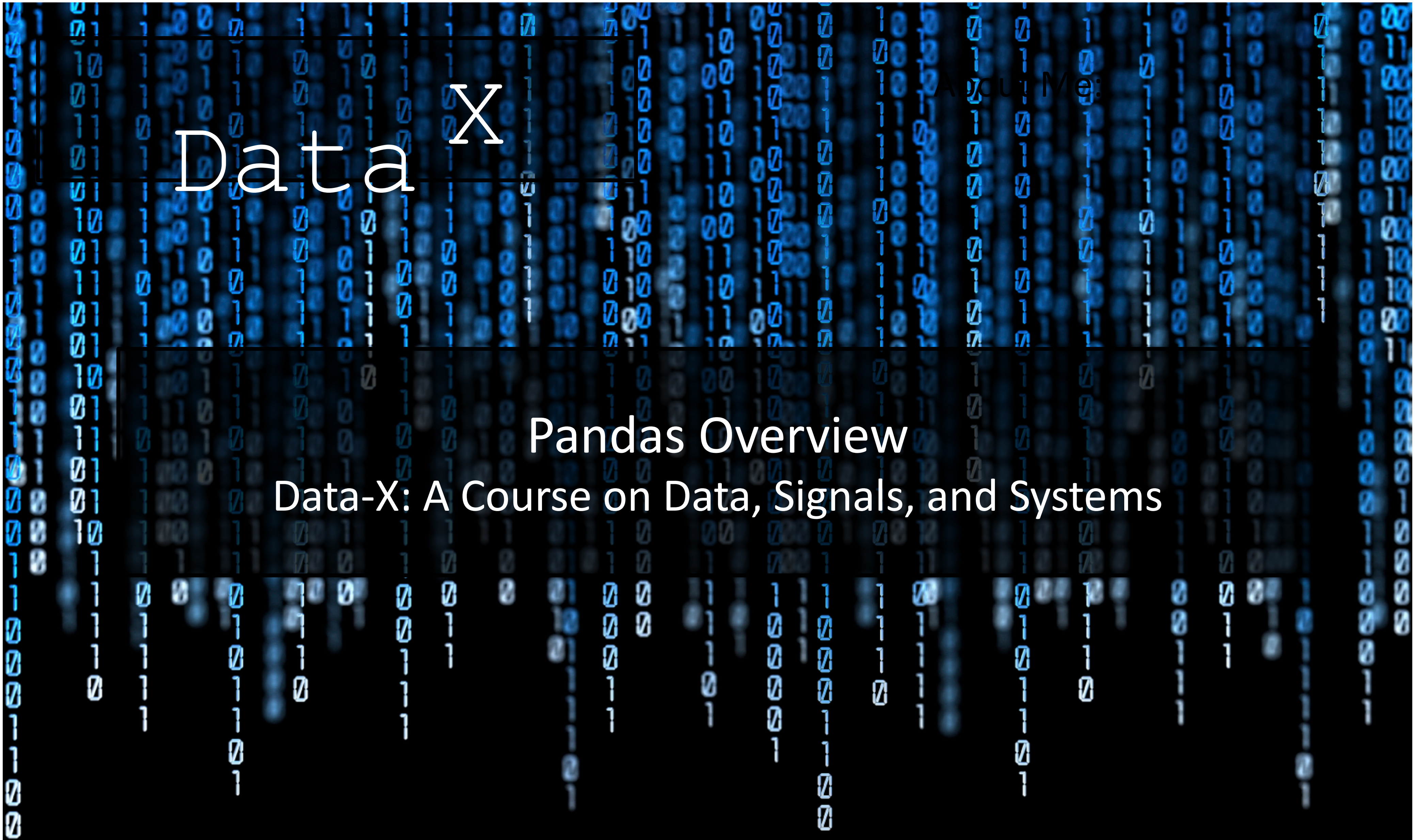

Data ^{X}

About Me:

Pandas Overview

Data-X: A Course on Data, Signals, and Systems

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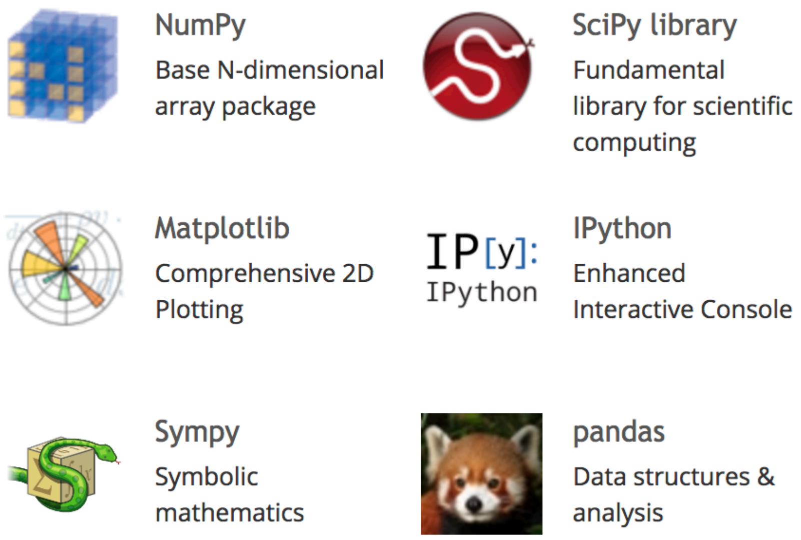
Chief Scientist & Founding Director,
Sutardja Center for Entrepreneurship & Technology
IEOR Emerging Area Professor Award, UC Berkeley

How Does Pandas Fit In?

- Python is great: easy to understand, compact, flexible – “duct tape of internet”
- Python was not originally built for data analytics
- Sci-Py extends to mathematics, science, and engineering



NumPy
Base N-dimensional array package

SciPy library
Fundamental library for scientific computing

Matplotlib
Comprehensive 2D Plotting

IPython
Enhanced Interactive Console

Sympy
Symbolic mathematics

pandas
Data structures & analysis

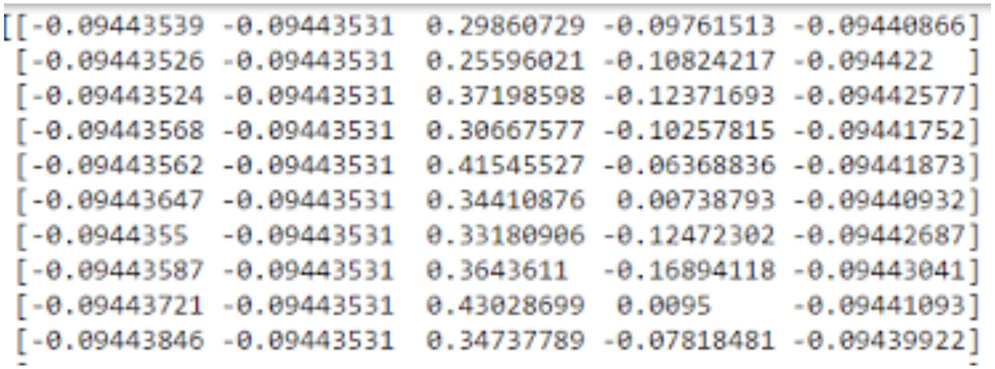
Numpy allows arrays and matrix math

Pandas provides a table structure

Pandas lets us construct tables, called Data Frames

With NumPy, we can store and manipulate a matrix

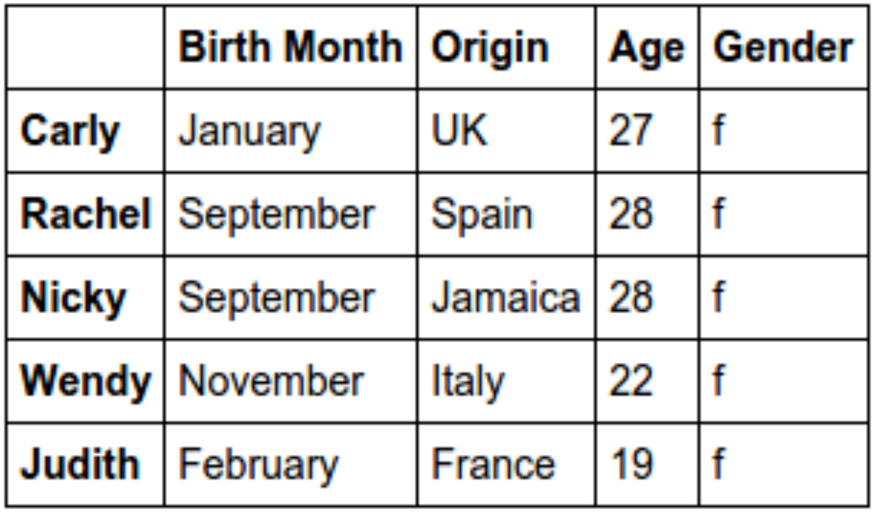
m =



```
[[-0.09443539 -0.09443531  0.29860729 -0.09761513 -0.09440866]
 [-0.09443526 -0.09443531  0.25596021 -0.10824217 -0.094422  ]
 [-0.09443524 -0.09443531  0.37198598 -0.12371693 -0.09442577]
 [-0.09443568 -0.09443531  0.30667577 -0.10257815 -0.09441752]
 [-0.09443562 -0.09443531  0.41545527 -0.06368836 -0.09441873]
 [-0.09443647 -0.09443531  0.34410876  0.00738793 -0.09440932]
 [-0.0944355  -0.09443531  0.33180906 -0.12472302 -0.09442687]
 [-0.09443587 -0.09443531  0.3643611  -0.16894118 -0.09443041]
 [-0.09443721 -0.09443531  0.43028699  0.0095     -0.09441093]
 [-0.09443846 -0.09443531  0.34737789 -0.07818481 -0.09439922]
```

