

# Python For Data Science Cheat Sheet

## Matplotlib

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### Matplotlib

Matplotlib is a Python 2D plotting library which produces publication-quality figures in a variety of hardcopy formats and interactive environments across platforms.



### 1 Prepare The Data

Also see Lists & NumPy

#### 1D Data

```
>>> import numpy as np
>>> x = np.linspace(0, 10, 100)
>>> y = np.cos(x)
>>> z = np.sin(x)
```

#### 2D Data or Images

```
>>> data = 2 * np.random.random((10, 10))
>>> data2 = 3 * np.random.random((10, 10))
>>> Y, X = np.mgrid[-3:3:100j, -3:3:100j]
>>> U = -1 - X**2 + Y
>>> V = 1 + X - Y**2
>>> from matplotlib.cbook import get_sample_data
>>> img = np.load(get_sample_data('axes_grid/bivariate_normal.npy'))
```

### 2 Create Plot

```
>>> import matplotlib.pyplot as plt
```

#### Figure

```
>>> fig = plt.figure()
>>> fig2 = plt.figure(figsize=plt.figaspect(2.0))
```

#### Axes

All plotting is done with respect to an Axes. In most cases, a subplot will fit your needs. A subplot is an axes on a grid system.

```
>>> fig.add_axes()
>>> ax1 = fig.add_subplot(221) # row-col-num
>>> ax3 = fig.add_subplot(212)
>>> fig3, axes = plt.subplots(nrows=2,ncols=2)
>>> fig4, axes2 = plt.subplots(ncols=3)
```

### 3 Plotting Routines

#### 1D Data

<pre>&gt;&gt;&gt; lines = ax.plot(x,y) &gt;&gt;&gt; ax.scatter(x,y) &gt;&gt;&gt; axes[0,0].bar([1,2,3],[3,4,5]) &gt;&gt;&gt; axes[1,0].barh([0.5,1,2.5],[0,1,2]) &gt;&gt;&gt; axes[1,1].axhline(0.45) &gt;&gt;&gt; axes[0,1].axvline(0.65) &gt;&gt;&gt; ax.fill(x,y,color='blue') &gt;&gt;&gt; ax.fill_between(x,y,color='yellow')</pre>	<p>Draw points with lines or markers connecting them</p> <p>Draw unconnected points, scaled or colored</p> <p>Plot vertical rectangles (constant width)</p> <p>Plot horizontal rectangles (constant height)</p> <p>Draw a horizontal line across axes</p> <p>Draw a vertical line across axes</p> <p>Draw filled polygons</p> <p>Fill between y-values and 0</p>
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#### 2D Data or Images

<pre>&gt;&gt;&gt; fig, ax = plt.subplots() &gt;&gt;&gt; im = ax.imshow(img,     cmap='gist_earth',     interpolation='nearest',     vmin=-2,     vmax=2)</pre>	Colormapped or RGB arrays
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#### Vector Fields

<pre>&gt;&gt;&gt; axes[0,1].arrow(0,0,0.5,0.5) &gt;&gt;&gt; axes[1,1].quiver(y,z) &gt;&gt;&gt; axes[0,1].streamplot(X,Y,U,V)</pre>	<p>Add an arrow to the axes</p> <p>Plot a 2D field of arrows</p> <p>Plot 2D vector fields</p>
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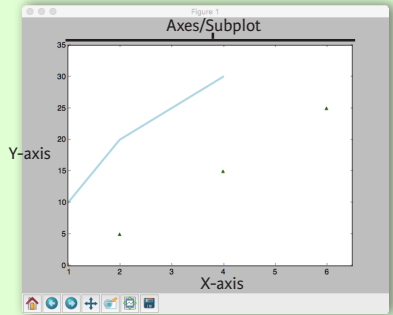
#### Data Distributions

<pre>&gt;&gt;&gt; ax1.hist(y) &gt;&gt;&gt; ax3.boxplot(y) &gt;&gt;&gt; ax3.violinplot(z)</pre>	<p>Plot a histogram</p> <p>Make a box and whisker plot</p> <p>Make a violin plot</p>
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<pre>&gt;&gt;&gt; axes2[0].pcolor(data2) &gt;&gt;&gt; axes2[0].pcolormesh(data) &gt;&gt;&gt; CS = plt.contour(Y,X,U) &gt;&gt;&gt; axes2[2].contourf(data1) &gt;&gt;&gt; axes2[2] = ax.clabel(CS)</pre>	<p>Pseudocolor plot of 2D array</p> <p>Pseudocolor plot of 2D array</p> <p>Plot contours</p> <p>Plot filled contours</p> <p>Label a contour plot</p>
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### Plot Anatomy & Workflow

