UFRN
UNIVERSIDADE FEDERAL DO RIO GRANDE DO NORTE

IMD INSTITUTO METRÓPOLE DIGITAL

IMD0905 - Data Science I

Lesson #9 - Introduction to Pandas

Ivanovitch Silva
September, 2018

Agenda

- About the two core pandas types: dataframes and series
- How to select data using row and column labels
- A variety of methods for exploring data with pandas
- How to assign data using various techniques in pandas
- How to use boolean indexing with pandas for selection and assignment

Update the repository

```
git clone https://github.com/ivanovitchm/IMD0905_datascience_one.git
```

Or ….

```
git pull
```

Understanding Pandas & Numpy

- Numpy
  a. Lack support for column names
  b. Support for only one data type per ndarray
  c. There are lots of low level methods, however there are many common analysis patterns that don't have pre-built methods.

The pandas library provides solutions to all of these pain points and more. Pandas is not so much a replacement for NumPy as an extension of NumPy.

THE WORLD'S LARGEST CORPORATIONS

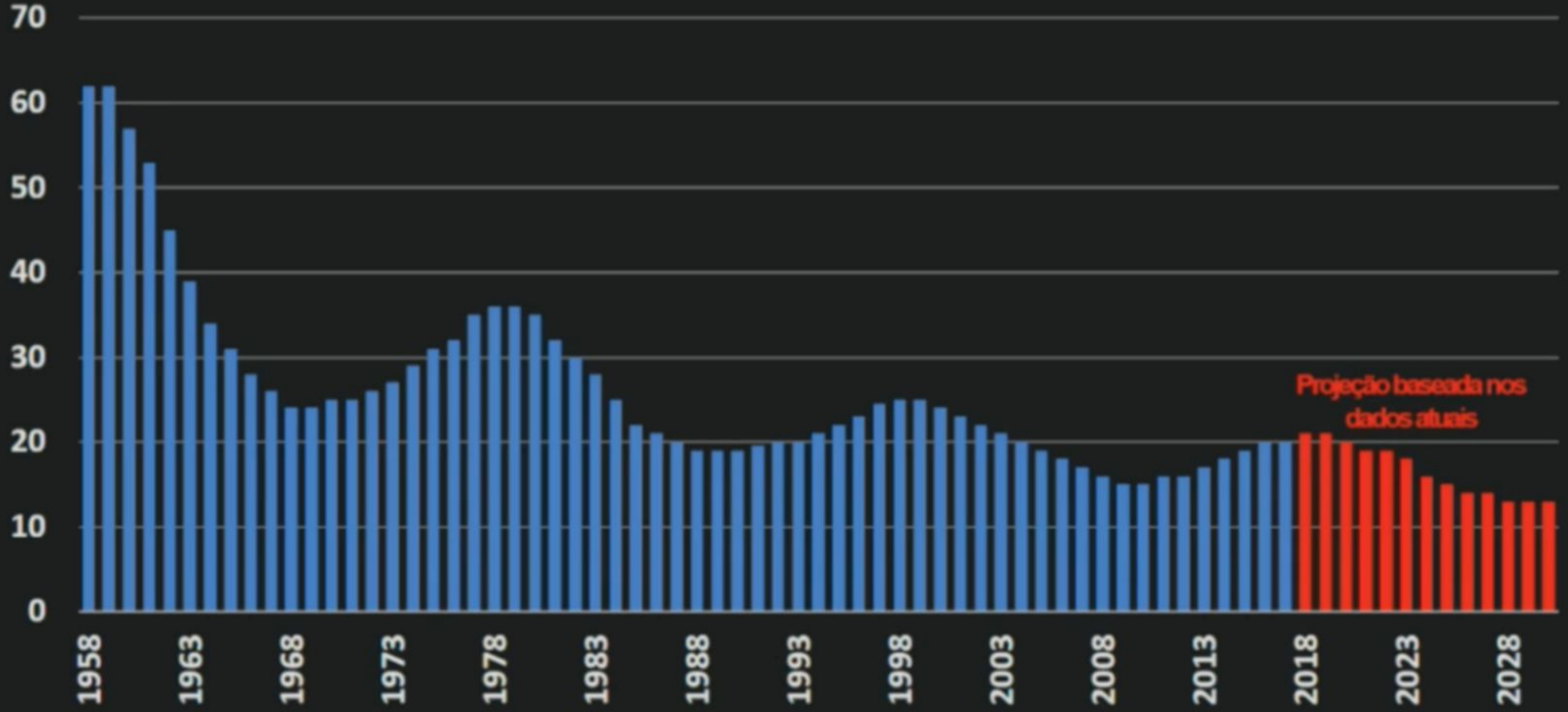
FORTUNE

GLOBAL

500

Tempo médio de permanência de uma empresa no S&P 500

(em anos)

