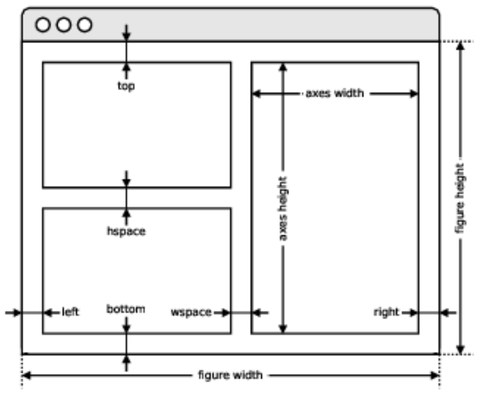
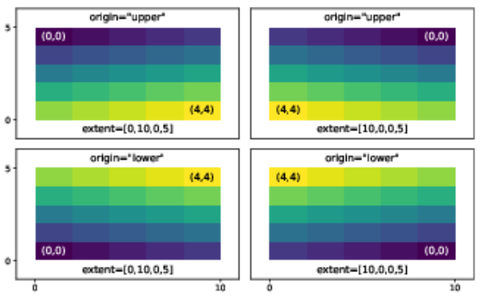
Axes adjustments API

plt.**subplots_adjust**(...)



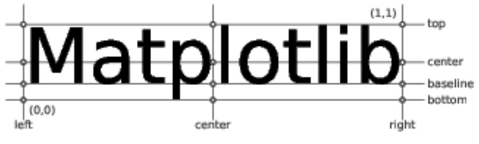
Extent & origin API

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)

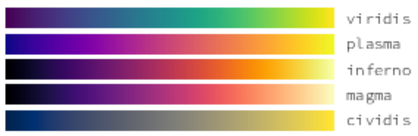
The quick brown fox jumps over the lazy dog — black (900)
The quick brown fox jumps over the lazy dog — bold (700)
The quick brown fox jumps over the lazy dog — semibold (600)
The quick brown fox jumps over the lazy dog — normal (400)
The quick brown fox jumps over the lazy dog — ultralight (100)

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

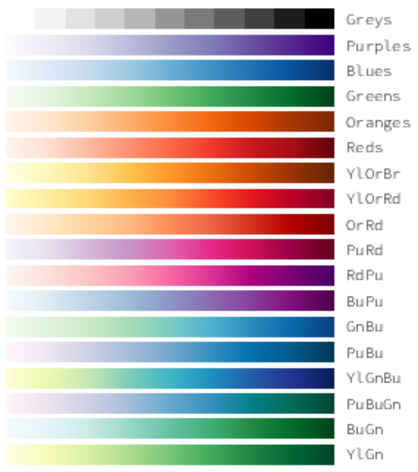
The quick brown fox jumps over the lazy dog — italic
The quick brown fox jumps over the lazy dog — normal