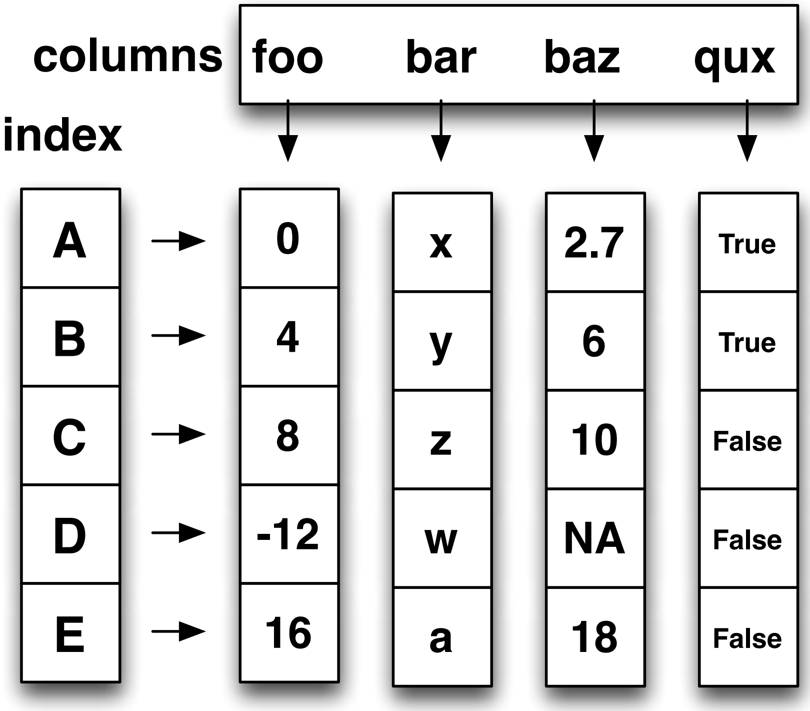
With Pandas, we can store and manipulate a full table

df =



	Birth Month	Origin	Age	Gender
Carly	January	UK	27	f
Rachel	September	Spain	28	f
Nicky	September	Jamaica	28	f
Wendy	November	Italy	22	f
Judith	February	France	19	f

Pandas has an object called a *Data Frame* which is like a table



index	foo	bar	baz	qux
A	0	x	2.7	True
B	4	y	6	True
C	8	z	10	False
D	-12	w	NA	False
E	16	a	18	False

- NumPy array-like
- Each column can have a different type
- Row and column index
- Size mutable: insert and delete columns