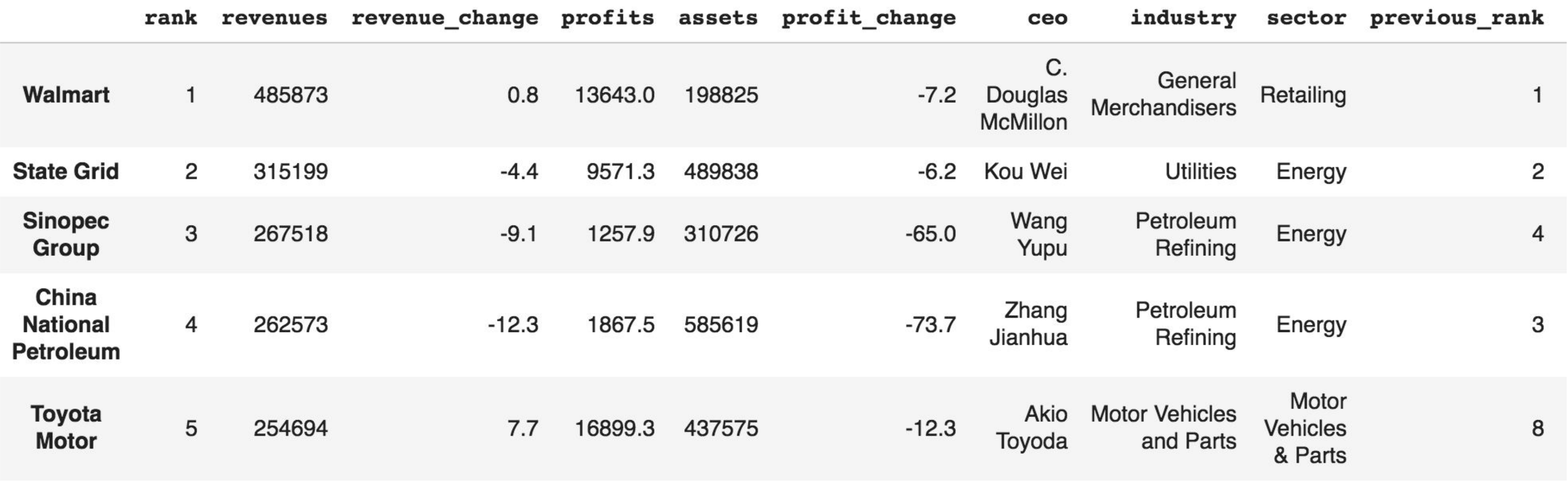


Fonte: INNOSIGHT, Richard N. Foster, Standard & Poor's

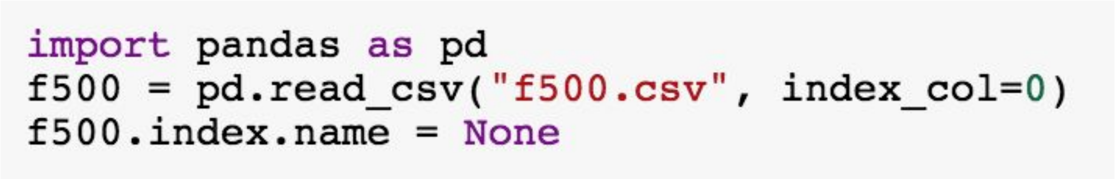
UMA EMPRESA DO S&P 500 ESTÁ SENDO SUBSTITUÍDA A CADA DUAS SEMANAS

Richard Foster

The dataset

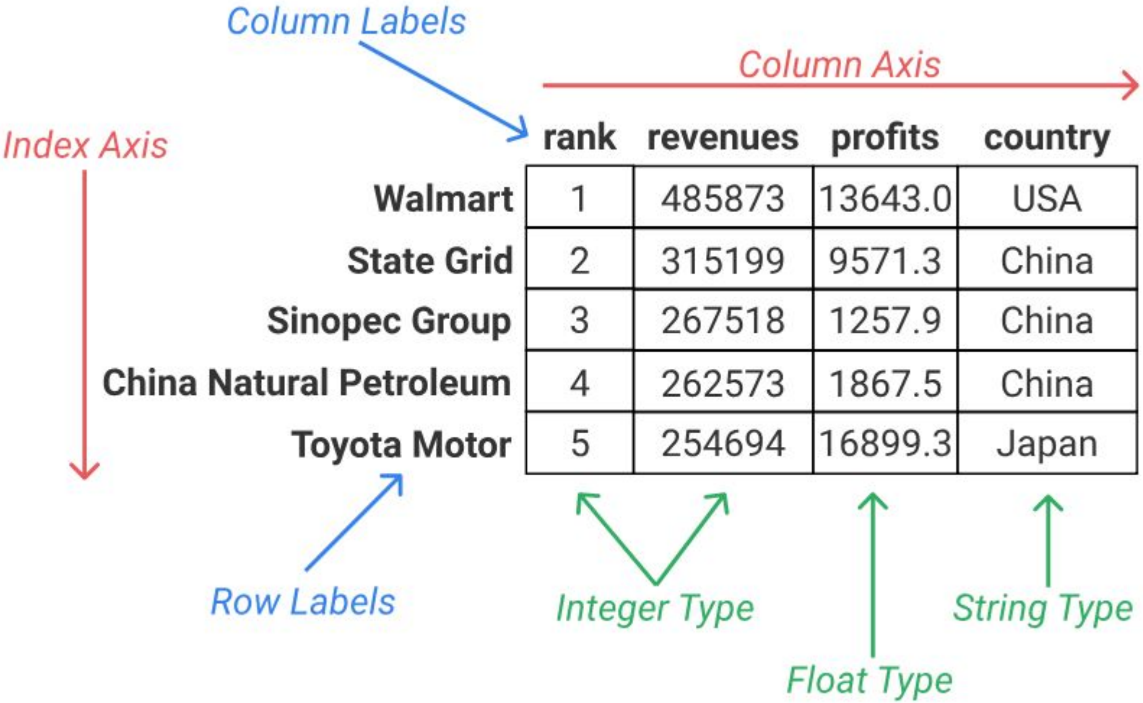


	rank	revenues	revenue_change	profits	assets	profit_change	ceo	industry	sector	previous_rank
Walmart	1	485873	0.8	13643.0	198825	-7.2	C. Douglas McMillon	General Merchandisers	Retailing	1
State Grid	2	315199	-4.4	9571.3	489838	-6.2	Kou Wei	Utilities	Energy	2
Sinopec Group	3	267518	-9.1	1257.9	310726	-65.0	Wang Yupu	Petroleum Refining	Energy	4
China National Petroleum	4	262573	-12.3	1867.5	585619	-73.7	Zhang Jianhua	Petroleum Refining	Energy	3
Toyota Motor	5	254694	7.7	16899.3	437575	-12.3	Akio Toyoda	Motor Vehicles and Parts	Motor Vehicles & Parts	8



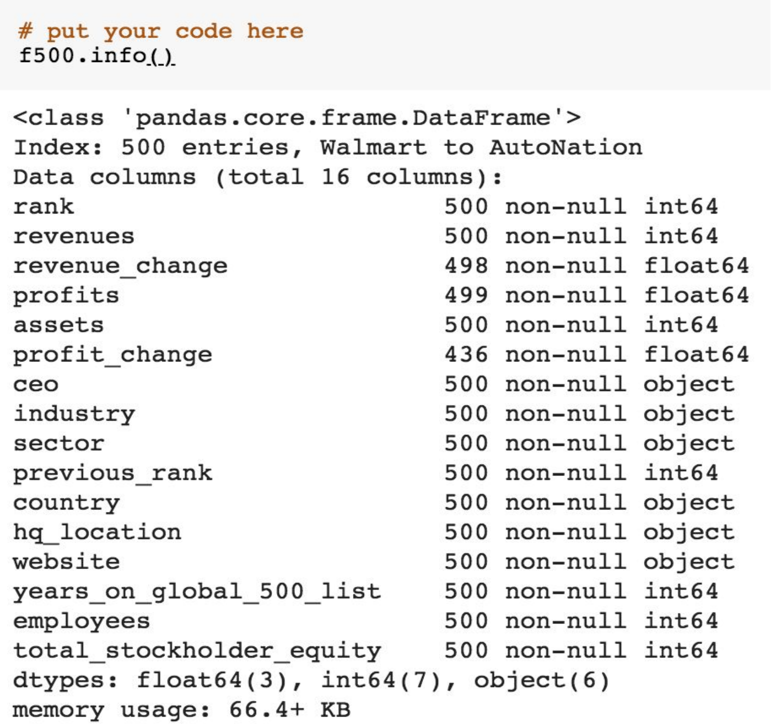
```
import pandas as pd
f500 = pd.read_csv("f500.csv", index_col=0)
f500.index.name = None
```

Introducing Dataframes



	rank	revenues	profits	country
Walmart	1	485873	13643.0	USA
State Grid	2	315199	9571.3	China
Sinopec Group	3	267518	1257.9	China
China Natural Petroleum	4	262573	1867.5	China
Toyota Motor	5	254694	16899.3	Japan

Introducing Dataframes



```
# put your code here
f500.info()
```

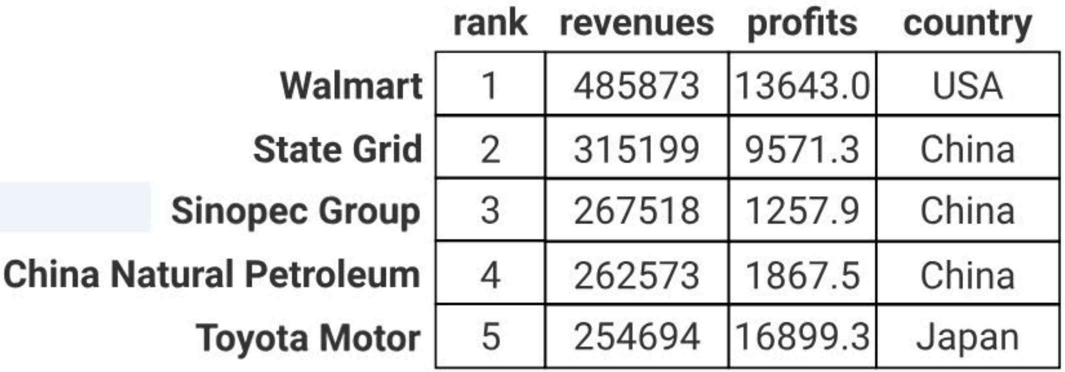
```
<class 'pandas.core.frame.DataFrame'>
Index: 500 entries, Walmart to AutoNation
Data columns (total 16 columns):
rank                        500 non-null int64
revenues                    500 non-null int64
revenue_change              498 non-null float64
profits                     499 non-null float64
assets                      500 non-null int64
profit_change               436 non-null float64
ceo                         500 non-null object
industry                    500 non-null object
sector                      500 non-null object
previous_rank               500 non-null int64
country                     500 non-null object
hq_location                 500 non-null object
website                     500 non-null object
years_on_global_500_list    500 non-null int64
employees                   500 non-null int64
total_stockholder_equity    500 non-null int64
dtypes: float64(3), int64(7), object(6)
memory usage: 66.4+ KB
```

f500.head()

f500.tail()

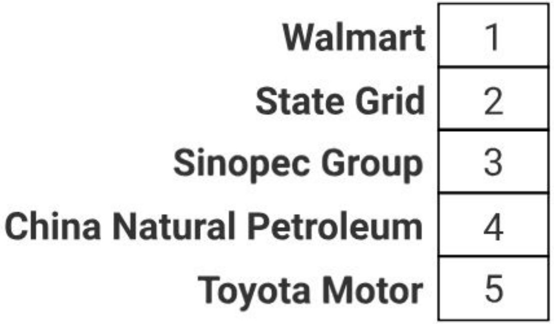
Selecting Columns From a Dataframe by label

```
f500_selection
```



	rank	revenues	profits	country
Walmart	1	485873	13643.0	USA
State Grid	2	315199	9571.3	China
Sinopec Group	3	267518	1257.9	China
China Natural Petroleum	4	262573	1867.5	China
Toyota Motor	5	254694	16899.3	Japan