SMALL-CAPS — small-caps
UPPERCASE — normal

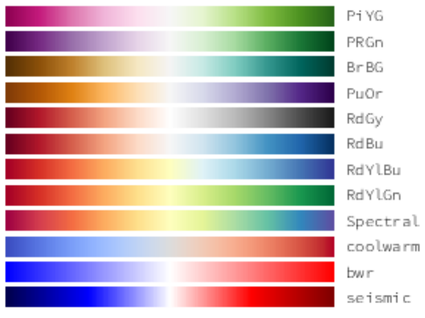
Uniform colormaps



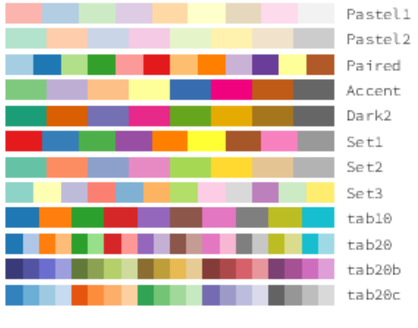
Sequential colormaps



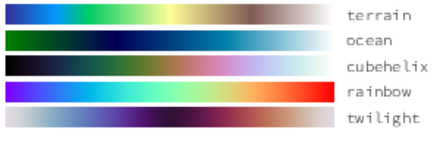
Diverging colormaps



Qualitative colormaps

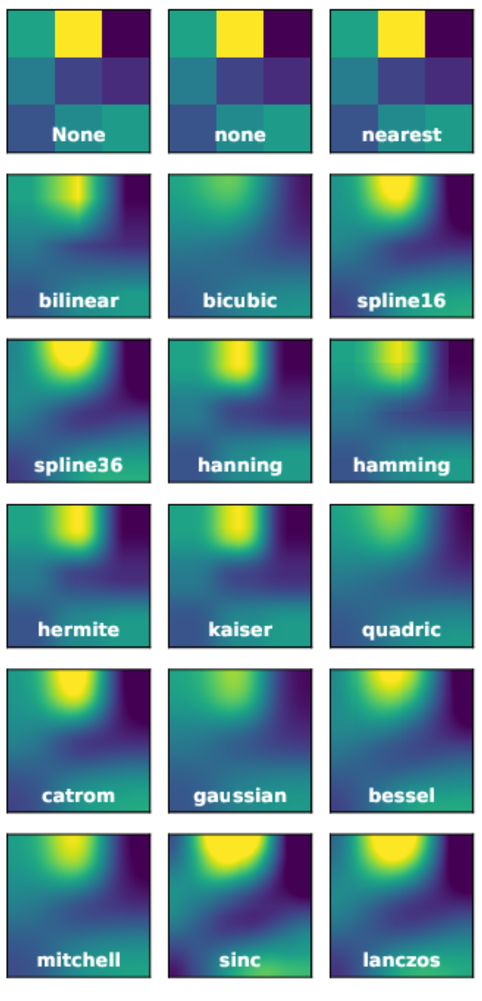


Miscellaneous colormaps

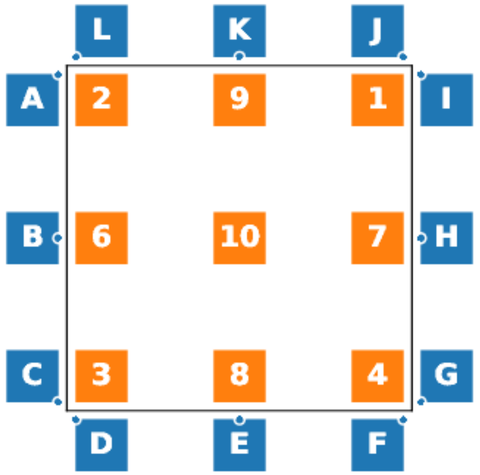


Color names API

Image interpolation API



Legend placement

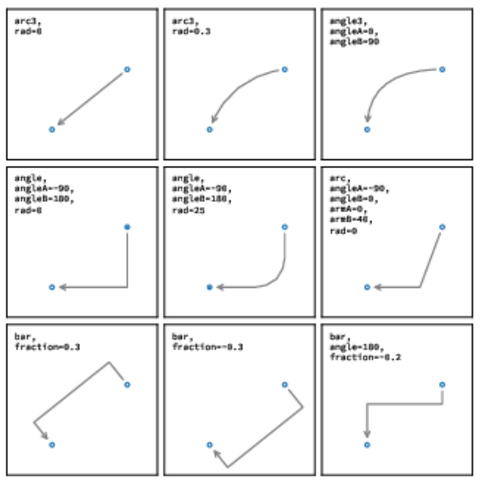


ax.**legend**(loc="string", bbox_to_anchor=(x,y))

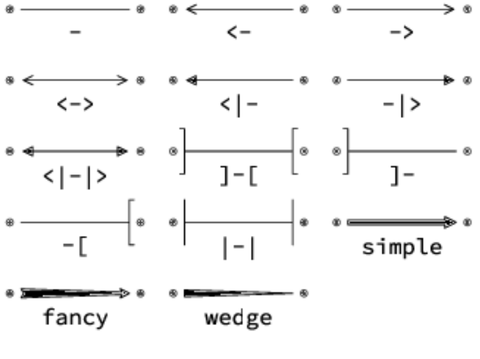
2: upper left	9: upper center	1: upper right
6: center left	10: center	7: center right
3: lower left	8: lower center	4: lower right

