Getting Started with Matplotlib

Pandas uses `matplotlib` to create visualizations. Therefore, before we learn how to plot with `pandas`, it's important to understand how `matplotlib` works at a high-level, which is the focus of this notebook.

About the Data

In this notebook, we will be working with 2 datasets:

- Facebook's stock price throughout 2018 (obtained using the `stock_analysis` package)
- Earthquake data from September 18, 2018 - October 13, 2018 (obtained from the US Geological Survey (USGS) using the USGS API)

Setup

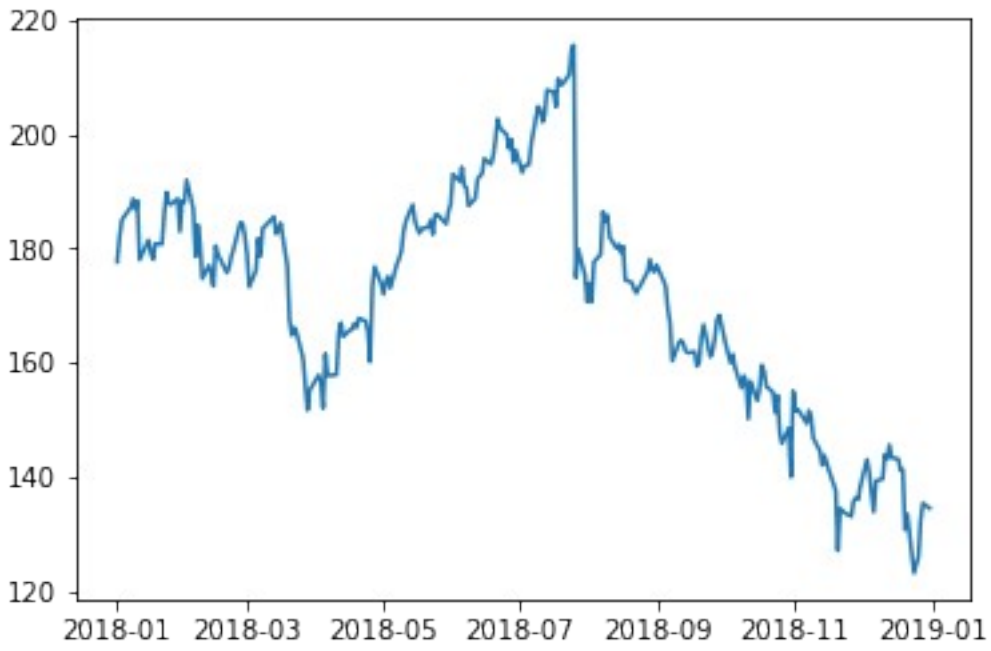
We need to import `matplotlib.pyplot` for plotting.

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

Plotting lines

```
fb = pd.read_csv(
    'data/fb_stock_prices_2018.csv', index_col='date',
parse_dates=True
)

plt.plot(fb.index, fb.open)
plt.show()
```



Since we are working in a Jupyter notebook, we can use the magic command `%matplotlib inline` once and not have to call `plt.show()` for each plot.

```
%matplotlib inline
import matplotlib.pyplot as plt
import pandas as pd

fb = pd.read_csv(
    'data/fb_stock_prices_2018.csv', index_col='date',
parse_dates=True
)
plt.plot(fb.index, fb.open)
```