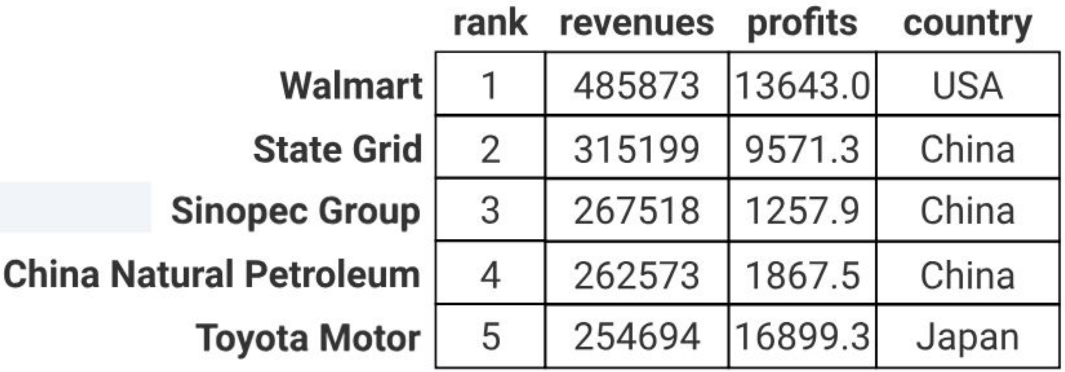
```
f500_selection.loc[:,"rank"]
```



Walmart	1
State Grid	2
Sinopec Group	3
China Natural Petroleum	4
Toyota Motor	5

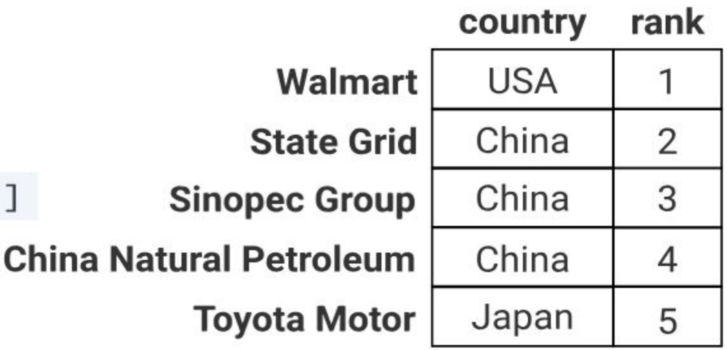
Selecting Columns From a Dataframe by label

```
f500_selection
```



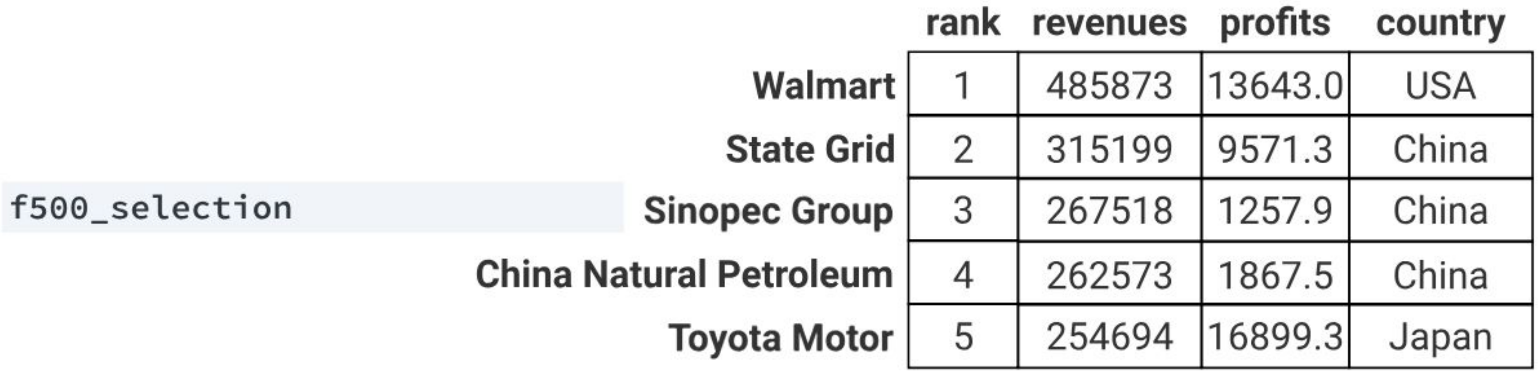
	rank	revenues	profits	country
Walmart	1	485873	13643.0	USA
State Grid	2	315199	9571.3	China
Sinopec Group	3	267518	1257.9	China
China Natural Petroleum	4	262573	1867.5	China
Toyota Motor	5	254694	16899.3	Japan

```
f500_selection.loc[:,["country","rank"]]
```



	country	rank
Walmart	USA	1
State Grid	China	2
Sinopec Group	China	3
China Natural Petroleum	China	4
Toyota Motor	Japan	5

Selecting Columns From a Dataframe by label



```
f500_selection
```

	rank	revenues	profits	country
Walmart	1	485873	13643.0	USA
State Grid	2	315199	9571.3	China
Sinopec Group	3	267518	1257.9	China
China Natural Petroleum	4	262573	1867.5	China
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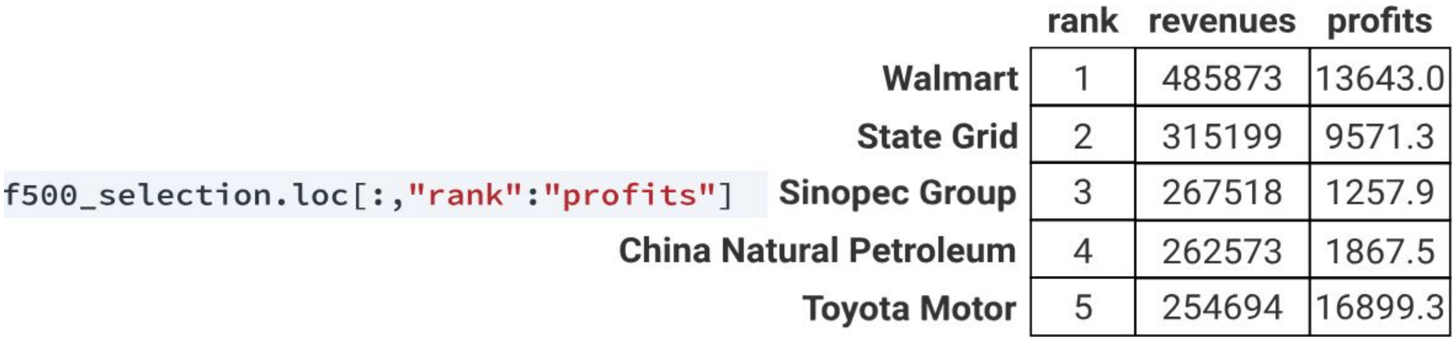
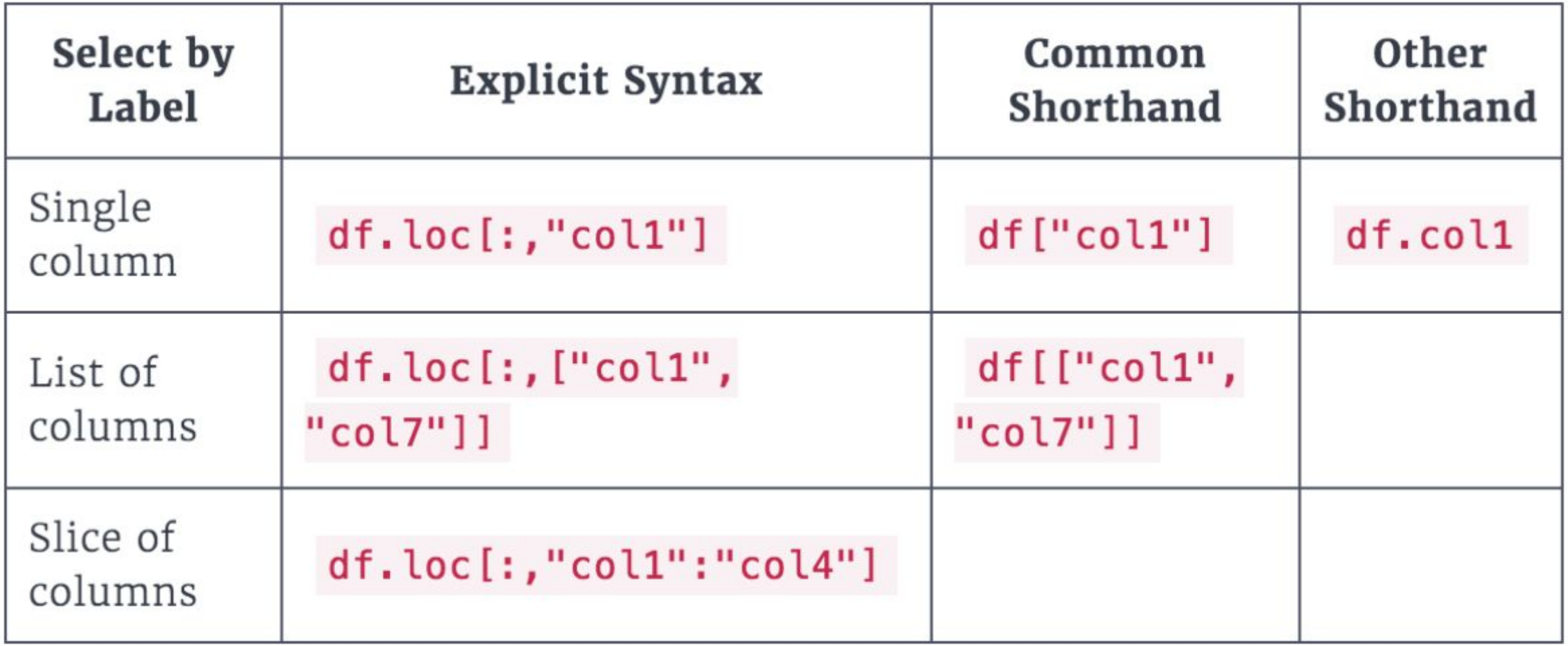


```
f500_selection.loc[:,"rank":"profits"]
```

