Reading external data & Plotting

Source (https://blockchain.info/charts/market-price)

Hands on!

In [1]:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt

%matplotlib inline
```

Pandas can easily read data stored in different file formats like CSV, JSON, XML or even Excel. Parsing always involves specifying the correct structure, encoding and other details. The `read_csv` method reads CSV files and accepts many parameters.

In [ ]:

```
pd.read_csv?
```

In [8]:

```
df = pd.read_csv('data/btc-market-price.csv')
```

In [9]:

```
df.head()
```

Out[9]:

	2017-04-02 00:00:00	1099.169125
0	2017-04-03 00:00:00	1141.813000
1	2017-04-04 00:00:00	1141.600363
2	2017-04-05 00:00:00	1133.079314
3	2017-04-06 00:00:00	1196.307937
4	2017-04-07 00:00:00	1190.454250

The CSV file we're reading has only two columns: `timestamp` and `price` . It doesn't have a header, it contains whitespaces and has values separated by commas. pandas automatically assigned the first row of data as headers, which is incorrect. We can overwrite this behavior with the `header` parameter:

In [10]:

```
df = pd.read_csv('data/btc-market-price.csv', header=None)
```

In [11]:

```
df.head()
```

Out[11]:

	0	1
0	2017-04-02 00:00:00	1099.169125
1	2017-04-03 00:00:00	1141.813000
2	2017-04-04 00:00:00	1141.600363
3	2017-04-05 00:00:00	1133.079314
4	2017-04-06 00:00:00	1196.307937

We can then set the names of each column explicitely by setting the `df.columns` attribute:

In [12]:

```
df.columns = ['Timestamp', 'Price']
```

In [14]:

```
df.shape
```

Out[14]:

```
(365, 2)
```

In [13]:

```
df.head()
```

Out[13]:

	Timestamp	Price
0	2017-04-02 00:00:00	1099.169125
1	2017-04-03 00:00:00	1141.813000
2	2017-04-04 00:00:00	1141.600363
3	2017-04-05 00:00:00	1133.079314
4	2017-04-06 00:00:00	1196.307937

In [17]:

```
df.tail(3) # the last three rows
```

Out[17]:

	Timestamp	Price
362	2018-03-30 00:00:00	6882.531667
363	2018-03-31 00:00:00	6935.480000
364	2018-04-01 00:00:00	6794.105000

The type of the `Price` column was correctly interpreted as `float`, but the `Timestamp` was interpreted as a regular string (`object` in pandas notation):

In [18]:

```
df.dtypes
```

Out[18]:

```
Timestamp     object
Price        float64
dtype: object
```

We can perform a vectorized operation to parse all the Timestamp values as `Datetime` objects:

In [19]:

```
pd.to_datetime(df['Timestamp']).head()
```

Out[19]:

```
0   2017-04-02
1   2017-04-03
2   2017-04-04
3   2017-04-05
4   2017-04-06
Name: Timestamp, dtype: datetime64[ns]
```

In [20]:

```
df['Timestamp'] = pd.to_datetime(df['Timestamp']) # turns time stamp into an actual date
```

In [21]:

```
df.head()
```

Out[21]:

	Timestamp	Price
0	2017-04-02	1099.169125
1	2017-04-03	1141.813000
2	2017-04-04	1141.600363
3	2017-04-05	1133.079314
4	2017-04-06	1196.307937

In [22]:

```
df.dtypes
```

Out[22]:

```
Timestamp    datetime64[ns]
Price               float64
dtype: object
```

The timestamp looks a lot like the index of this `DataFrame` : `date > price` . We can change the autoincremental ID generated by pandas and use the `Timestamp DS` column as the Index:

In [23]:

```
df.set_index('Timestamp', inplace=True)
```

In [24]:

```
df.head()
```

Out[24]:

	Price
Timestamp	
2017-04-02	1099.169125
2017-04-03	1141.813000
2017-04-04	1141.600363
2017-04-05	1133.079314
2017-04-06	1196.307937

In [27]:

```
df.loc['2017-09-29'] # to get a value from a particular row you need '.loc'
```

Out[27]:

```
Price    4193.574667
Name: 2017-09-29 00:00:00, dtype: float64
```

Putting everything together

And now, we've finally arrived to the final, desired version of the `DataFrame` parsed from our CSV file. The steps were:

In [28]:

```
df = pd.read_csv('data/btc-market-price.csv', header=None)
df.columns = ['Timestamp', 'Price']
df['Timestamp'] = pd.to_datetime(df['Timestamp'])
df.set_index('Timestamp', inplace=True)
```

In [29]:

```
df.head()
```

Out[29]:

	Price
Timestamp	
2017-04-02	1099.169125
2017-04-03	1141.813000
2017-04-04	1141.600363
2017-04-05	1133.079314
2017-04-06	1196.307937

There should be a better way. And there is 😎. And there usually is, explicitly with all these repetitive tasks with pandas.

The `read_csv` function is extremely powerful and you can specify many more parameters at import time. We can achive the same results with only one line by doing:

In [30]:

```
df = pd.read_csv(
    'data/btc-market-price.csv',
    header=None,
    names=['Timestamp', 'Price'],
    index_col=0,
    parse_dates=True
)
```

In [31]:

```
df.head()
```

Out[31]:

	Price
Timestamp	
2017-04-02	1099.169125
2017-04-03	1141.813000
2017-04-04	1141.600363
2017-04-05	1133.079314
2017-04-06	1196.307937

In [32]:

```
df.loc['2017-09-29']
```

Out[32]:

```
Price    4193.574667
Name: 2017-09-29 00:00:00, dtype: float64
```

Plotting basics

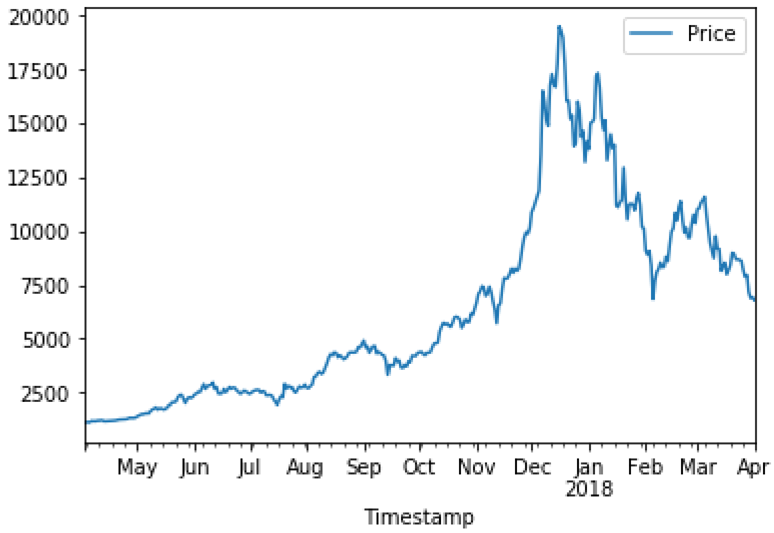
`pandas` integrates with Matplotlib and creating a plot is as simple as:

In [38]:

```
df.plot()
```

Out[38]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7efc299665e0>
```



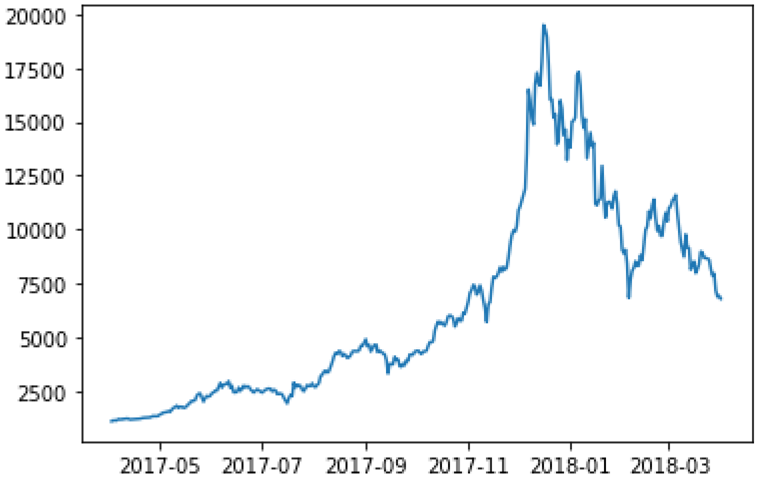
Behind the scenes, it's using `matplotlib.pyplot` 's interface. We can create a similar plot with the `plt.plot()` function:

In [35]:

```
plt.plot(df.index, df['Price'])
```

Out[35]:

```
[<matplotlib.lines.Line2D at 0x7efc29a8c700>]
```



`plt.plot()` accepts many parameters, but the first two ones are the most important ones: the values for the `X` and `Y` axes. Another example:

In [36]:

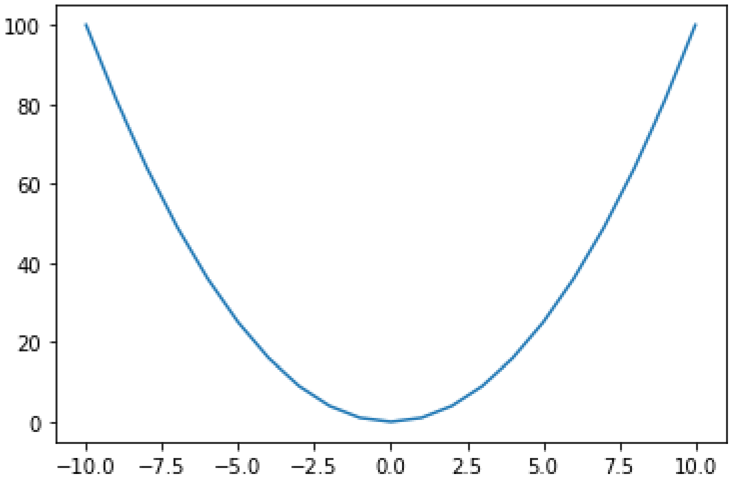
```
x = np.arange(-10, 11)
```

In [37]:

```
plt.plot(x, x ** 2)
```

Out[37]:

```
[<matplotlib.lines.Line2D at 0x7efc299abf10>]
```



We're using `matplotlib` 's global API, which is horrible but it's the most popular one. We'll learn later how to use the *OOP* API which will make our work much easier.

In [ ]:

```
plt.plot(x, x ** 2)
plt.plot(x, -1 * (x ** 2))
```

Each `plt` function alters the global state. If you want to set settings of your plot you can use the `plt.figure` function. Others like `plt.title` keep altering the global plot:

In [ ]:

```
plt.figure(figsize=(12, 6))
plt.plot(x, x ** 2)
plt.plot(x, -1 * (x ** 2))

plt.title('My Nice Plot')
```

Some of the arguments in `plt.figure` and `plt.plot` are available in the pandas' `plot` interface:

In [ ]:

```
df.plot(figsize=(16, 9), title='Bitcoin Price 2017-2018')
```

A more challenging parsing

To demonstrate plotting two columns together, we'll try to add Ether prices to our `df` DataFrame. The ETH prices data can be found in the `data/eth-price.csv` file. The problem is that it seems like that CSV file was created by someone who really hated programmers. Take a look at it and see how ugly it looks like. We'll still use `pandas` to parse it.

In [39]:

```
eth = pd.read_csv('data/eth-price.csv')

eth.head()
```

Out[39]:

	Date(UTC)	UnixTimeStamp	Value
0	4/2/2017	1491091200	48.55
1	4/3/2017	1491177600	44.13
2	4/4/2017	1491264000	44.43
3	4/5/2017	1491350400	44.90
4	4/6/2017	1491436800	43.23

As you can see, it has a `Value` column (which represents the price), a `Date(UTC)` one that has a string representing dates and also a `UnixTimeStamp` date represeting the datetime in unix timestamp format. The header is read automatically, let's try to parse dates with the CSV Reader:

In [40]:

```
eth = pd.read_csv('data/eth-price.csv', parse_dates=True)

print(eth.dtypes)
eth.head()
```

```
Date(UTC)         object
UnixTimeStamp      int64
Value            float64
dtype: object
```

Out[40]:

	Date(UTC)	UnixTimeStamp	Value
0	4/2/2017	1491091200	48.55
1	4/3/2017	1491177600	44.13
2	4/4/2017	1491264000	44.43
3	4/5/2017	1491350400	44.90
4	4/6/2017	1491436800	43.23

Seems like the `parse_dates` attribute didn't work. We'll need to add a little bit more customization. Let's divide this problem and focus on the problem of "date parsing" first. The simplest option would be to use the `UnixTimeStamp` column. The `pandas` module has a `to_datetime` function that converts Unix timestamps to Datetime objects automatically:

In [41]:

```
pd.to_datetime(eth['UnixTimeStamp']).head()
```

Out[41]:

```
0   1970-01-01 00:00:01.491091200
1   1970-01-01 00:00:01.491177600
2   1970-01-01 00:00:01.491264000
3   1970-01-01 00:00:01.491350400
4   1970-01-01 00:00:01.491436800
Name: UnixTimeStamp, dtype: datetime64[ns]
```

The problem is the precision of unix timestamps. To match both columns we'll need to use the same index and, our `df` containing Bitcoin prices, is "per day":

In [42]:

```
df.head()
```

Out[42]:

	Price
Timestamp	
2017-04-02	1099.169125
2017-04-03	1141.813000
2017-04-04	1141.600363
2017-04-05	1133.079314
2017-04-06	1196.307937

We could either, remove the precision of `UnixTimeStamp` or attempt to parse the `Date(UTC)` . Let's do String parsing of `Date(UTC)` for fun:

In [43]:

```
pd.to_datetime(eth['Date(UTC)']).head()
```

Out[43]:

```
0   2017-04-02
1   2017-04-03
2   2017-04-04
3   2017-04-05
4   2017-04-06
Name: Date(UTC), dtype: datetime64[ns]
```

That seems to work fine! Why isn't it then parsing the `Date(UTC)` column? Simple, the `parse_dates=True` parameter will instruct pandas to parse the index of the `DataFrame` . If you want to parse any other column, you must explicitly pass the column position or name:

In [44]:

```
pd.read_csv('data/eth-price.csv', parse_dates=[0]).head()
```

Out[44]:

	Date(UTC)	UnixTimeStamp	Value
0	2017-04-02	1491091200	48.55
1	2017-04-03	1491177600	44.13
2	2017-04-04	1491264000	44.43
3	2017-04-05	1491350400	44.90
4	2017-04-06	1491436800	43.23

Putting everything together again:

In [45]:

```
eth = pd.read_csv('data/eth-price.csv', parse_dates=True, index_col=0)
print(eth.info())

eth.head()
```

```
<class 'pandas.core.frame.DataFrame'>
DatetimeIndex: 362 entries, 2017-04-02 to 2018-04-01
Data columns (total 2 columns):
 #   Column         Non-Null Count  Dtype
---  ------         --------------  -----
 0   UnixTimeStamp  362 non-null    int64
 1   Value          362 non-null    float64
dtypes: float64(1), int64(1)
memory usage: 8.5 KB
None
```

Out[45]:

	UnixTimeStamp	Value
Date(UTC)		
2017-04-02	1491091200	48.55
2017-04-03	1491177600	44.13
2017-04-04	1491264000	44.43
2017-04-05	1491350400	44.90
2017-04-06	1491436800	43.23

We can now combine both `DataFrame` s into one. Both have the same index, so aligning both prices will be easy. Let's first create an empty `DataFrame` and with the index from Bitcoin prices:

In [46]:

```
prices = pd.DataFrame(index=df.index)
```

In [47]:

```
prices.head()
```

Out[47]:

Timestamp
2017-04-02
2017-04-03
2017-04-04
2017-04-05
2017-04-06

And we can now just set columns from the other `DataFrame` s:

In [48]:

```
prices['Bitcoin'] = df['Price']
```

In [49]:

```
prices['Ether'] = eth['Value']
```

In [50]:

```
prices.head()
```

Out[50]:

	Bitcoin	Ether
Timestamp		
2017-04-02	1099.169125	48.55
2017-04-03	1141.813000	44.13
2017-04-04	1141.600363	44.43
2017-04-05	1133.079314	44.90
2017-04-06	1196.307937	43.23

