2, 3, 5, 6]`
Element wise Subtraction	`a - b [or np.subtract(a,b)]` `# [0, 1, 1, 2]`
Element wise Multiplication	`a * b [or np.multiply(a,b)]` `# [1, 2, 6, 8]`
Element wise Division	`a/b [or np.divide(a, b)]` `# [1., 2., 1.5., 2.]`

· Comparison

Element wise comparison Returns bool array	`a==b, a>=b, a<=b`
Array wise equality Returns True/False	`np.array_equal(a, b)`

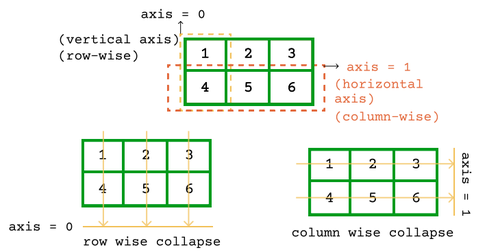
· Matrix Multiplication

```
mat1 = np.array([[2], [1]])
mat2 = np.array([[2, 4]])
```

Returns matrix mul. of arrays provided the condition for matrix multiplication is satisfied.	`np.matmul(mat1, mat2)`
	`# array([[4, 8],[2, 4]])`
	
	`mat1 @ mat2`
	`# array([[4, 8],[2, 4]])`

inputs are 2D.
Other cases for np.dot():
 	
Case1: It performs dot product if both inputs are scalar
 	
Case2: Perform simple multiplication if both inputs are scalars
	`np.dot(mat1, mat2)`
	`# returns [[4,8],[2,4]]`
	
	`np.dot(a, b)`
	`# [2,4,6] <= 1*2+2*2+3*2`
	
	`np.dot(2, 3)`
	`# returns 6`

7 AXIS



8 BROADCASTING

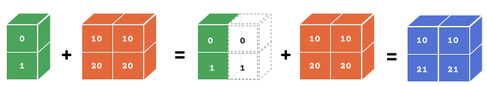
For each dimension (going from right side)
1. The size of each dimension should be same OR
2. The size of one dimension should be 1

RULE 1 : If two arrays differ in the number of dimensions, the shape of one with fewer dimensions is padded with ones on its leading(Left Side).

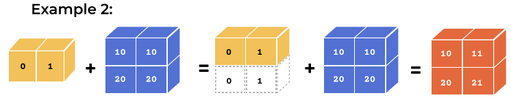
RULE 2 : If the shape of two arrays does not match in any dimensions, the array with shape equal to 1 is stretched to match the other shape i.e. broadcasted.

RULE 3 : If in any dimension the sizes disagree and neither equal to 1 , then Error is raised.

Example 1:



Example 2:



Example 3:

```
arr1 shape = (2, 4)
arr2 shape = (4, 4)
arr1 + arr2 shape = error # RULE 3
```

Example 4:

```
arr1 shape = (15, 3, 5)
arr2 shape = (3, 1)
arr1 + arr2 shape = (15, 3, 5) # RULE1 + RULE2
```

9 ARRAY MANIPULATION

· Reshaping

```
array3d = np.array([[[1 , 2]], [[5, 6]]])
```

Reshapes the array
Can use -ve index in reshape
	`array3d.reshape(2, 2)`
	`# returns [[1, 2],[5, 6]]`
	
	`arr5.reshape(2, -1)`
	`# [[1, 2],[5, 6]]`

Returns a flattened array i.e. 1D array. Returns copy of array	`array3d.flatten()` `#returns array([1,2,5,6])`
Returns a flattened array. Returns view of array	`array3d.ravel()`

Transposes the array	`reshaped_arr.T`
	
	`np.transpose(array3d,`
	`axis = [2, 1, 0])`
	`# array([[[1,5]],[[2,6]]])`

· Sorting

Sorts original array. Doesn't return anything	`arr2.sort()`

Returns sorted array. Doesn't make changes to original array	`np.sort(arr)`
	`# array([[2.,7.,11.],`
	`[2.,4.,8. ]])`

Sorts array row wise i.e. along the vertical axis
Sorts array along the horizontal axis i.e. column wise
	`np.sort(arr, axis = 0)`
	`# array([[2.,7.,2. ],`
	`[4.,8.,11.]])`
	`np.sort(arr, axis = 1)`
	`# array([[2.,7.,11.],`
	`[2.,4.,8. ]])`

