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## NumPy Operations

### Arithmetic

You can easily perform array with array arithmetic, or scalar with array arithmetic. Let's see some examples:

```
In [1]: import numpy as np
arr = np.arange(0,10)
```

```
In [2]: arr + arr
```

```
Out[2]: array([ 0,  2,  4,  6,  8, 10, 12, 14, 16, 18])
```

```
In [3]: arr * arr
```

```
Out[3]: array([ 0,  1,  4,  9, 16, 25, 36, 49, 64, 81])
```

```
In [4]: arr - arr
```

```
Out[4]: array([0, 0, 0, 0, 0, 0, 0, 0, 0, 0])
```

```
In [5]: # Warning on division by zero, but not an error!
# Just replaced with nan
arr/arr
```

```
/Users/marci/anaconda/lib/python3.5/site-packages/ipykernel/__main__.py:1: RuntimeWarning: invalid value encountered in true_divide
  if __name__ == '__main__':
```

```
Out[5]: array([ nan,  1.,  1.,  1.,  1.,  1.,  1.,  1.,  1.,  1.])
```

```
In [6]: # Also warning, but not an error instead infinity
1/arr
```

```
/Users/marci/anaconda/lib/python3.5/site-packages/ipykernel/__main__.py:1: RuntimeWarning: divide by zero encountered in true_divide
  if __name__ == '__main__':
```

```
Out[6]: array([          inf,  1.          ,  0.5          ,  0.33333333,  0.25          ,
                0.2          ,  0.16666667,  0.14285714,  0.125          ,  0.11111111])
```

```
In [10]: arr**3
```

```
Out[10]: array([ 0,  1,  8, 27, 64, 125, 216, 343, 512, 729])
```

## Universal Array Functions

Numpy comes with many [universal array functions](http://docs.scipy.org/doc/numpy/reference/ufuncs.html) (<http://docs.scipy.org/doc/numpy/reference/ufuncs.html>), which are essentially just mathematical operations you can use to perform the operation across the array. Let's show some common ones:

```
In [12]: #Taking Square Roots
np.sqrt(arr)
```

```
Out[12]: array([ 0.          ,  1.          ,  1.41421356,  1.73205081,  2.          ,
                2.23606798,  2.44948974,  2.64575131,  2.82842712,  3.          ])
```

```
In [13]: #Calculating exponential (e^)
np.exp(arr)
```

```
Out[13]: array([ 1.00000000e+00,  2.71828183e+00,  7.38905610e+00,
                2.00855369e+01,  5.45981500e+01,  1.48413159e+02,
                4.03428793e+02,  1.09663316e+03,  2.98095799e+03,
                8.10308393e+03])
```

```
In [14]: np.max(arr) #same as arr.max()
```

```
Out[14]: 9
```

```
In [15]: np.sin(arr)
```

```
Out[15]: array([ 0.          ,  0.84147098,  0.90929743,  0.14112001, -0.7568025 ,
                -0.95892427, -0.2794155 ,  0.6569866 ,  0.98935825,  0.41211849])
```

```
In [16]: np.log(arr)
```

```
/Users/marci/anaconda/lib/python3.5/site-packages/ipykernel/__main__.py:1: RuntimeWarning: divide by zero encountered in log
  if __name__ == '__main__':
```

```
Out[16]: array([          -inf,  0.          ,  0.69314718,  1.09861229,  1.38629436,
                1.60943791,  1.79175947,  1.94591015,  2.07944154,  2.19722458])
```

# Great Job!

That's all we need to know for now!