

# Matplotlib Introduction

Molecular Statistics

April 4, 2017

## 1 Introduction

**Matplotlib** (MPL) is a module for Python used for plotting. It is very useful for visualizing all kinds of data types and is extremely customizable. For plot examples see [matplotlib.org/gallery.html](http://matplotlib.org/gallery.html) and [weblog.oria.fr/~rougier/teaching/matplotlib](http://weblog.oria.fr/~rougier/teaching/matplotlib).

This short introduction will go through small plots with code examples. For advanced examples (like 3D plots), see the examples above or use "Google".

To utilize the power of matplotlib in a simple way we use a wrapper function called **pyplot** (PLT), which basically means that we can use matplotlib without any crazy coding (involving classes and instances etc). This is simply done by importing the pyplot module in the head of your `.py` file.

```
1 import numpy as np
2 import matplotlib.pyplot as plt
```

After creating a plot, there are several ways to show the results. You can either open a window to show the plot or save the plot as an image or another format.

```
1 plt.show() # Show the plot in a new window
2 plt.savefig('my_plot.png') # Save the plot in a file
```

The `savefig()` function can save to `.png`, `.eps`, `.svg`, as well as `.pdf` formats, which are very useful for use in L<sup>A</sup>T<sub>E</sub>X.

When working with multiple plots in the same script, remember to clear the plot data after each figure is shown or saved, or you will see a mess of data in your plots. This is done using the `clf()` function from PLT.

```
1 plt.clf()
```

If you want to make your graphs look good with different colors, fonts and spacings, then I would recommend you to look at [github.com/charnley/matplotlib-header](https://github.com/charnley/matplotlib-header) and [matplotlib.org/users/customizing.html](http://matplotlib.org/users/customizing.html).


Happy Pyplot'ing!

## 2 Examples

### 2.1 XY

A simple example is to plot  $x$  and  $y$  coordinates based on two simple python lists. For  $y(x) = x^2$ .

```
1 import matplotlib.pyplot as plt
2
3 x = range(1, 20)
4 y = [i**2 for i in x]
5
6 plt.plot(x, y)
7 plt.savefig('figure_xy.eps')
```



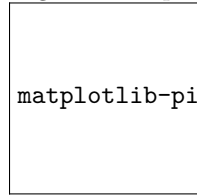
matplotlib-pics.pdf

## 2.2 Titles and labels

However a graph is worth nothing without title and axis-labels, which can be included by the following syntax. It is also possible to include latex code in the strings.

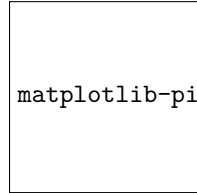
```
1 import matplotlib.pyplot as plt
2
3 # Data
4 x = range(1, 20)
5 y = [i**2 for i in x]
6
7
8 # First graph
9 plt.title('Nice Graph Title')
10 plt.xlabel('Energy [kcal/mol]')
11 plt.ylabel('Something else  $\hat{\lambda}^2$ ')
12
13 plt.plot(x, y)
14 plt.savefig('figure_title.eps')
15
16
17 # Clear data
18 plt.clf()
19
20
21 # Second graph
22 plt.title('Another nice title')
23 plt.xlabel('X [ $R^2$ ]')
24 plt.ylabel('Y [ $\hat{\epsilon}$ ]')
25
26 # Place some text
27 plt.text(5, 200, r' $\mu=100, \sigma=15$ ')
28
29 plt.plot(x, y)
30 plt.savefig('figure_title_text.eps')
```

figure\_title.eps



matplotlib-pics.pdf

figure\_title\_text.eps



matplotlib-pics.pdf

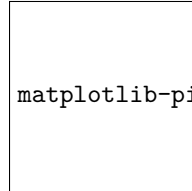
## 2.3 Multiple lines

Usually you will need to plot multiple datasets in the same figure which is done by adding more `plot()` functions. For customization you can add labels and choose color and line-type for the specific data sets. See appendix A for a full list of colors and line styles. If you do not choose a color, a color will be chosen by default.

Note that the location of the legend box can be set by changing the string location.

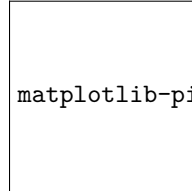
```
1 import matplotlib.pyplot as plt
2 import numpy as np
3
4 # Data
5 x = np.arange(0, 14, 0.1)
6 y_cos = [np.cos(i) for i in x]
7 y_sin = [np.sin(i) for i in x]
8
9 # First plot
10 plt.plot(x, y_cos, 'r-')
11 plt.plot(x, y_sin, 'b-')
12
13 plt.savefig('figure_sincos1.eps')
14
15 # Clear MPL data
16 plt.clf()
17
18 # Second figure
19 plt.plot(x, y_cos, '-', label="Cos
    function")
20 plt.plot(x, y_sin, '.-', label="Sin
    function")
21
22 # Location of legend
23 plt.legend(loc='upper left')
24
25 plt.savefig('figure_sincos2.eps')
```

figure\_sincos2.eps



matplotlib-pics.pdf

figure\_sincos2.eps



matplotlib-pics.pdf

## A Plot styling

### A.1 Colors

b	blue
g	green
r	red
c	cyan
m	magenta
y	yellow
k	black
w	white

### A.2 Line styles

0	tickleft
1	tickright
2	tickup
3	tickdown
4	caretleft
D	diamond
6	caretup
7	caretdown
s	square
—	vline
x	x
5	caretright
-	hline
^	triangle up
d	thin diamond
h	hexagon1
+	plus
*	star
,	pixel
o	circle
.	point
'1'	tri down
p	pentagon
'3'	tri left
'2'	tri up
'4'	tri right
H	hexagon2
v	triangle down
'8'	octagon
<	triangle left
>	triangle right