matplotlib Cheat sheet

Version 3.5.0

Quick start

API

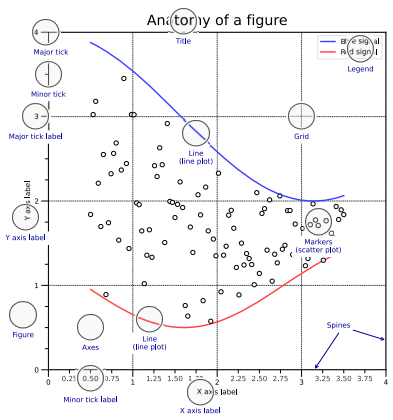
```
import numpy as np
import matplotlib as mpl
import matplotlib.pyplot as plt


X = np.linspace(0, 2*np.pi, 100)
Y = np.cos(X)

fig, ax = plt.subplots()
ax.plot(X, Y, color='green')

fig.savefig("figure.pdf")
plt.show()
```

Anatomy of a figure



Subplots layout

API

```
subplot[s](rows,cols,…)
fig, axs = plt.subplots(3, 3)

G = gridspec(rows,cols,…)
ax = G[0,:]

ax.inset_axes(extent)

d=make_axes_locatable(ax)
ax = d.new_horizontal('10%')
```

Getting help

- matplotlib.org
- github.com/matplotlib/matplotlib/issues
- discourse.matplotlib.org
- stackoverflow.com/questions/tagged/matplotlib
- https://gitter.im/matplotlib/matplotlib
- twitter.com/matplotlib
- Matplotlib users mailing list

Basic plots

API

```
plot([X],Y,[fmt],…)
```
X, **Y**, fmt, color, marker, linestyle

```
scatter(X,Y,…)
```
X, **Y**, [s]izes, [c]olors, marker, cmap

```
bar[h](x,height,…)
```
x, **height**, width, bottom, align, color

```
imshow(Z,…)
```
Z, cmap, interpolation, extent, origin

```
contour[f]([X],[Y],Z,…)
```
X, Y, **Z**, levels, colors, extent, origin

```
pcolormesh([X],[Y],Z,…)
```
X, Y, **Z**, vmin, vmax, cmap

```
quiver([X],[Y],U,V,…)
```
X, Y, **U**, **V**, C, units, angles

```
pie(X,…)
```
Z, explode, labels, colors, radius

```
text(x,y,text,…)
```
x, **y**, **text**, va, ha, size, weight, transform

```
fill[_between][x](…)
```
X, Y1, Y2, color, where

Advanced plots

API

```
step(X,Y,[fmt],…)
```
X, **Y**, fmt, color, marker, where

```
boxplot(X,…)
```
X, notch, sym, bootstrap, widths

```
errorbar(X,Y,xerr,yerr,…)
```
X, **Y**, xerr, yerr, fmt

```
hist(X, bins, …)
```
X, bins, range, density, weights

```
violinplot(D,…)
```
D, positions, widths, vert

```
barbs([X],[Y], U, V, …)
```
X, Y, **U**, **V**, C, length, pivot, sizes

```
eventplot(positions,…)
```
positions, orientation, lineoffsets

```
hexbin(X,Y,C,…)
```
X, **Y**, C, gridsize, bins

Scales

API

```
ax.set_[xy]scale(scale,…)
```
linear any values
log values > 0
symlog any values
logit 0 < values < 1

Projections

API

```
subplot(…,projection=p)
```
p='polar'
p='3d'

p=ccrs.Orthographic()
import cartopy.crs as ccrs

Lines

API

linestyle or ls

"-" ":" "--" "-." (0,(0.01,2))

capstyle or dash_capstyle

"butt" "round" "projecting"

Markers

API

markevery

10 [0, -1] (25, 5) [0, 25, -1]

Colors

API

'Cn'
'x'
'name'
(R,G,B[,A])
'#RRGGBB[AA]'
'x.y'

Colormaps

API

```
plt.get_cmap(name)
```

Uniform: viridis, magma, plasma

Sequential: Greys, YlOrBr, Wistia

Diverging: Spectral, coolwarm, RdGy

Qualitative: tab10, tab20

Cyclic: twilight

Tick locators

API

```
from matplotlib import ticker
ax.[xy]axis.set_[minor|major]_locator(locator)

ticker.NullLocator()
ticker.MultipleLocator(0.5)
ticker.FixedLocator([0, 1, 5])
ticker.LinearLocator(numticks=3)
ticker.IndexLocator(base=0.5, offset=0.25)
ticker.AutoLocator()
ticker.MaxNLocator(n=4)
ticker.LogLocator(base=10, numticks=15)
```

