Module 02

Numpy Operations

Data Science Developer

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Outline

- Mathematical Numpy Operation Arithmetic
- Mathematical Numpy Operation Math Function

Artihmetics

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Arithmetic 1D Array

```
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])
```

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Arithmetic 1D Array

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

```
C:\Users\harto\Anaconda3\lib\site-packages\ipykernel_launcher.py:3: Ru
  This is separate from the ipykernel package so we can avoid doing im
```

```
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
```

```
C:\Users\harto\Anaconda3\lib\site-packages\ipykernel_launcher.py:2: Ru
```

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

```
In [7]: arr**3
```

```
Out[7]: array([  0,   1,   8,  27,  64, 125, 216, 343, 512, 729], dtype=int32)
```

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Arithmetic 2D Array

```
In [8]: matrix = np.arange(16).reshape(4,4)

In [9]: matrix
Out[9]: array([[ 0,  1,  2,  3],
               [ 4,  5,  6,  7],
               [ 8,  9, 10, 11],
               [12, 13, 14, 15]])

In [10]: matrix + matrix
Out[10]: array([[ 0,  2,  4,  6],
                [ 8, 10, 12, 14],
                [16, 18, 20, 22],
                [24, 26, 28, 30]])

In [11]: matrix * matrix
Out[11]: array([[  0,   1,   4,   9],
                [ 16,  25,  36,  49],
                [ 64,  81, 100, 121],
                [144, 169, 196, 225]])
```

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Arithmetic 2D Array

```
In [12]: matrix/matrix
```

```
C:\Users\muhyi\AppData\Local\Continuum\anaconda3\lib\site-packages\ipykernel_la
uncher.py:1: RuntimeWarning: invalid value encountered in true_divide
  """Entry point for launching an IPython kernel.
```

```
Out[12]: array([[nan,  1.,  1.,  1.],
                [ 1.,  1.,  1.,  1.],
                [ 1.,  1.,  1.,  1.],
                [ 1.,  1.,  1.,  1.]])
```

```
In [13]: 1/matrix
```

```
C:\Users\muhyi\AppData\Local\Continuum\anaconda3\lib\site-packages\ipykernel_la
uncher.py:1: RuntimeWarning: divide by zero encountered in true_divide
  """Entry point for launching an IPython kernel.
```

```
Out[13]: array([[       inf, 1.        , 0.5       , 0.33333333],
                [0.25      , 0.2       , 0.16666667, 0.14285714],
                [0.125     , 0.11111111, 0.1       , 0.09090909],
                [0.08333333, 0.07692308, 0.07142857, 0.06666667]])
```

```
In [14]: matrix**3
```

```
Out[14]: array([[   0,    1,    8,   27],
                [  64,  125,  216,  343],
                [ 512,  729, 1000, 1331],
                [1728, 2197, 2744, 3375]], dtype=int32)
```

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Array Function

Universal Array Functions

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]:
```
#Calcualting 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
```

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Universal Array Functions

```
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
  if __name__ == '__main__':

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

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Universal Array Functions

```
In [16]: np.exp(matrix)

Out[16]: 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, 2.20264658e+04, 5.98741417e+04],
                [1.62754791e+05, 4.42413392e+05, 1.20260428e+06, 3.26901737e+06]])

In [17]: np.max(matrix)

Out[17]: 15

In [18]: np.log(matrix)

C:\Users\muhyi\AppData\Local\Continuum\anaconda3\lib\site-packages\ipykernel_la
uncher.py:1: RuntimeWarning: divide by zero encountered in log
  """Entry point for launching an IPython kernel.

Out[18]: array([[      -inf, 0.        , 0.69314718, 1.09861229],
                [1.38629436, 1.60943791, 1.79175947, 1.94591015],
                [2.07944154, 2.19722458, 2.30258509, 2.39789527],
                [2.48490665, 2.56494936, 2.63905733, 2.7080502 ]])
```

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Logical

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Logical Expression for Numpy

```
In [21]: np.where(arr > 5, 1, arr)
Out[21]: array([0, 1, 2, 3, 4, 5, 1, 1, 1, 1])

In [22]: np.where(arr > 5, 1, 0)
Out[22]: array([0, 0, 0, 0, 0, 0, 1, 1, 1, 1])

In [23]: np.where(matrix <= 10, 0, matrix)
Out[23]: array([[ 0,  0,  0,  0],
                [ 0,  0,  0,  0],
                [ 0,  0,  0, 11],
                [12, 13, 14, 15]])

In [24]: np.where(matrix <= 10, 0, 1)
Out[24]: array([[0, 0, 0, 0],
                [0, 0, 0, 0],
                [0, 0, 0, 1],
                [1, 1, 1, 1]])
```

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