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?
→ ax.clear()
... close all figures?
→ plt.close("all")
... remove ticks?
→ ax.set_xticks([])
... remove tick labels ?
→ ax.set_[xy]ticklabels([])
... rotate tick labels ?
→ ax.set_[xy]ticks(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?
→ ax.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

NUMFOCUS
OPEN CODE = BETTER SCIENCE

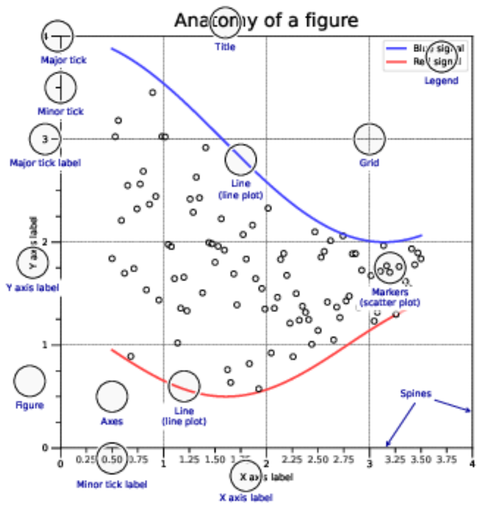
matplotlib

Cheat sheet — Version 3.4.2

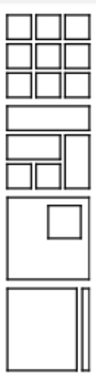
Quick start

```
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='C1')

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

Anatomy of a figure



Subplots layout



```
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
- gitter.im/matplotlib
- twitter.com/matplotlib
- Matplotlib users mailing list

Basic plots

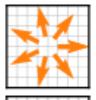
```
plot([X],Y,[fmt],…)
```
X, Y, fmt, color, marker, linestyle

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

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

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

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



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

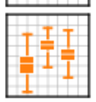
```
pie(X,[explode],…)
```
Z, explode, labels, colors, radius


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

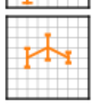
```
fill[_between][x]( … )
```
X, Y1, Y2, color, where

Advanced plots

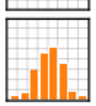
```
step(X,Y,[fmt],…)
```
X, Y, fmt, color, marker, where



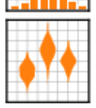
```
boxplot(X,…)
```
X, notch, sym, bootstrap, widths



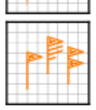
```
errorbar(X,Y,xerr,yerr,…)
```
X, Y, xerr, yerr, fmt



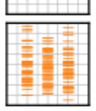
```
hist(X, bins, …)
```
X, bins, range, density, weights



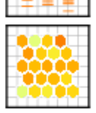
```
violinplot(D,…)
```
D, positions, widths, vert



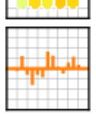
```
barbs([X],[Y], U, V, …)
```
X, Y, U, V, C, length, pivot, sizes



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



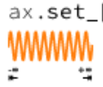
```
hexbin(X,Y,C,…)
```
X, Y, C, gridsize, bins



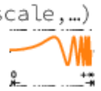
```
xcorr(X,Y,…)
```
X, Y, normed, detrend

Scales

```
ax.set_[xy]scale(scale,…)
```



linear — any values



log — values > 0

symlog — any values

logit — 0 < values < 1

Projections

```
subplot(…,projection=p)
```

p='polar'

p='3d'

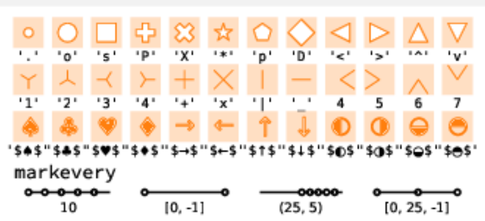
```
p=Orthographic()
from cartopy.crs import Cartographic
```