Tick formatters

API

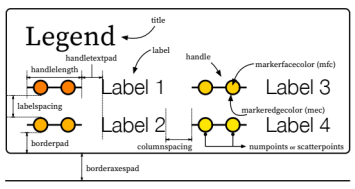
```
from matplotlib import ticker
ax.[xy]axis.set_[minor|major]_formatter(formatter)

ticker.NullFormatter()
ticker.FixedFormatter(['zero', 'one', 'two', …])
ticker.FuncFormatter(lambda x, pos: "[%.2f]" % x)
ticker.FormatStrFormatter('>%d<')
ticker.ScalarFormatter()
ticker.StrMethodFormatter('{x}')
ticker.PercentFormatter(xmax=5)
```

Ornaments

API

```
ax.legend(…)
```
handles, labels, loc, title, frameon




```
ax.colorbar(…)
```
mappable, ax, cax, orientation

```
ax.annotate(…)
```
text, **xy**, **xytext**, xycoords, textcoords, arrowprops

Event handling

API

```
fig, ax = plt.subplots()
def on_click(event):
  print(event)
fig.canvas.mpl_connect(
  'button_press_event', on_click)
```

Animation

API

```
import matplotlib.animation as mpla

T = np.linspace(0, 2*np.pi, 100)
S = np.sin(T)
line, = plt.plot(T, S)
def animate(i):
    line.set_ydata(np.sin(T+i/50))
anim = mpla.FuncAnimation(
    plt.gcf(), animate, interval=5)
plt.show()
```

Styles

API

```
plt.style.use(style)
```

default, classic, grayscale, ggplot, seaborn, fast, bmh, Solarize_Light2, seaborn-notebook

Quick reminder

```
ax.grid()
ax.set_[xy]lim(vmin, vmax)
ax.set_[xy]label(label)
ax.set_[xy]ticks(ticks, [labels])
ax.set_[xy]ticklabels(labels)
ax.set_title(title)
ax.tick_params(width=10, …)
ax.set_axis_[on|off]()

fig.suptitle(title)
fig.tight_layout()
plt.gcf(), plt.gca()
mpl.rc('axes', linewidth=1, …)
[fig|ax].patch.set_alpha(0)
text=r'$\frac{-e^{i\pi}}{2^n}$'
```

Keyboard shortcuts

API

ctrl + s	Save	ctrl + w	Close plot
r	Reset view	f	Fullscreen 0/1
f	View forward	b	View back
p	Pan view	o	Zoom to rect
x	X pan/zoom	y	Y pan/zoom
g	Minor grid 0/1	G	Major grid 0/1
l	X axis log/linear	L	Y axis log/linear

Ten simple rules

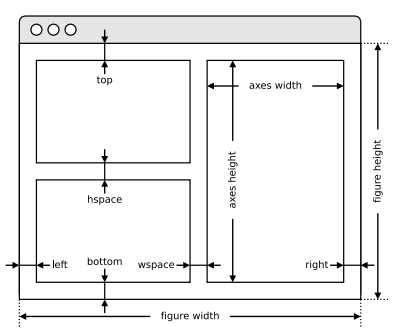
READ

1. Know your audience
2. Identify your message
3. Adapt the figure
4. Captions are not optional
5. Do not trust the defaults
6. Use color effectively
7. Do not mislead the reader
8. Avoid "chartjunk"
9. Message trumps beauty
10. Get the right tool

Axes adjustments

API

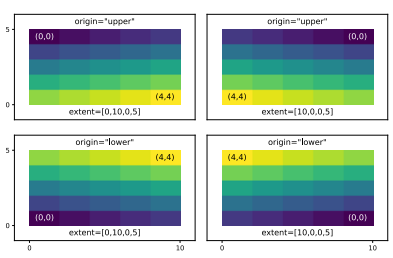
plt.**subplots_adjust**(…)



Extent & origin

API

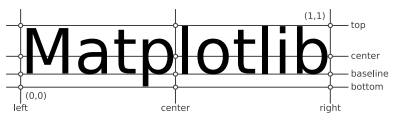
ax.**imshow**(extent=…, origin=…)