#### Plot Anatomy



#### Workflow

The basic steps to creating plots with matplotlib are:

- 1 Prepare data
- 2 Create plot
- 3 Plot
- 4 Customize plot
- 5 Save plot
- 6 Show plot

```
>>> import matplotlib.pyplot as plt
>>> x = [1,2,3,4]
>>> y = [10,20,25,30]
>>> fig = plt.figure()
>>> ax = fig.add_subplot(111)
>>> ax.plot(x, y, color='lightblue', linewidth=3)
>>> ax.scatter([2,4,6],
    [5,15,25],
    color='darkgreen',
    marker='^')
>>> ax.set_xlim(1, 6.5)
>>> plt.savefig('foo.png')
>>> plt.show()
```

### 4 Customize Plot

#### Colors, Color Bars & Color Maps

```
>>> plt.plot(x, x, x, x**2, x, x**3)
>>> ax.plot(x, y, alpha = 0.4)
>>> ax.plot(x, y, c='k')
>>> fig.colorbar(im, orientation='horizontal')
>>> im = ax.imshow(img,
    cmap='seismic')
```

#### Markers

```
>>> fig, ax = plt.subplots()
>>> ax.scatter(x,y,marker=".")
>>> ax.plot(x,y,marker="o")
```

#### Linestyles

```
>>> plt.plot(x,y,linewidth=4.0)
>>> plt.plot(x,y,ls='solid')
>>> plt.plot(x,y,ls='--')
>>> plt.plot(x,y,'--',x**2,y**2,'-.')
>>> plt.setp(lines,color='r',linewidth=4.0)
```

#### Text & Annotations

```
>>> ax.text(1,
    -2.1,
    'Example Graph',
    style='italic')
>>> ax.annotate("Sine",
    xy=(8, 0),
    xycoords='data',
    xytext=(10.5, 0),
    textcoords='data',
    arrowprops=dict(arrowstyle="->",
        connectionstyle="arc3"),)
```

#### Mathtext

```
>>> plt.title(r'$\sigma_i=15$', fontsize=20)
```

#### Limits, Legends & Layouts

##### Limits & Autoscaling

```
>>> ax.margins(x=0.0,y=0.1)
>>> ax.axis('equal')
>>> ax.set(xlim=[0,10.5],ylim=[-1.5,1.5])
>>> ax.set_xlim(0,10.5)
```

##### Legends

```
>>> ax.set(title='An Example Axes',
    ylabel='Y-Axis',
    xlabel='X-Axis')
>>> ax.legend(loc='best')
```

##### Ticks

```
>>> ax.xaxis.set(ticks=range(1,5),
    ticklabels=[3,100,-12,"foo"])
>>> ax.tick_params(axis='y',
    direction='inout',
    length=10)
```

##### Subplot Spacing

```
>>> fig3.subplots_adjust(wspace=0.5,
    hspace=0.3,
    left=0.125,
    right=0.9,
    top=0.9,
    bottom=0.1)
```

```
>>> fig.tight_layout()
```

##### Axis Spines

```
>>> ax1.spines['top'].set_visible(False)
>>> ax1.spines['bottom'].set_position(('outward',10))
```

Add padding to a plot

Set the aspect ratio of the plot to 1

Set limits for x-and y-axis

Set limits for x-axis

Set a title and x-and y-axis labels

No overlapping plot elements

Manually set x-ticks

Make y-ticks longer and go in and out

Adjust the spacing between subplots

Fit subplot(s) in to the figure area

Make the top axis line for a plot invisible

Move the bottom axis line outward

### 5 Save Plot

#### Save figures

```
>>> plt.savefig('foo.png')
```

#### Save transparent figures

```
>>> plt.savefig('foo.png', transparent=True)
```

### 6 Show Plot

```
>>> plt.show()
```

### Close & Clear

```
>>> plt.cla()
>>> plt.clf()
>>> plt.close()
```

Clear an axis

Clear the entire figure

Close a window