Lines

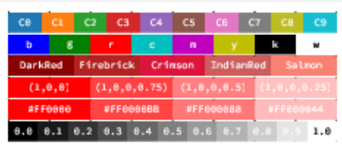
```
linestyle or ls
```


```
capstyle or dash_capstyle
```

Markers

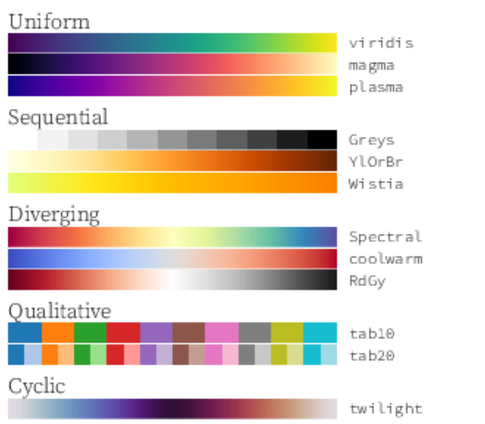


Colors



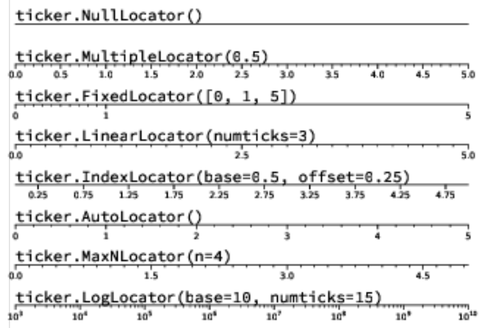
Colormaps

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



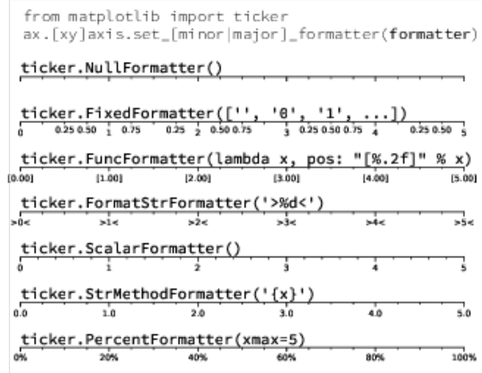
Tick locators

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



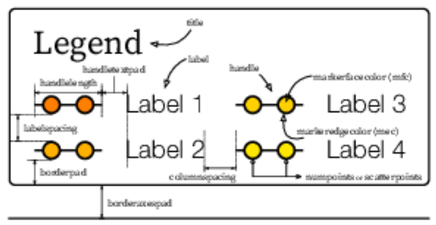
Tick formatters

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

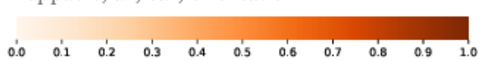


Ornaments

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




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




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

Event handling

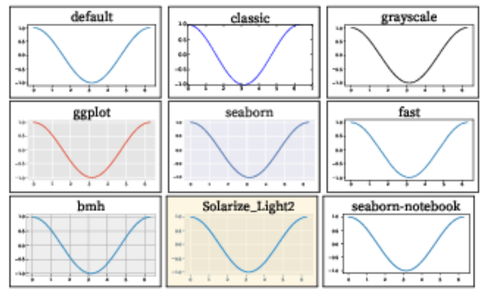
```
fig, ax = plt.subplots()
def on_click(event):
  print(event)
fig.canvas.mpl_connect(
  'button_press_event', on_click)
```

Animation

```
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

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



Quick reminder

```
ax.grid()
ax.patch.set_alpha(0)
ax.set_[xy]lim(vmin, vmax)
ax.set_[xy]label(label)
ax.set_[xy]ticks(list)
ax.set_[xy]ticklabels(list)
ax.set_[sup]title(title)
ax.tick_params(width=10, …)
ax.set_axis_[on|off]()

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

Keyboard shortcuts

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

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