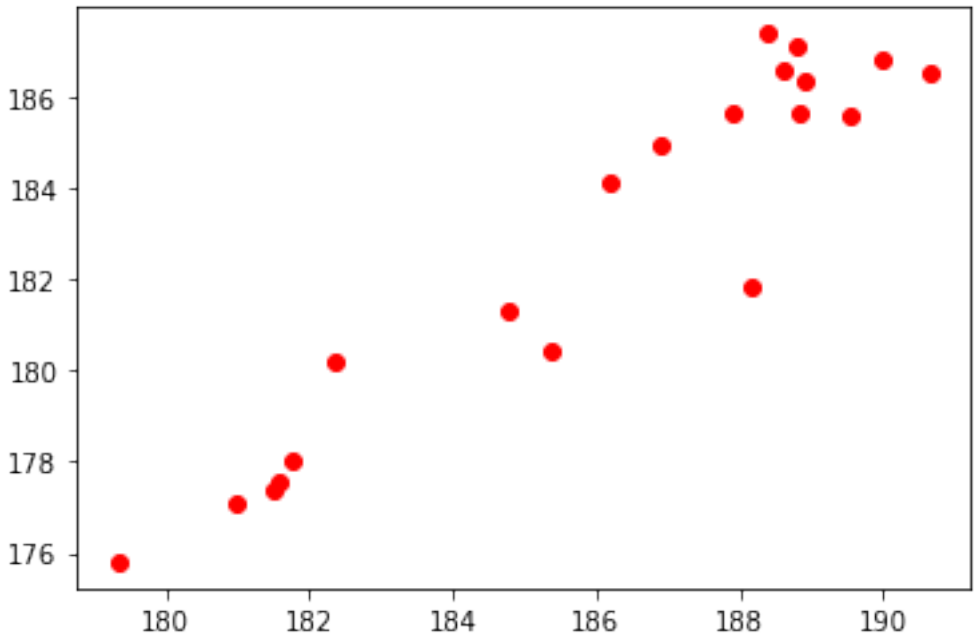
```
[<matplotlib.lines.Line2D at 0x7b969aad07f0>]
```

Scatter plots

We can pass in a string specifying the style of the plot. This is of the form `[marker][linestyle][color]`. For example, we can make a black dashed line with `'--k'` or a red scatter plot with `'or'`:

```
plt.plot('high', 'low', 'or', data=fb.head(20))
```

```
[<matplotlib.lines.Line2D at 0x7b969aa8d8d0>]
```



Here are some examples of how you make a format string:

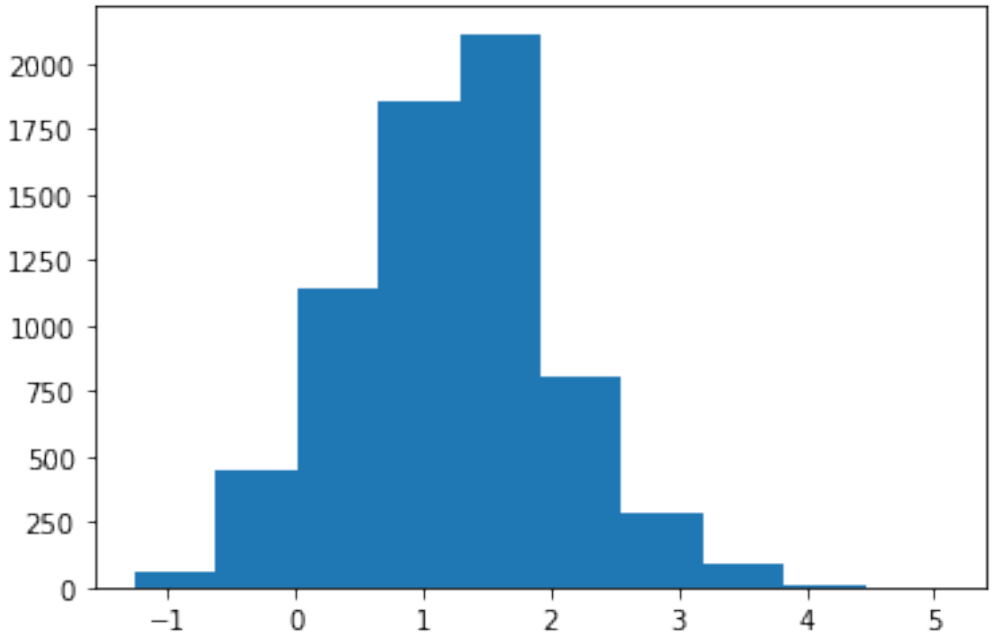
Marker	Linestyle	Color	Format String	Result
	`-`	`b`	`-b`	blue solid line
`.`		`k`	`.k`	black points
	`--`	`r`	`--r`	red dashed line
`o`	`-`	`g`	`o-g`	green solid line with circles
	`:`	`m`	`:m`	magenta dotted line
`x`	`-.`	`c`	`x-.c`	cyan dot-dashed line with x's

Note that we can also use format strings of the form `[color][marker][linestyle]`, but the parsing by `matplotlib` (in rare cases) might not be what we were aiming for. Consult the *Notes* section in the documentation for the complete list of options.