Returns indices that would sort the array	`np.argsort(arr)` `# [4, 0, 3, 1, 2]`

· Splitting

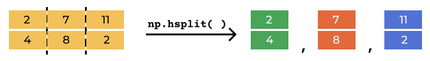
· **np.split( )** : Split array into multiple sub arrays

```
np.split(arr, indices_or_sections= 2)
# [array([1,2]),array([3,4])]

np.split(arr, indices_or_sections = [1,3])
# [array([1]), array([2, 3]), array([4])]
```

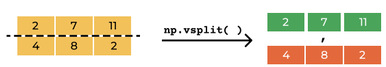

· **np.hsplit( )** : Split along horizontal axis i.e. column wise

```
np.hsplit(arr2, [1,2])
# [array([[2.],[4.]]), array([[7.], [8.]]),
array([[11.], [ 2.]])]
```



· **np.vsplit( )** :Split along vertical axis i.e. row wise

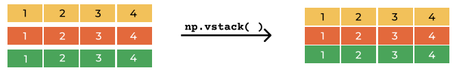
```
np.vsplit(arr2, 2)
# [array([[2.,7.,11.]]), array([[4.,8.,2.]])]
```



· Merging

· **np.vstack()** :Stacks array vertically ie. row wise append (axis = 0)

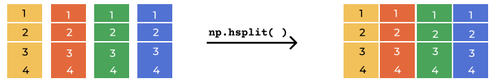
```
np.vstack()
np.vstack((arr, arr, arr))
# [[1, 2, 3, 4],[1, 2, 3, 4],[1, 2, 3, 4]]
```



· **np.hstack()** :Stacks array horizontally i.e. column wise append (axis = 1)

```
np.hstack()
arr6 = arr.reshape(4,1)
# [[1],[2],[3],[4]]

np.hstack((arr6, arr6, arr6))
# [[1, 1, 1],[2, 2, 2],[3, 3, 3],[4, 4, 4]]
```



· **np.concatenate()** : Concatenate two or more array along the given axis

```
np.concatenate([arr, arr])
# [1, 2, 3, 4, 1, 2, 3, 4]

arr_2d = arr.reshape(1,-1)
np.concatenate([arr,arr], axis=0)
#[[1,2,3,4], [1,2,3,4]]

np.concatenate([arr,arr], axis=1)
array([[1,2,3,4,1,2,3,4]])
```

10 ARGUMENT BASED FUNCTION

Get indices of non zero elements	`np.argwhere(arr1)` `# array([[0],[1],[2],[3],[4]])`

Get indices of minimum value. Other similar func: **np.argmax()**	`np.argmin(arr1)`
	`# returns 3`
	`np.argmin(arr2)`
	`# array([0, 0, 1])`

Returns indices that would sort the array	`np.argsort(arr)` `# array([3, 0, 4, 1, 2])`

11 UNIVERSAL FUNCTIONS

· Aggregate

Sums all the elements of array
 	
Sums the elements along the vertical axis(rowwise).
We can also take sum along horizontal axis (axis =1)
	`np.sum()`
	`np.sum(arr2)`
	`# returns 34.0`
	
	`np.sum(arr2,axis = 0)`
	`# returns [6.,15.,3.]`

Takes mean of all the elements of array
 	
Takes mean along the horizontal axis (column wise)
	`np.mean(arr2)`
	`# returns 5.666667`
	
	`np.mean(arr2, axis = 1)`
	`# [6.6667, 4.66667]`

Returns element with minimum value. Can also find mean row wise/ column wise using axis 0/1 Other similar func: np.max()	`np.min(arr2)` `# returns 2.0`

· Logical

Returns True if the any of the corresponding elements in the array follow provided condition	`np.any(arr1 < arr3)`
	
	`# returns True`

Returns True only if the all of the corresponding elements in the array follow provided condition	`np.all(arr1 < arr3)`
	
	`# returns False`

Vectorized if else over an array. Returns an array where value = x if the condition is True else y.	`np.where(condition =`
	`arr1 > 2,x = 1,y= 0)`
	
	`# array([1,1,1,0,1])`

12 COPYING ARRAY

Creates a copy of an array. Masking and array op creates copy.	`copy = arr1.copy()`
Creates View of an array. Slicing creates view	`view = arr1.view()`

13 MISC

Change the datatype of an array	`arr.astype(int)`