	rank	revenues	profits
Walmart	1	485873	13643.0
State Grid	2	315199	9571.3
Sinopec Group	3	267518	1257.9
China Natural Petroleum	4	262573	1867.5
Toyota Motor	5	254694	16899.3

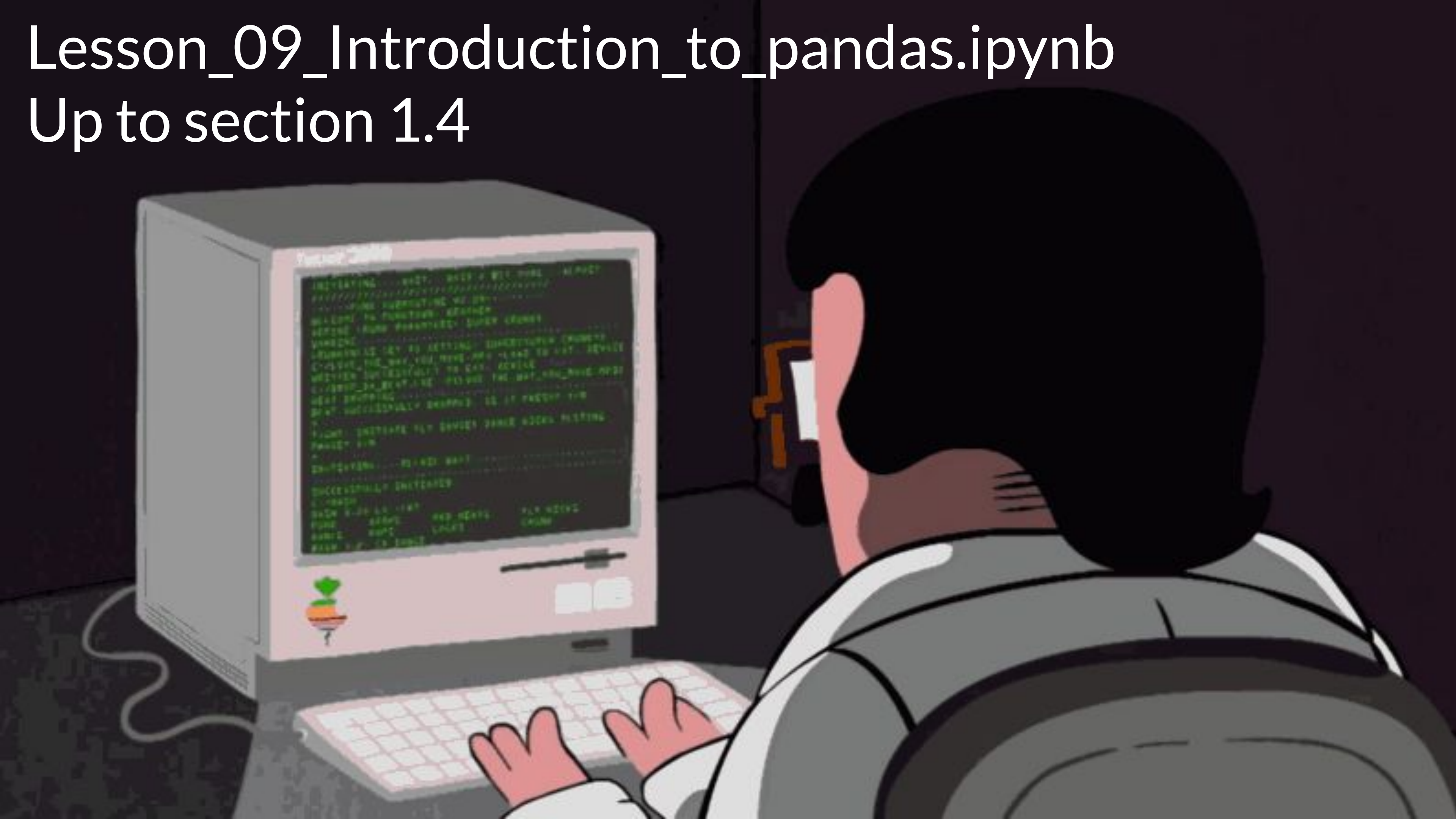
Column selection shortcuts



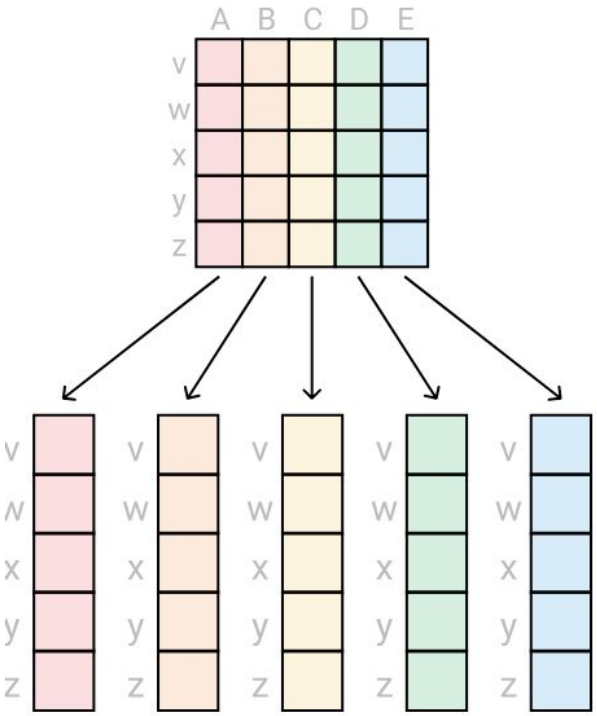
Select by Label	Explicit Syntax	Common Shorthand	Other Shorthand
Single column	`df.loc[:,"col1"]`	`df["col1"]`	`df.col1`
List of columns	`df.loc[:,["col1", "col7"]]`	`df[["col1", "col7"]]`	
Slice of columns	`df.loc[:,"col1":"col4"]`		