Histograms

```
quakes = pd.read_csv('data/earthquakes.csv')
plt.hist(quakes.query('magType == "ml"').mag)
```

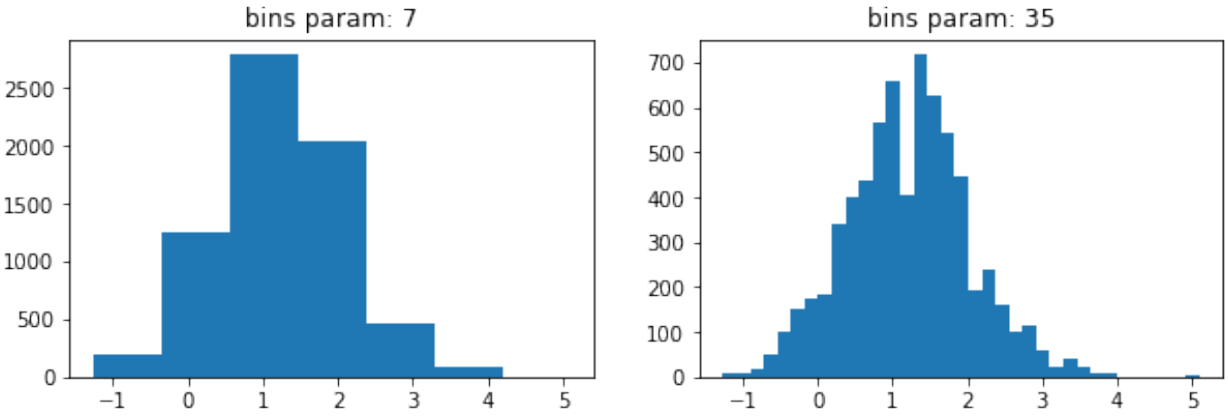
```
(array([6.400e+01, 4.450e+02, 1.137e+03, 1.853e+03, 2.114e+03,
8.070e+02,
        2.800e+02, 9.200e+01, 9.000e+00, 2.000e+00]),
 array([-1.26 , -0.624,  0.012,  0.648,  1.284,  1.92 ,  2.556,
3.192,
         3.828,  4.464,  5.1  ]),
 <BarContainer object of 10 artists>)
```



Bin size matters

Notice how our assumptions of the distribution of the data can change based on the number of bins (look at the drop between the two highest peaks on the righthand plot):

```
x = quakes.query('magType == "ml"').mag
fig, axes = plt.subplots(1, 2, figsize=(10, 3))
for ax, bins in zip(axes, [7, 35]):
    ax.hist(x, bins=bins)
    ax.set_title(f'bins param: {bins}')
```



Plot components

`Figure`

Top-level object that holds the other plot components.

```
fig = plt.figure()
```

```
<Figure size 432x288 with 0 Axes>
```