Text alignments

API

ax.**text**(…, ha=… , va=…, …)



Text parameters

API

ax.**text**(…, family=…, size=…, weight=…)
ax.**text**(…, fontproperties=…)

The quick brown fox — xx-large (1.73)
The quick brown fox — x-large (1.44)
The quick brown fox — large (1.20)
The quick brown fox — medium (1.00)
The quick brown fox — small (0.83)
The quick brown fox — x-small (0.69)
The quick brown fox — xx-small (0.58)

The quick brown fox jumps over the lazy dog — black (900)
The quick brown fox jumps over the lazy dog — bold (700)
The quick brown fox jumps over the lazy dog — semibold (600)
The quick brown fox jumps over the lazy dog — normal (400)
The quick brown fox jumps over the lazy dog — ultralight (100)

The quick brown fox jumps over the lazy dog — monospace
The quick brown fox jumps over the lazy dog — serif
The quick brown fox jumps over the lazy dog — sans
The quick brown fox jumps over the lazy dog — cursive

The quick brown fox jumps over the lazy dog — italic
The quick brown fox jumps over the lazy dog — normal

THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG — small-caps
The quick brown fox jumps over the lazy dog — normal

Uniform colormaps

viridis, plasma, inferno, magma, cividis

Sequential colormaps

Greys, Purples, Blues, Greens, Oranges, Reds, YlOrBr, YlOrRd, OrRd, PuRd, RdPu, BuPu, GnBu, PuBu, YlGnBu, PuBuGn, BuGn, YlGn

Diverging colormaps

PiYG, PRGn, BrBG, PuOr, RdGy, RdBu, RdYlBu, RdYlGn, Spectral, coolwarm, bwr, seismic

Qualitative colormaps

Pastel1, Pastel2, Paired, Accent, Dark2, Set1, Set2, Set3, tab10, tab20, tab20b, tab20c

Miscellaneous colormaps

terrain, ocean, cubehelix, rainbow, twilight

Color names

API

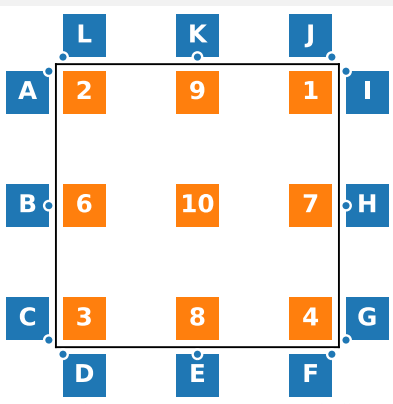
black, k, dimgray, dimgrey, gray, grey, darkgray, darkgrey, silver, lightgray, lightgrey, gainsboro, whitesmoke, w, white, snow, rosybrown, lightcoral, indianred, brown, firebrick, maroon, darkred, r, red, mistyrose, salmon, tomato, darksalmon, coral, orangered, lightsalmon, sienna, seashell, chocolate, saddlebrown, sandybrown, peachpuff, peru, linen, bisque, darkorange, burlywood, antiquewhite, tan, navajowhite, blanchedalmond, papayawhip, moccasin, orange, wheat, oldlace, floralwhite, darkgoldenrod, goldenrod, cornsilk, gold, lemonchiffon, khaki, palegoldenrod, darkkhaki, ivory, beige, lightyellow, lightgoldenrodyellow, olive, y, yellow, olivedrab, yellowgreen, darkolivegreen, greenyellow, chartreuse, lawngreen, honeydew, darkseagreen, palegreen, lightgreen, forestgreen, limegreen, darkgreen, g, green, lime, seagreen, mediumseagreen, springgreen, mintcream, mediumspringgreen, mediumaquamarine, aquamarine, turquoise, lightseagreen, mediumturquoise, azure, lightcyan, paleturquoise, darkslategray, darkslategrey, teal, darkcyan, c, aqua, cyan, darkturquoise, cadetblue, powderblue, lightblue, deepskyblue, skyblue, lightskyblue, steelblue, aliceblue, dodgerblue, lightslategray, lightslategrey, slategray, slategrey, lightsteelblue, cornflowerblue, royalblue, ghostwhite, lavender, midnightblue, navy, darkblue, mediumblue, b, blue, slateblue, darkslateblue, mediumslateblue, mediumpurple, rebeccapurple, blueviolet, indigo, darkorchid, darkviolet, mediumorchid, thistle, plum, violet, purple, darkmagenta, m, fuchsia, magenta, orchid, mediumvioletred, deeppink, hotpink, lavenderblush, palevioletred, crimson, pink, lightpink