Lesson_09_Introduction_to_pandas.ipynb

Up to section 1.4



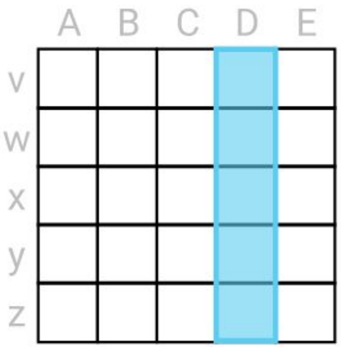
Selecting Items from a Series by Label



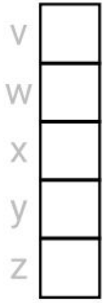
Original Dataframe

Code

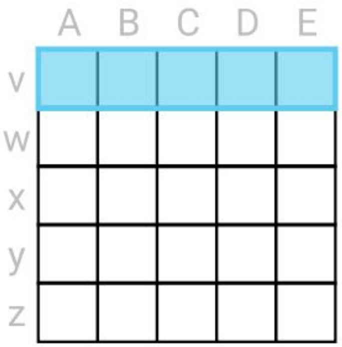
Result



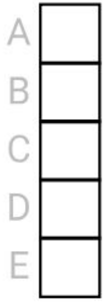
```
single_col = df["D"]
```



`single_col` is a series object



```
single_row = df.head(1)
```

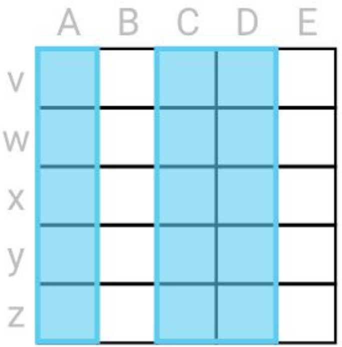


`single_row` is a series object

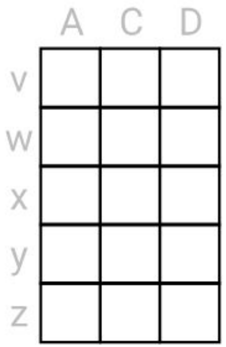
Original Dataframe

Code

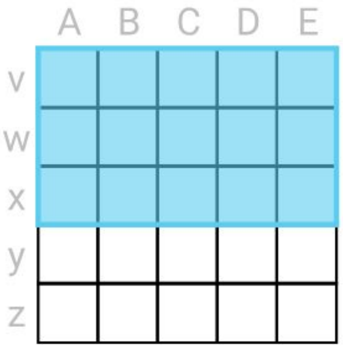
Result



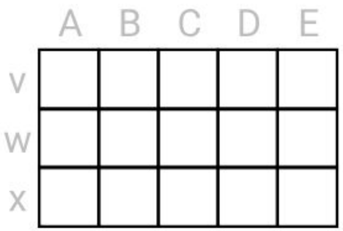
```
multi_cols = df[["A", "C", "D"]]
```



`multi_cols` is a dataframe object

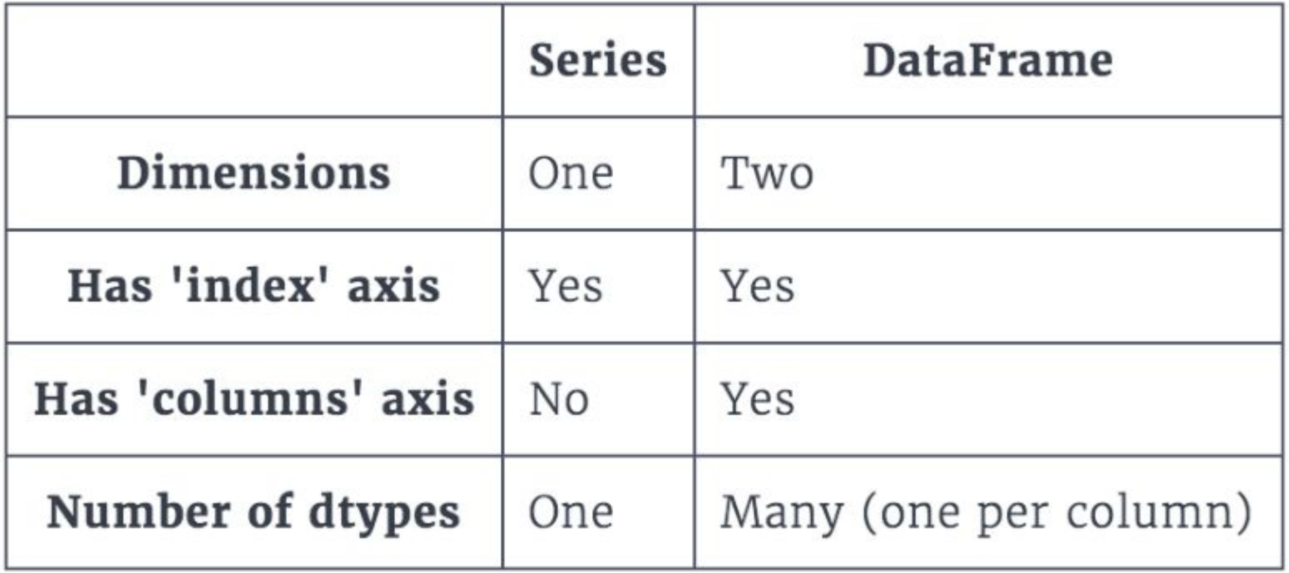


```
multi_rows = df.head(3)
```



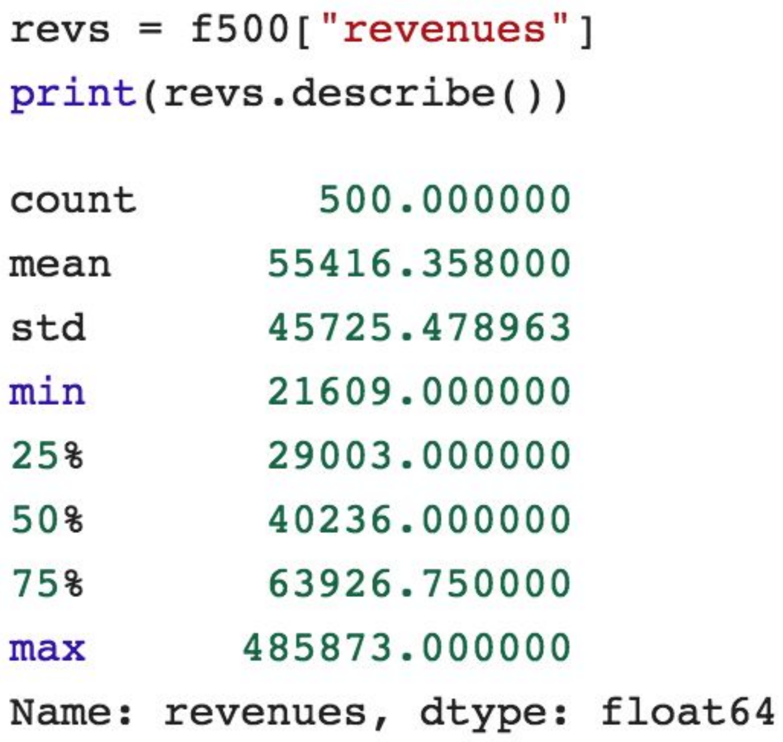
`multi_rows` is a dataframe object

Dataframe vs Series



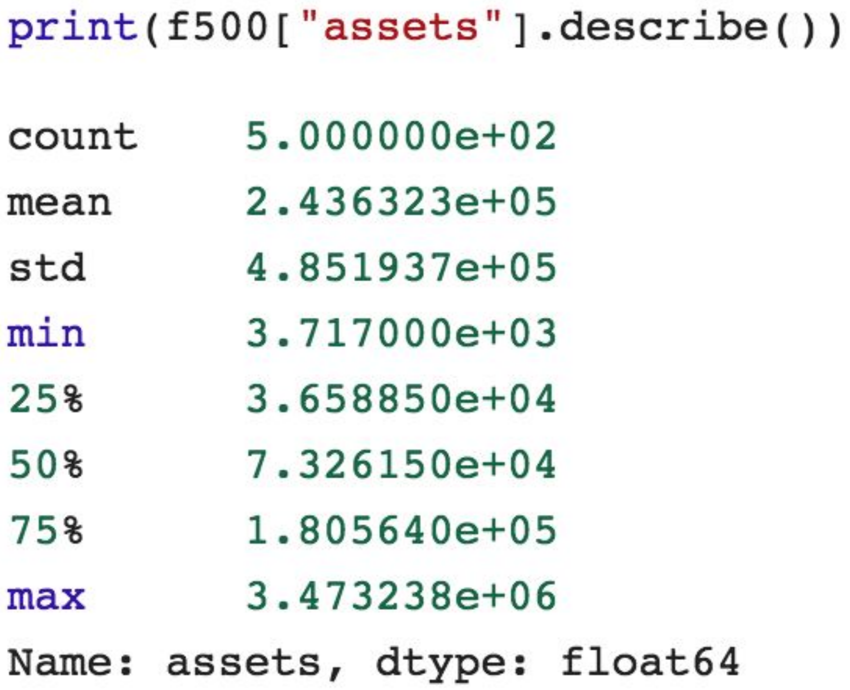
	Series	DataFrame
Dimensions	One	Two
Has 'index' axis	Yes	Yes
Has 'columns' axis	No	Yes
Number of dtypes	One	Many (one per column)

