Announcements

- 1. Reading:
 - (a) Pyplot Tutorial
 - (b) IEEE: The Top Programming Languages
 - (c) In Matplotlib 2.x By Example by Yu, Chung, and Yim
 - i. Chapter 1, Hello Plotting World!
 - ii. Chapter 2, Figure Aesthetics
- 2. Supplemental materials:
 - (a) Ten Simple Rules for Better Figures
 - (b) matplotlib web site
 - (c) matplotlib.pyplot API reference
 - (d) pandas: powerful Python data analysis toolkit
 - (e) Sparkfun: Graph Sensor Data with Python and Matplotlib
 - (f) Plotting with MATLAB
 - (g) MATLAB Graphics at MathWorks





- Don't fit a curve to the data points unless you are sure you know the shape of the curve.
- For measured data, clearly mark the measured data points.
- Don't crowd the tics on either axis, don't put tics in the center of the graph.
- Don't use exponential notation for tic labels.
- Provide a legend or other labels to indicate what is being plotted if there is more than one dataset.
- Label the units for each axis.
- Don't use pastel or light colors.



A bad graph



Figure 1 presents the spectrum of a typical dc charger injecting into the power-main-switching frequency harmonics at 70 kHz (main frequency), 140 kHz, 210 kHz, 280 kHz and so on.

Electronic Engineering Times, March 5, 2012, p. 36

- No units on X axis
- Has both a title and a caption, they are inconsistent
- X axis title is unclear
- X axis tics inconsistent with text
- Misspelled word in title
- Y axis units (dB) need a reference

Another bad graph



Figure 1 shows some measurements of capacitance as a function of dc voltage on a 10- μ F, 25V Y5V 1206 capacitor. EDN, August 2012, p. 55

- Excessive grid lines
- Poor choice of line/point styles
- Vertical axis units should be µF
- Tic values don't line up with grid
- Blurry, not a vector graphic
- Not connected well with the text

matplotlib

https://matplotlib.org/



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

```
mydataframe = pd.read_csv('./Diodes.csv')
```

```
plt.plot('v1', 'ID7', data=mydataframe)
```

plt.show()

Graphing quantitative information

• Axis labels should provide a very brief descriptive name for the axis and, in parentheses, the symbol for its SI unit

- Axis ranges should begin at zero, not extend significantly beyond range of important data
- Axis tics should be spaced so labels are readable
- Use 1/2/5 multiples of standard SI units for tic spacing

```
plt.xlabel("My X Axis Label")
plt.ylabel("My Y Axis Label")
plt.axis([minx, maxx, miny, maxy])
plt.legend()
```

- Choose units that give plotted values a magnitude between 0.1 and 1000
- Use only engineering prefixes (e.g. n, μ , m, k, G). There are a few exceptions, such as cm.
- Never use "e" notation for axis tics (e.g. 3.14e 01). For logarithmic axes, use exponential notation (10^{-2} , 10^3) or decimal fractions (0.01, 1000)

```
# Increase price of spam by ten cents
mydataframe['spam'] = mydataframe['spam'] + 0.10
```

- Move the "key" (or "legend") inside the plot area
- Use descriptive names for data series in the key

```
plt.plot('price', 'myitem3', data=mydataframe, label="SPAM")
```

• Eliminate the key altogether, label the data series themselves

```
plt.plot('price', 'myitem3', data=mydataframe)
plt.text(MyX,MyY,"SPAM")
#plt.legend()
```

- Graphs used in documents need a short caption, usually including a figure number that can be referenced in the text
- · Graphs used in presentations need a title
- If data is from another source, provide a citation with the graphic

```
plt.title("My Great Plot Title")
plt.savefig("MyPlotFile.pdf")
```

matplotlib (PDF, 7675 bytes)



Graphing quantitative information

Plot data points instead of lines if the data set is small or the mathematical relationship is unknown

- Avoid point symbols that have a similar appearance
- Make point symbols large when compared to line thickness
- Connect the points with line segments **or** plot the fit curve. In the text, clarify what you have done.

Plot data points using red filled circles
plt.plot('price', 'myitem3', 'or', data=mydataframe)

matplotlib



File formats for graphics

- Use a vector format for data graphs (e.g. pdf, eps, svg)
- If a vector format cannot be used, save the graphic as a PNG or TIFF using a density of 300 dpi or greater

• JPEG files should only be used for photographs in a presentation or on a web page

MATLAB/Octave - Reading data from a file

A common generic file format for data is the CSV (comma separated value) file.

```
v1,I(D0),I(D9),I(D8)
0.000e+00,0.000e+00,0.000e+00,0.000e+00
4.000e-02,1.558e-08,1.405e-07,4.001e-14
8.000e-02,3.486e-08,1.299e-06,8.005e-14
M = dlmread('mydata.csv',',','A1..A500');
M = csvread('mydata.csv','A1..A500');
```

Columns are *letters*, starting with A.

Rows are *numbers*, starting with 1.

MATLAB/Octave - Plotting

Other commands you might need:

```
plot(MyXArray, MyYArray);
title('My Plot Title');
xlabel('My X Axis Label');
ylabel('My Y Axis Label');
axis([MinX, MaxX, MinY, MaxY]);
grid on/off;
text(Xloc, Yloc, 'Some String');
saveas(Fig,'MyFilename','Filetype');
```

Note that strings are enclosed in **single** quotes, unlike most other programming languages.

The Result



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