Wes Mckinney

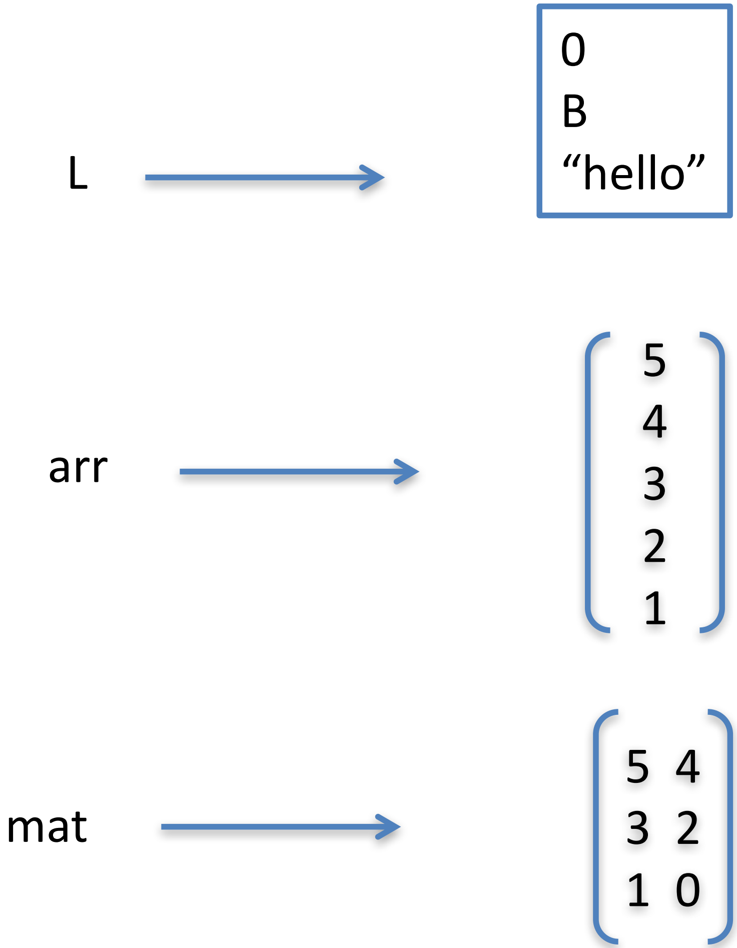
Data Structures - High Level

List:
L = [0, b, “hello”]
What is L2 = [0, b, (b,bat)]?

Numpy Array: (vector)
arr = np.array([5,4,3,2,1])

Numpy Array: (matrix)
mat =
np.array([[5,4],[3,2],[1,0]])

Using the Axis:
mat.sum(axis=0)
mat.min(axis=1)



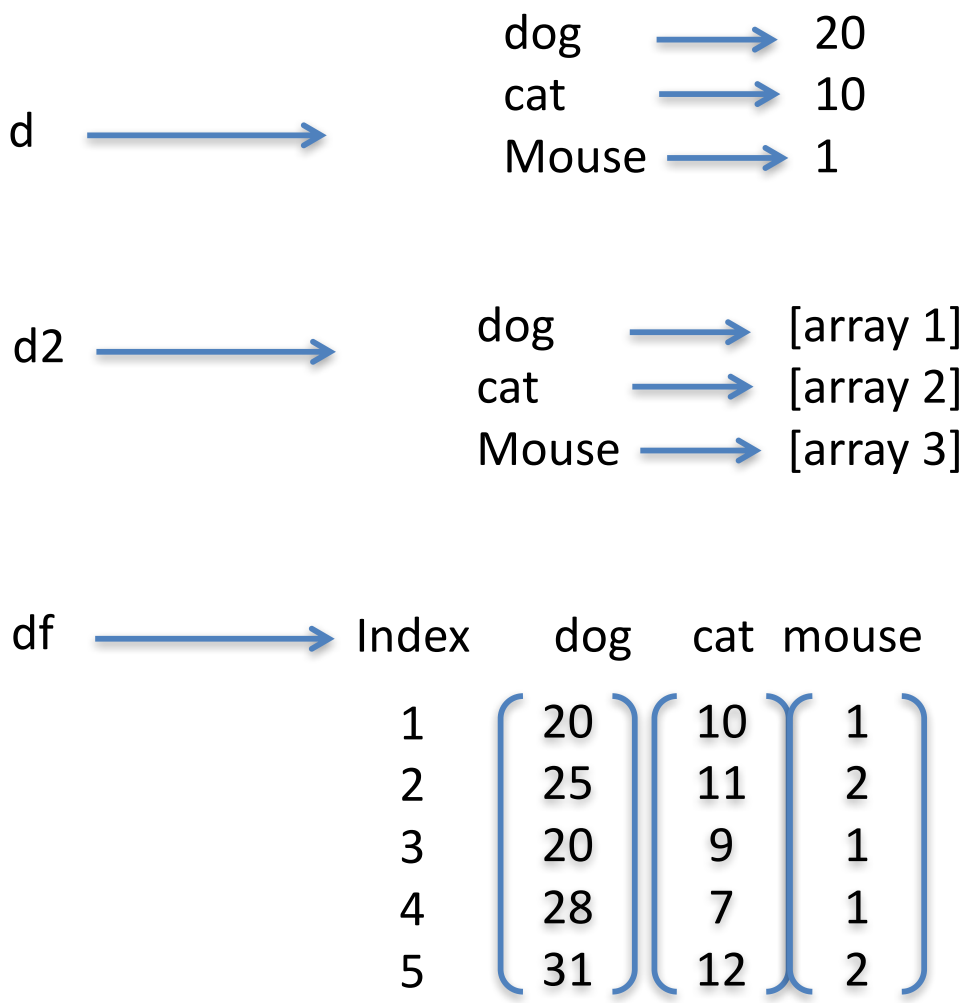
Data Structures - High Level

Dictionary:
d = { ‘dog’:20, ‘cat’:10, ‘mouse’:1}

What is d[‘cat’]?