Series and Dataframe Describe Methods



```
revs = f500["revenues"]
print(revs.describe())

count       500.000000
mean      55416.358000
std       45725.478963
min       21609.000000
25%       29003.000000
50%       40236.000000
75%       63926.750000
max      485873.000000
Name: revenues, dtype: float64
```



```
print(f500["assets"].describe())

count    5.000000e+02
mean     2.436323e+05
std      4.851937e+05
min      3.717000e+03
25%      3.658850e+04
50%      7.326150e+04
75%      1.805640e+05
max      3.473238e+06
Name: assets, dtype: float64
```

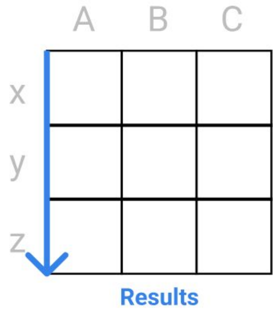
Lesson_09_Introduction_to_pandas.ipynb

Sections 1.5, 1.6, 1.7

More data exploration methods

```
DataFrame.method(axis=0)
or
DataFrame.method(axis="index")
```

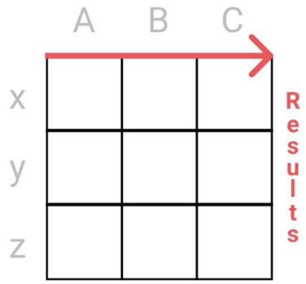
Calculates along the **row** axis



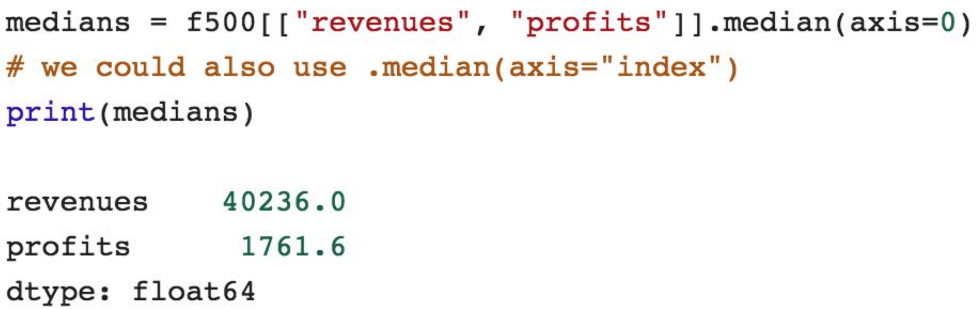
Calculates result for each **column**.

```
DataFrame.method(axis=1)
or
DataFrame.method(axis="column")
```

Calculates along the **column** axis



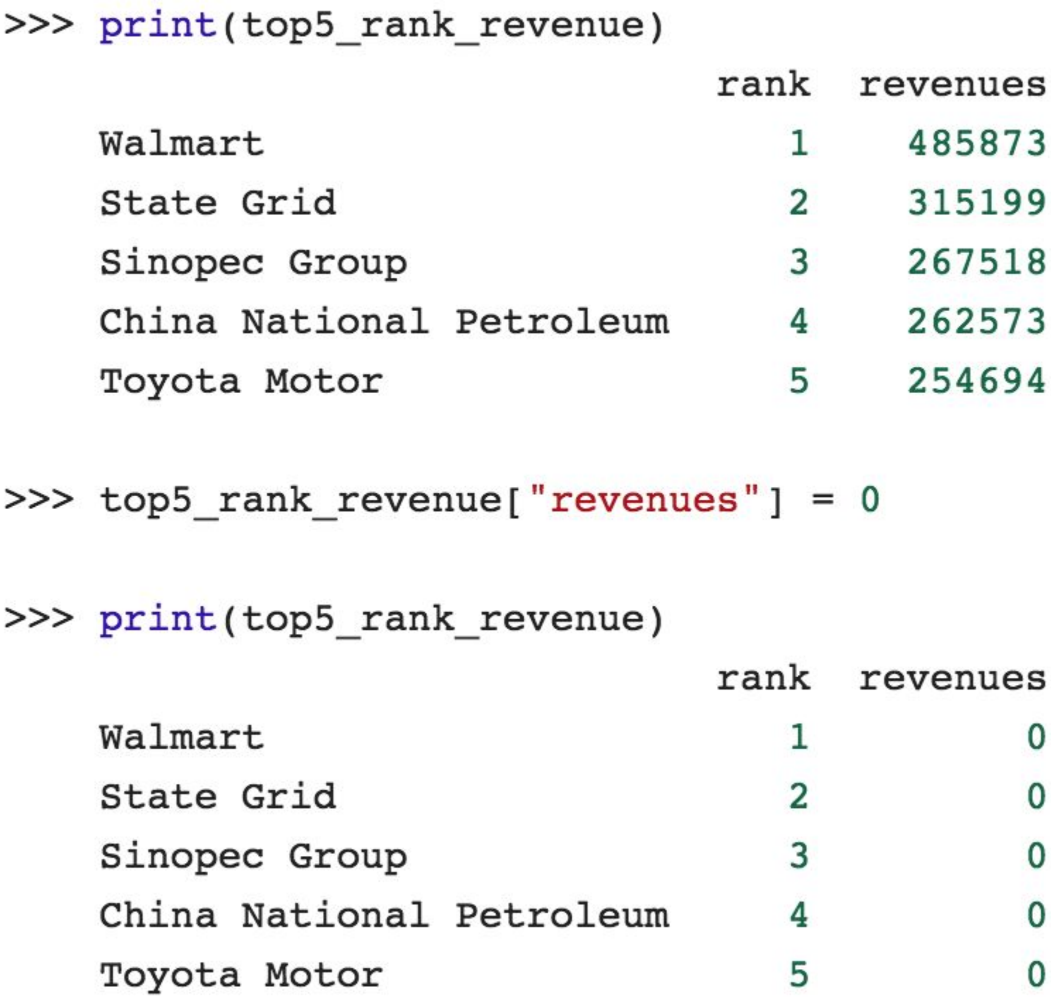
Calculates result for each **row**.



```
medians = f500[["revenues", "profits"]].median(axis=0)
# we could also use .median(axis="index")
print(medians)

revenues    40236.0
profits      1761.6
dtype: float64
```

Assignment with Pandas

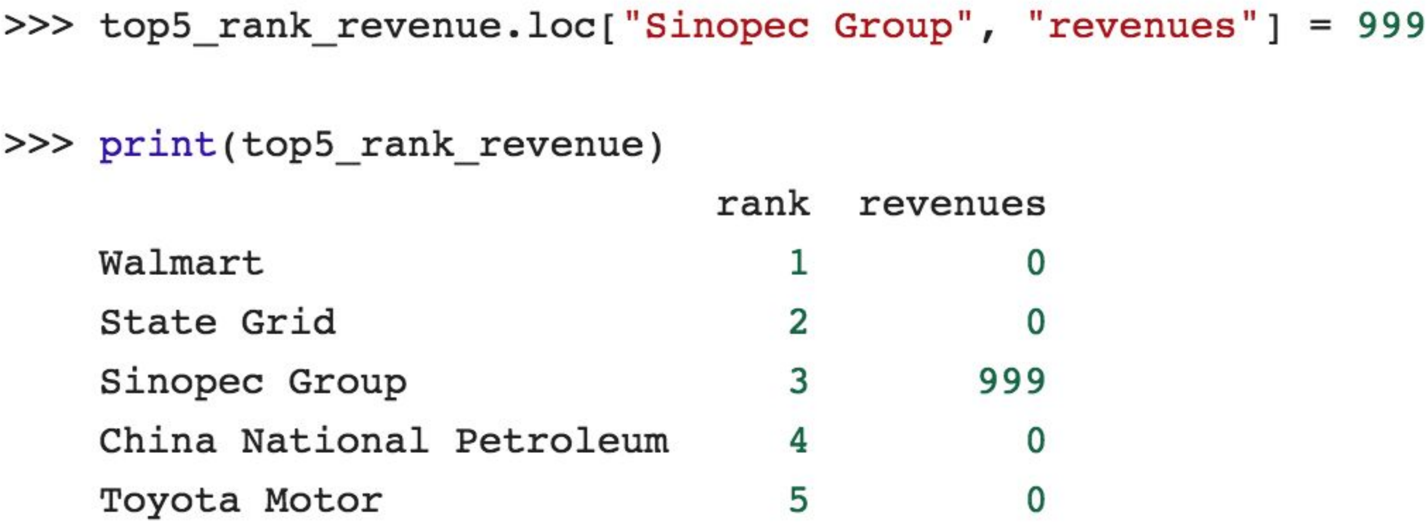


```
>>> print(top5_rank_revenue)
                             rank  revenues
    Walmart                     1    485873
    State Grid                  2    315199
    Sinopec Group               3    267518
    China National Petroleum    4    262573
    Toyota Motor                5    254694

>>> top5_rank_revenue["revenues"] = 0

>>> print(top5_rank_revenue)
                             rank  revenues
    Walmart                     1         0
    State Grid                  2         0
    Sinopec Group               3         0
    China National Petroleum    4         0
    Toyota Motor                5         0
```