Image interpolation

API

None, none, nearest, bilinear, bicubic, spline16, spline36, hanning, hamming, hermite, kaiser, quadric, catrom, gaussian, bessel, mitchell, sinc, lanczos

Legend placement



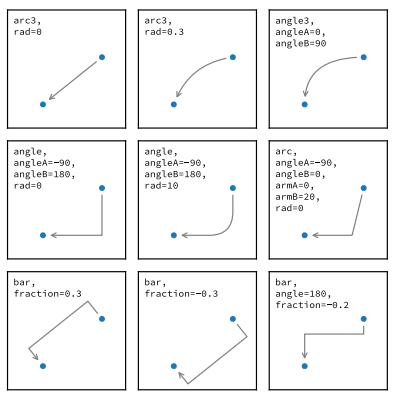
ax.**legend**(loc="string", bbox_to_anchor=(x,y))

2: upper left	9: upper center	1: upper right
6: center left	10: center	7: center right
3: lower left	8: lower center	4: lower right

A: upper right / (-0.1,0.9)
B: center right / (-0.1,0.5)
C: lower right / (-0.1,0.1)
D: upper left / (0.1,-0.1)
E: upper center / (0.5,-0.1)
F: upper right / (0.9,-0.1)
G: lower left / (1.1,0.1)
H: center left / (1.1,0.5)
I: upper left / (1.1,0.9)
J: lower right / (0.9,1.1)
K: lower center / (0.5,1.1)
L: lower left / (0.1,1.1)

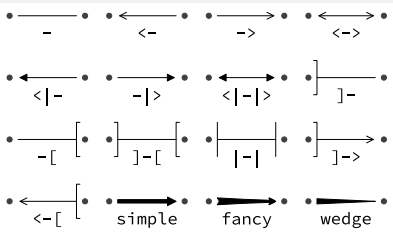
Annotation connection styles

API



Annotation arrow styles

API



How do I …

… resize a figure?
→ fig.set_size_inches(w, h)
… save a figure?
→ fig.savefig("figure.pdf")
… save a transparent figure?
→ fig.savefig("figure.pdf", transparent=True)
… clear a figure/an axes?
→ fig.clear() → ax.clear()
… close all figures?
→ plt.close("all")
… remove ticks?
→ ax.set_[xy]ticks([])
… remove tick labels ?
→ ax.set_[xy]ticklabels([])
… rotate tick labels ?
→ ax.tick_params(axis="x", rotation=90)
… hide top spine?
→ ax.spines['top'].set_visible(False)
… hide legend border?
→ ax.legend(frameon=False)
… show error as shaded region?
→ ax.fill_between(X, Y+error, Y-error)
… draw a rectangle?
→ ax.add_patch(plt.Rectangle((0, 0), 1, 1)
… draw a vertical line?
→ ax.axvline(x=0.5)
… draw outside frame?
→ fig.plot(…, clip_on=False)
… use transparency?
→ ax.plot(…, alpha=0.25)
… convert an RGB image into a gray image?
→ gray = 0.2989*R + 0.5870*G + 0.1140*B
… set figure background color?
→ fig.patch.set_facecolor("grey")
… get a reversed colormap?
→ plt.get_cmap("viridis_r")
… get a discrete colormap?
→ plt.get_cmap("viridis", 10)
… show a figure for one second?
→ fig.show(block=False), time.sleep(1)

Performance tips

`scatter(X, Y)`	slow
`plot(X, Y, marker="o", ls="")`	fast
`for i in range(n): plot(X[i])`	slow
`plot(sum([x+[None] for x in X],[]))`	fast
`cla(), imshow(…), canvas.draw()`	slow
`im.set_data(…), canvas.draw()`	fast

Beyond Matplotlib

Seaborn: Statistical data visualization
Cartopy: Geospatial data processing
yt: Volumetric data visualization
mpld3: Bringing Matplotlib to the browser
Datashader: Large data processing pipeline
plotnine: A grammar of graphics for Python

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