Pandas Data Frame:
Made of Dictionary of ‘labels’ and numpy-like arrays called Series
d2 = { ‘dog’:ar1, ‘cat’:ar2, ‘mouse’:ar3}

df = pd.DataFrame(d2)
What is df[‘cat’]?



d → dog → 20
cat → 10
Mouse → 1

d2 → dog → [array 1]
cat → [array 2]
Mouse → [array 3]

df →

Index	dog	cat	mouse
1	20	10	1
2	25	11	2
3	20	9	1
4	28	7	1
5	31	12	2

* Actually made from the Series object in Pandas

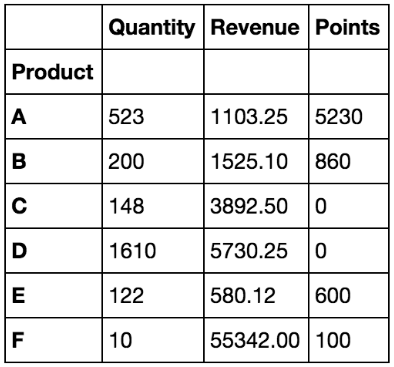
Code Example in Python Notebook

- Get Stock Data
- Use Pandas to get a CSV format
- Slice the Table
- Convert to Numpy Array Format
- Sample Numpy Operations

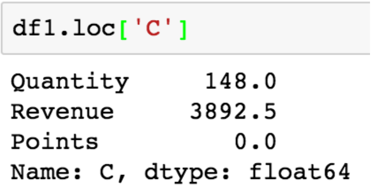
More topics in the 10 Min Guide to Pandas Notebook

Indexing

DF1



	Quantity	Revenue	Points
Product			
A	523	1103.25	5230
B	200	1525.10	860
C	148	3892.50	0
D	1610	5730.25	0
E	122	580.12	600
F	10	55342.00	100



```
df1.loc['C']
```

```
Quantity      148.0
Revenue      3892.5
Points          0.0
Name: C, dtype: float64
```

Computational Tools

- Covariance
  ```
  >>> s1 = Series(randn(1000))
  >>> s2 = Series(randn(1000))
  >>> s1.cov(s2)
  0.013973709323221539
  ```
- Also: pearson, kendall, spearman

Maik Röder

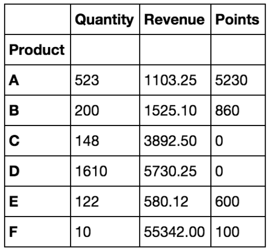
Descriptive statistics

```
>>> df.mean()
one       2.263617
two      -1.316694
three    -1.975041
```

- Also: count, sum, median, min, max, abs, prod, std, var, skew, kurt, quantile, cumsum, cumprod, cummax, cummin

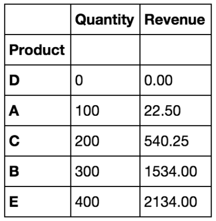
Maik Röder

Adding Pandas Tables



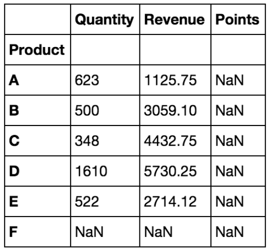
	Quantity	Revenue	Points
Product			
A	523	1103.25	5230
B	200	1525.10	860
C	148	3892.50	0
D	1610	5730.25	0
E	122	580.12	600
F	10	55342.00	100

+



	Quantity	Revenue
Product		
D	0	0.00
A	100	22.50
C	200	540.25
B	300	1534.00
E	400	2134.00

=



	Quantity	Revenue	Points
Product			
A	623	1125.75	NaN
B	500	3059.10	NaN
C	348	4432.75	NaN
D	1610	5730.25	NaN
E	522	2714.12	NaN
F	NaN	NaN	NaN

df_add = df1.add(df2, fill_value=0)

End of Section