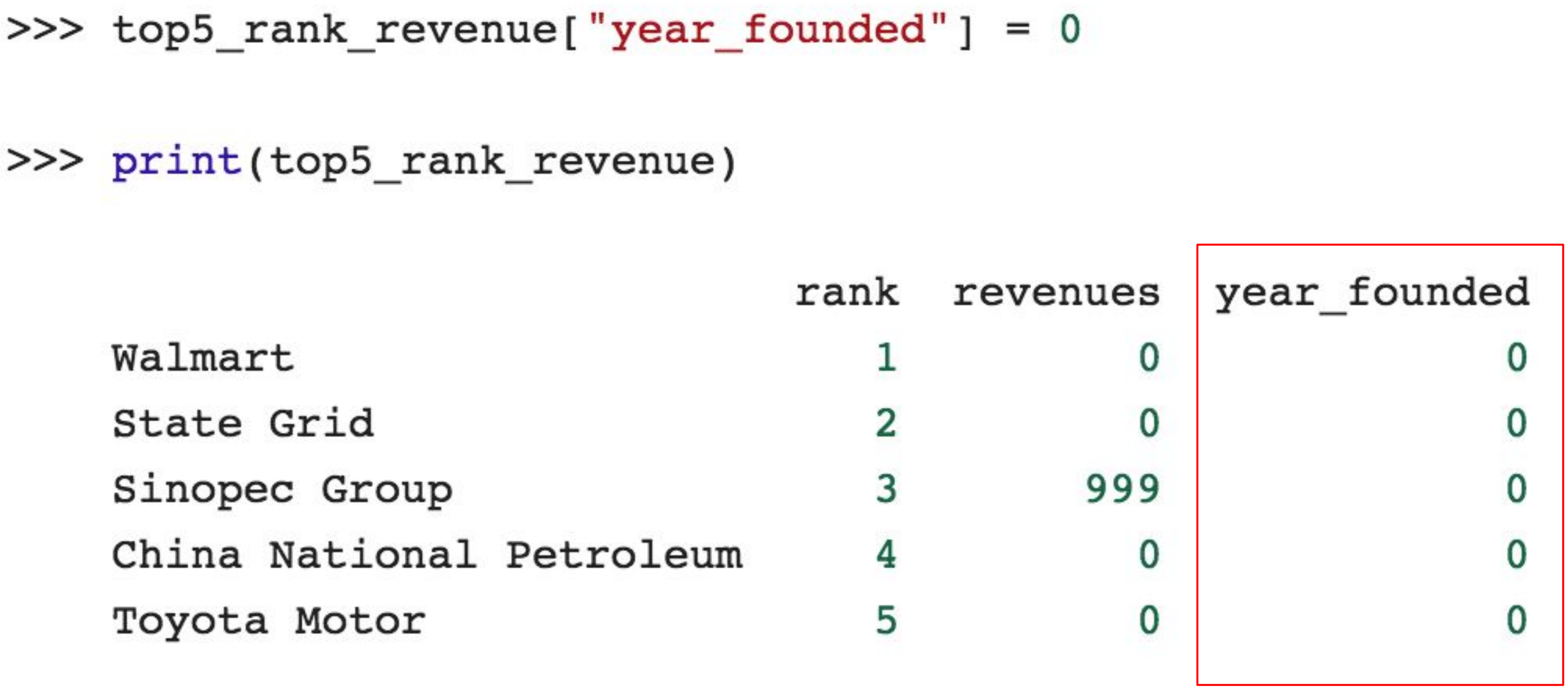
Assignment with Pandas



```
>>> top5_rank_revenue.loc["Sinopec Group", "revenues"] = 999

>>> print(top5_rank_revenue)
                              rank  revenues
    Walmart                      1         0
    State Grid                   2         0
    Sinopec Group                3       999
    China National Petroleum     4         0
    Toyota Motor                 5         0
```

Add a new column

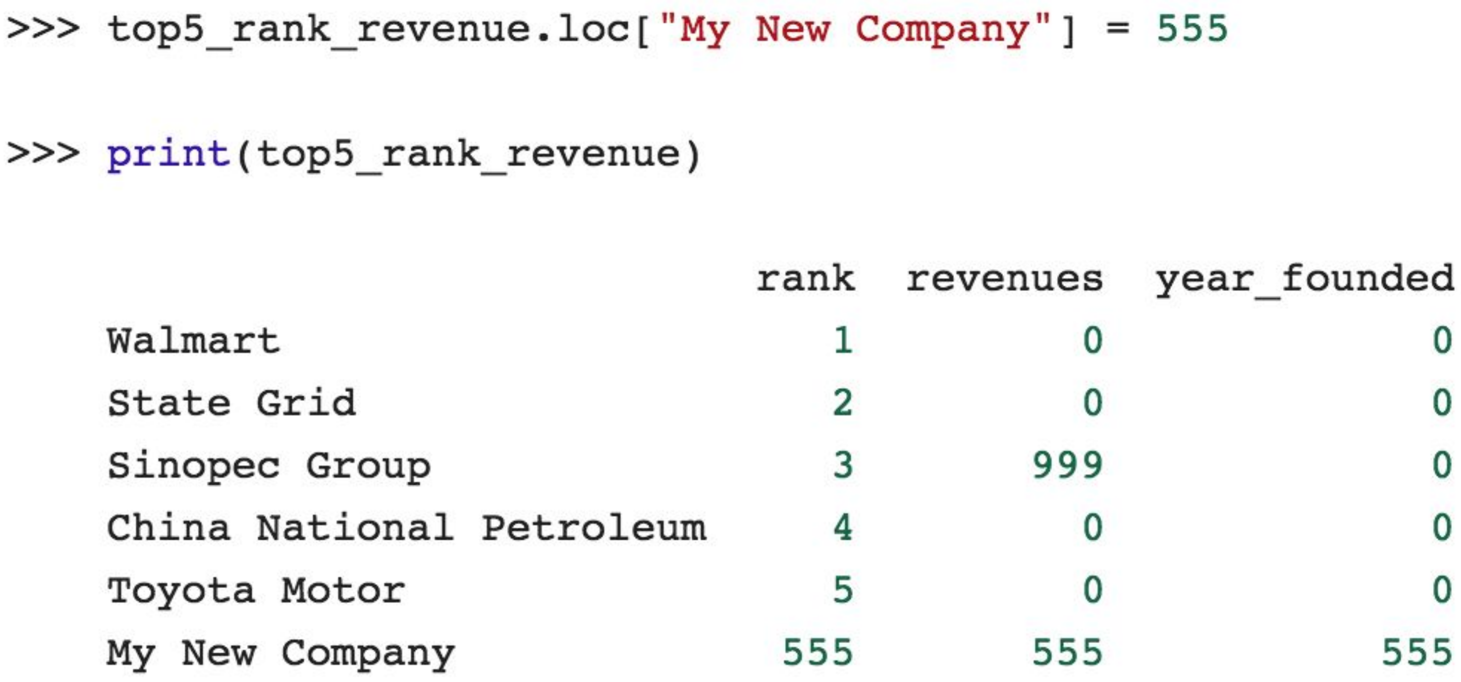


```
>>> top5_rank_revenue["year_founded"] = 0

>>> print(top5_rank_revenue)

                         rank  revenues  year_founded
    Walmart                 1         0             0
    State Grid              2         0             0
    Sinopec Group           3       999             0
    China National Petroleum 4        0             0
    Toyota Motor            5         0             0
```