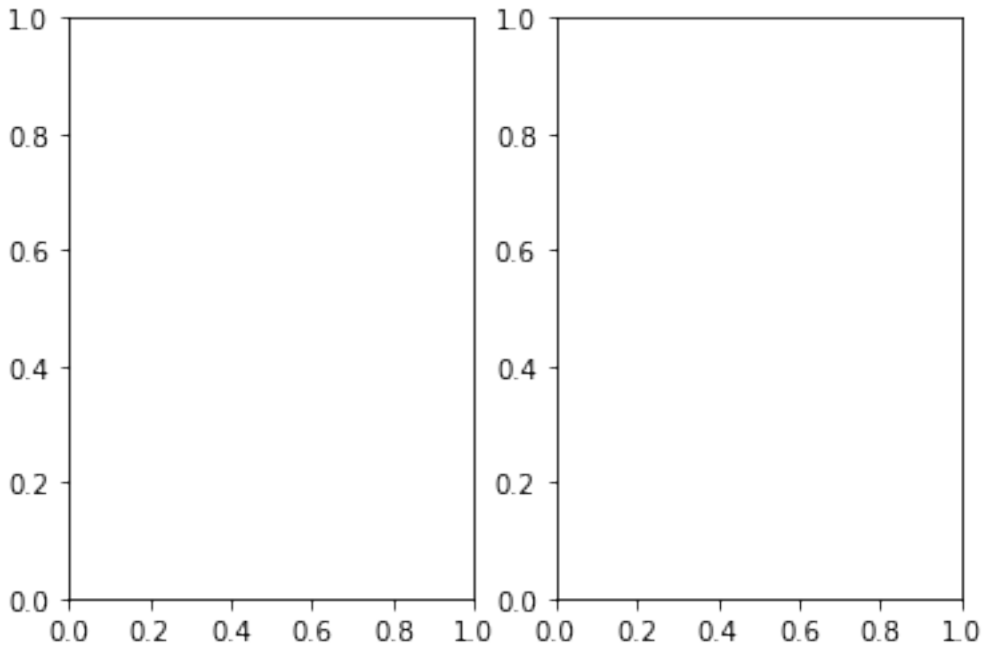
`Axes`

Individual plots contained within the `Figure`.

Creating subplots

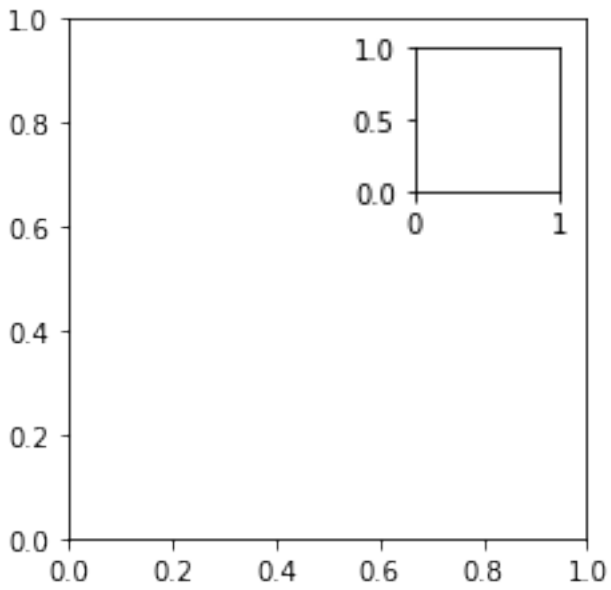
Simply specify the number of rows and columns to create:

```
fig, axes = plt.subplots(1, 2)
```



As an alternative to using `plt.subplots()` we can add `Axes` objects to the `Figure` object on our own. This allows for some more complex layouts, such as picture in picture:

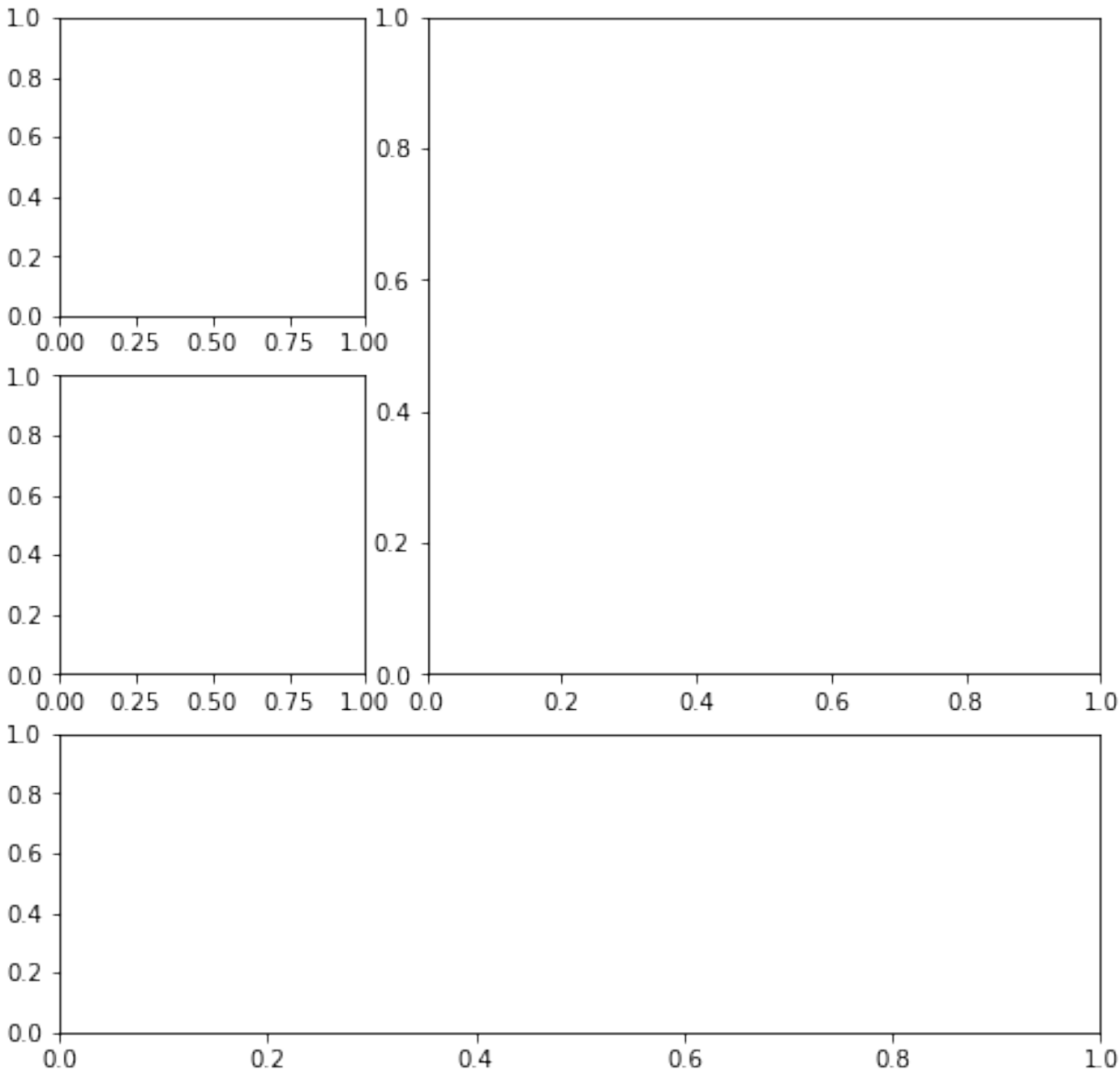
```
fig = plt.figure(figsize=(3, 3))
outside = fig.add_axes([0.1, 0.1, 0.9, 0.9])
inside = fig.add_axes([0.7, 0.7, 0.25, 0.25])
```



Creating Plot Layouts with `gridspec`

We can create subplots with varying sizes as well:

```
fig = plt.figure(figsize=(8, 8))
gs = fig.add_gridspec(3, 3)
top_left = fig.add_subplot(gs[0, 0])
mid_left = fig.add_subplot(gs[1, 0])
top_right = fig.add_subplot(gs[:2, 1:])
bottom = fig.add_subplot(gs[2,:])
```



Saving plots

Use `plt.savefig()` to save the last created plot. To save a specific `Figure` object, use its `savefig()` method.

```
fig.savefig('empty.png')
```

Cleaning up

It's important to close resources when we are done with them. We use `plt.close()` to do so. If we pass in nothing, it will close the last plot, but we can pass in the specific `Figure` object to close or say `'all'` to close all `Figure` objects that are open. Let's close all the `Figure` objects that are open with `plt.close()`:

```
plt.close('all')
```