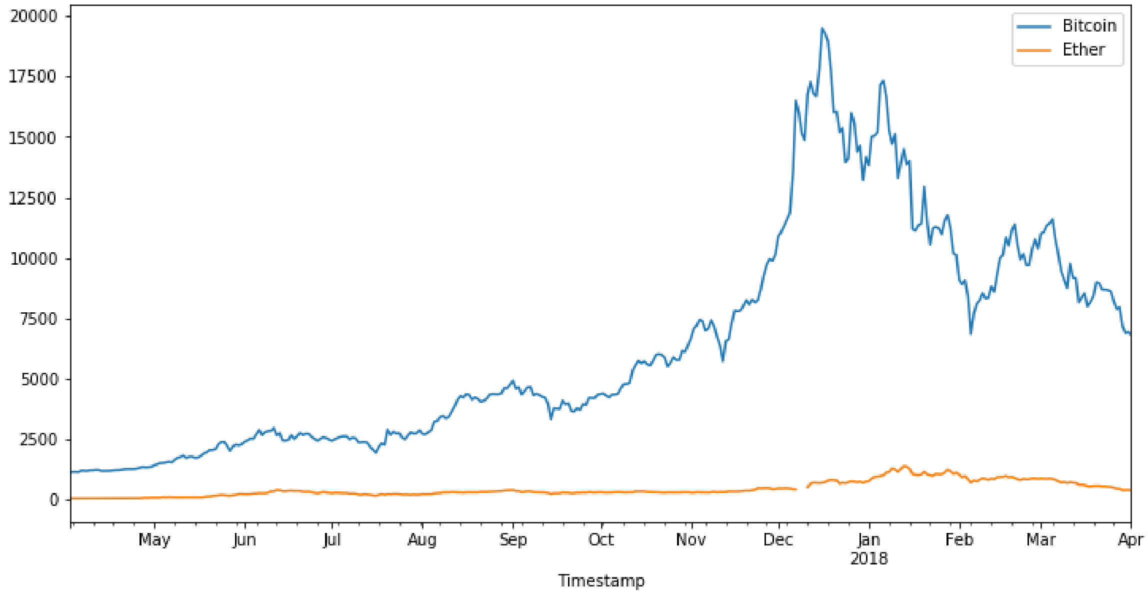
We can now try plotting both values:

In [51]:

```
prices.plot(figsize=(12, 6))
```

Out[51]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7efc298f7ca0>
```



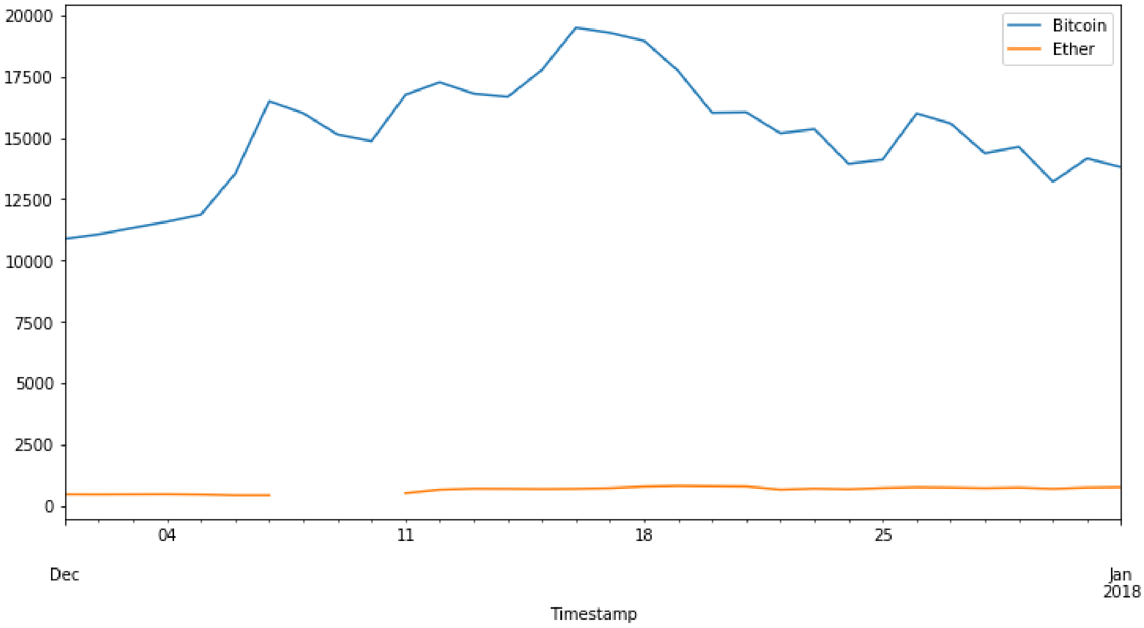
🤔seems like there's a tiny gap between Dec 2017 and Jan 2018. Let's zoom in there:

In [52]:

```
prices.loc['2017-12-01':'2018-01-01'].plot(figsize=(12, 6)) # zoom in
```

Out[52]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7efc297fb040>
```



Oh no, missing data 😱. We'll learn how to deal with that later 😉.

Btw, did you note that fancy indexing `'2017-12-01':'2018-01-01'` 😏. That's pandas power 💪. We'll learn how to deal with TimeSeries later too.