Add a new row

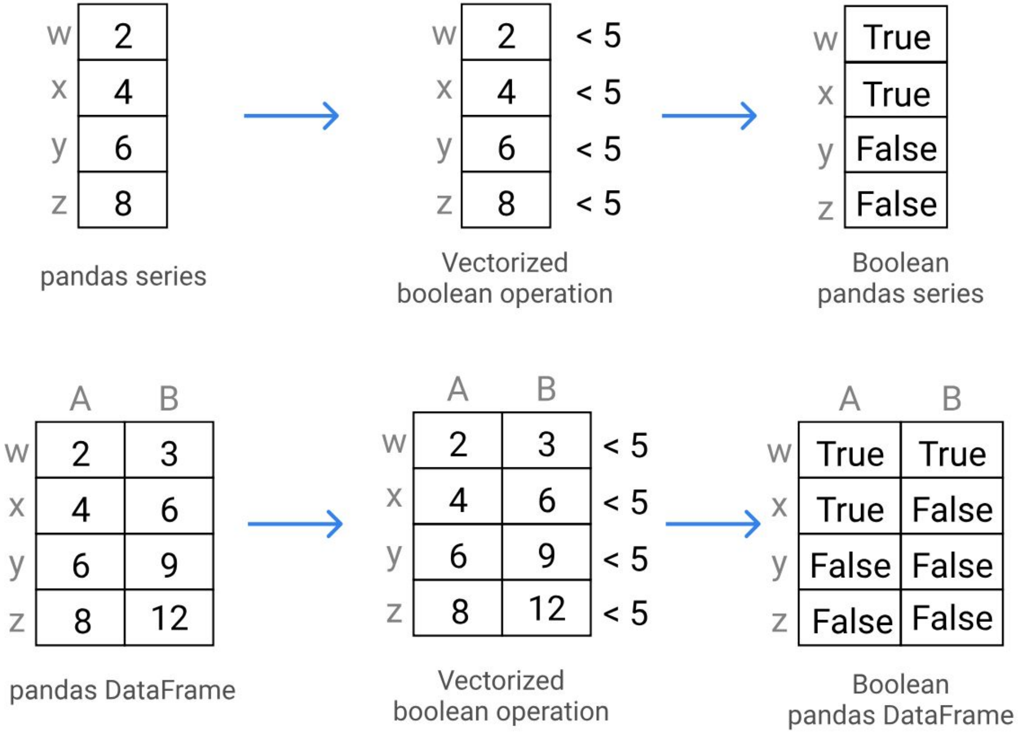


```
>>> top5_rank_revenue.loc["My New Company"] = 555

>>> print(top5_rank_revenue)

                          rank  revenues  year_founded
Walmart                      1         0             0
State Grid                   2         0             0
Sinopec Group                3       999             0
China National Petroleum     4         0             0
Toyota Motor                 5         0             0
My New Company             555       555           555
```

Using boolean indexing with pandas objects



w	2
x	4
y	6
z	8

pandas series

w	2	< 5
x	4	< 5
y	6	< 5
z	8	< 5

Vectorized boolean operation

w	True
x	True
y	False
z	False

Boolean pandas series

	A	B
w	2	3
x	4	6
y	6	9
z	8	12

pandas DataFrame

	A	B	
w	2	3	< 5
x	4	6	< 5
y	6	9	< 5
z	8	12	< 5

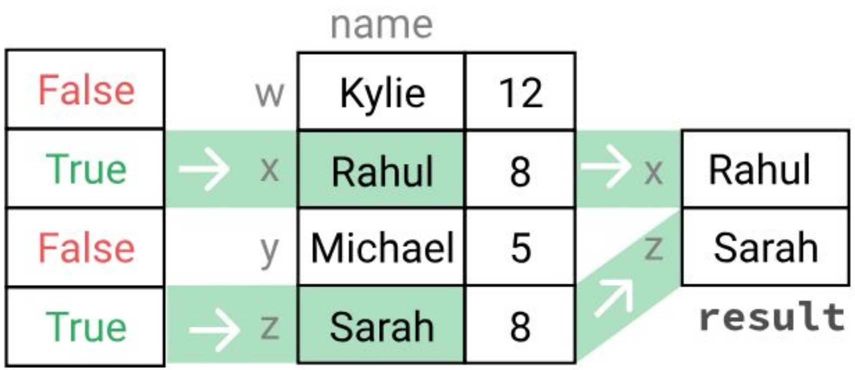
Vectorized boolean operation

	A	B
w	True	True
x	True	False
y	False	False
z	False	False

Boolean pandas DataFrame

Using boolean indexing with pandas objects

```
result = df.loc[num_bool, “name”]
```

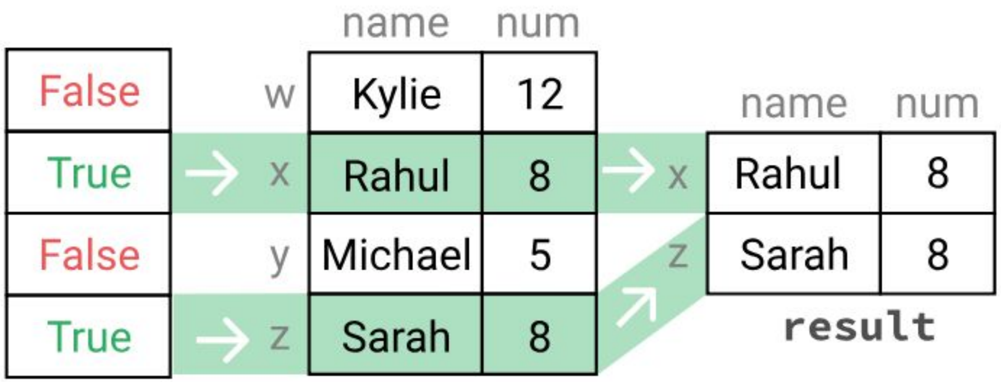


		name	
False	w	Kylie	12
True	x	Rahul	8
False	y	Michael	5
True	z	Sarah	8

x	Rahul
z	Sarah

result

```
result = df[num_bool]
```

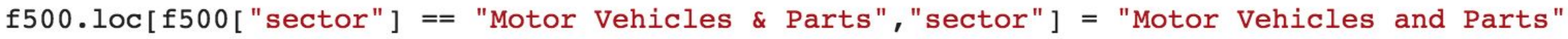


		name	num
False	w	Kylie	12
True	x	Rahul	8
False	y	Michael	5
True	z	Sarah	8

	name	num
x	Rahul	8
z	Sarah	8

result

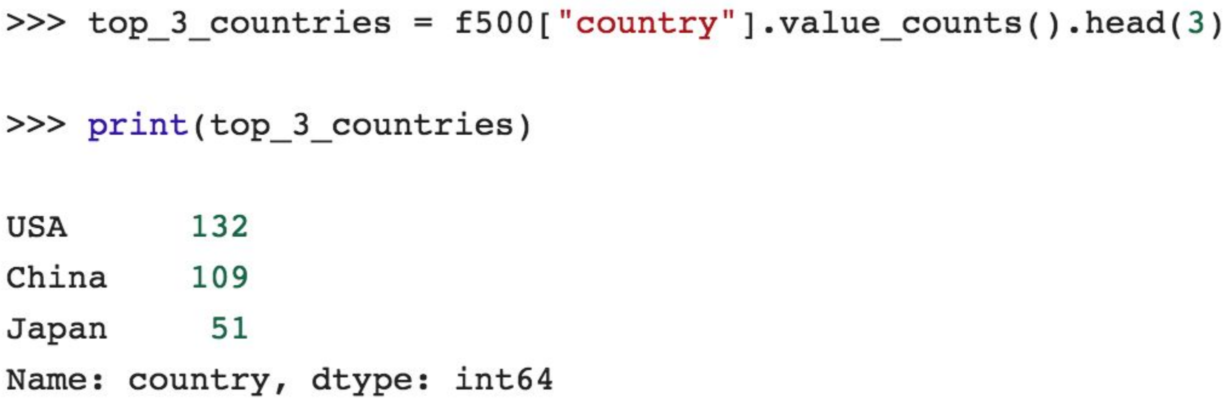
Using boolean arrays to assign values



```
f500.loc[f500["sector"] == "Motor Vehicles & Parts","sector"] = "Motor Vehicles and Parts"
```

Challenge

Finding top performers by country



```
>>> top_3_countries = f500["country"].value_counts().head(3)

>>> print(top_3_countries)

USA        132
China      109
Japan       51
Name: country, dtype: int64
```

Lesson_09_Introduction_to_pandas.ipynb