Additional plotting options

Specifying figure size

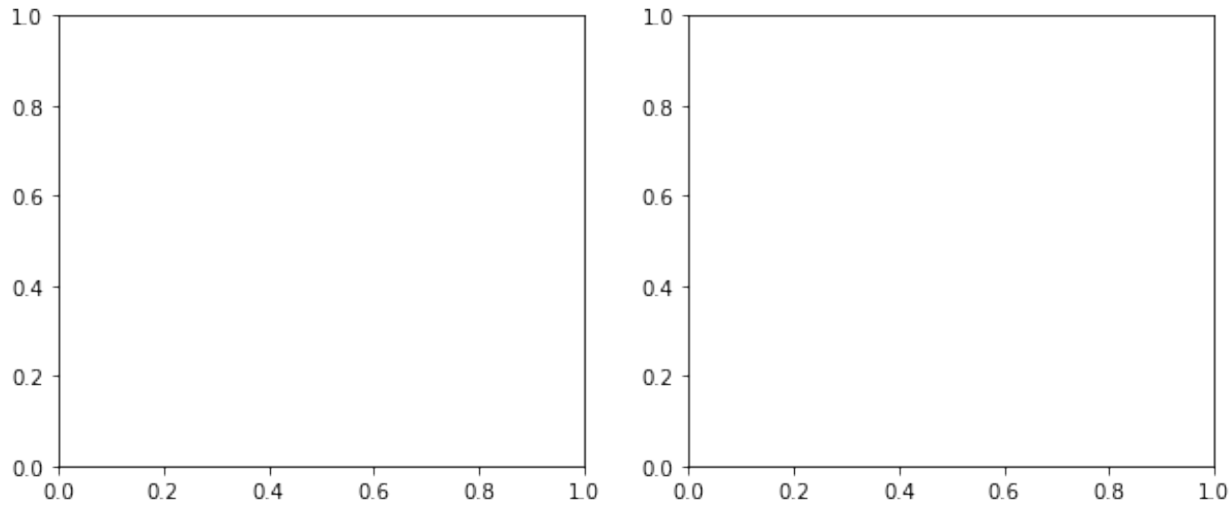
Just pass the `figsize` argument to `plt.figure()`. It's a tuple of `(width, height)`:

```
fig = plt.figure(figsize=(10, 4))
```

```
<Figure size 720x288 with 0 Axes>
```

This can be specified when creating subplots as well:

```
fig, axes = plt.subplots(1, 2, figsize=(10, 4))
```



`rcParams`

A small subset of all the available plot settings (shuffling to get a good variation of options):

```
import random
import matplotlib as mpl

rcparams_list = list(mpl.rcParams.keys())
random.seed(20) # make this repeatable
random.shuffle(rcparams_list)
sorted(rcparams_list[:20])
```

```
['axes.axisbelow',
 'axes.formatter.limits',
 'boxplot.vertical',
 'contour.corner_mask',
```

```
 'date.autoformatter.month',
 'legend.labelspacing',
 'lines.dashed_pattern',
 'lines.dotted_pattern',
 'lines.scale_dashes',
 'lines.solid_capstyle',
 'lines.solid_joinstyle',
 'mathtext.tt',
 'patch.linewidth',
 'pdf.fonttype',
 'savefig.jpeg_quality',
 'svg.fonttype',
 'text.latex.preview',
 'toolbar',
 'ytick.labelright',
 'ytick.minor.size']
```

We can check the current default `figsize` using `rcParams`:

```
mpl.rcParams['figure.figsize']
```

```
[6.0, 4.0]
```

We can also update this value to change the default (until the kernel is restarted):

```
mpl.rcParams['figure.figsize'] = (300, 10)
mpl.rcParams['figure.figsize']
```

```
[300.0, 10.0]
```

Use `rcdefaults()` to restore the defaults. Note this is slightly different than before because running `%matplotlib inline` sets a different value for `figsize` (see more). After we reset, we are going back to the default value of `figsize` before that import:

```
mpl.rcdefaults()
mpl.rcParams['figure.figsize']
```

```
[6.4, 4.8]
```

This can also be done via `pyplot`:

```
plt.rc('figure', figsize=(20, 20)) # change `figsize` default to (20,
20)
plt.rcdefaults() # reset the default
```