matplotlib

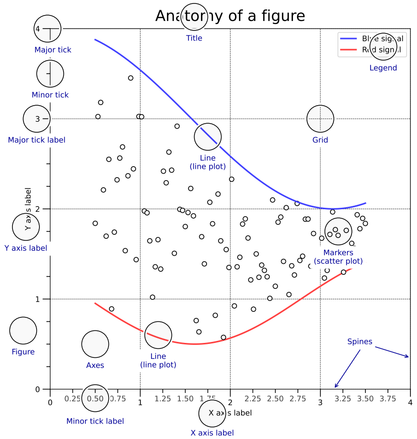
Cheat sheet

Version 3.9.4

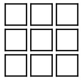
Quick start API

```
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()
```

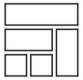
Anatomy of a figure



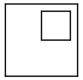
Subplots layout API



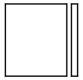
`subplot[s](rows, cols, …)` API
`fig, axs = plt.subplots(3, 3)`



`G = gridspec(rows,cols, …)` API
`ax = G[0, :]`



`ax.inset_axes(extent)` API

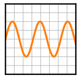


`d=make_axes_locatable(ax)` API
`ax = d.new_horizontal('10%')`

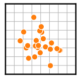
Getting help

- 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

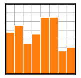
Basic plots



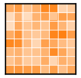
`plot([X], Y, [fmt], …)` API
X, **Y**, fmt, color, marker, linestyle



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



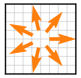
`bar[h](x, height, …)` API
x, **height**, width, bottom, align, color



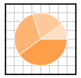
`imshow(Z, …)` API
Z, cmap, interpolation, extent, origin

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

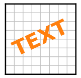
`pcolormesh([X], [Y], Z, …)` API
X, Y, **Z**, vmin, vmax, cmap



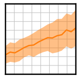
`quiver([X], [Y], U, V, …)` API
X, Y, **U**, **V**, C, units, angles



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

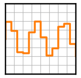


`text(x, y, text, …)` API
x, **y**, **text**, va, ha, size, weight, transform

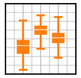


`fill[_between][x](…)` API
X, **Y1**, Y2, color, where

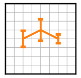
Advanced plots



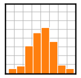
`step(X, Y, [fmt], …)` API
X, **Y**, fmt, color, marker, where



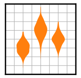
`boxplot(X, …)` API
X, notch, sym, bootstrap, widths



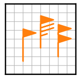
`errorbar(X,Y,xerr,yerr, …)` API
X, **Y**, xerr, yerr, fmt



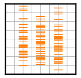
`hist(X, bins, …)` API
X, bins, range, density, weights



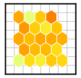
`violinplot(D, …)` API
D, positions, widths, vert



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



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



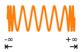
`hexbin(X, Y, C, …)` API
X, **Y**, C, gridsize, bins

Scales API

`ax.set_[xy]scale(scale, …)`

`linear`
any values

`log`
values > 0



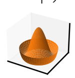
`symlog`
any values

`logit`
0 < values < 1

Projections API

`subplot(…, projection=p)`

`p='polar'`

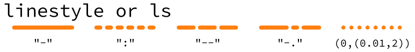


`p='3d'` API

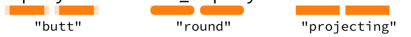
`p=ccrs.Orthographic()` API
`import cartopy.crs as ccrs`

Lines API

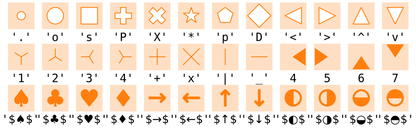
`linestyle or ls`



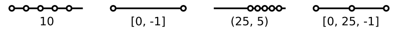
`capstyle or dash_capstyle`



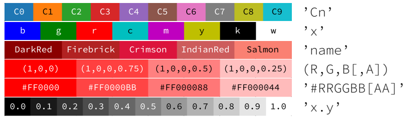
Markers API



`markevery`



Colors API



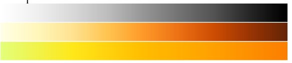
Colormaps API

`plt.get_cmap(name)`

Uniform

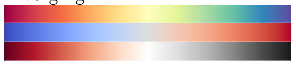
viridis
magma
plasma

Sequential



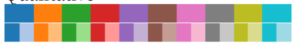
Greys
YlOrBr
Wistia

Diverging



Spectral
coolwarm
RdGy

Qualitative



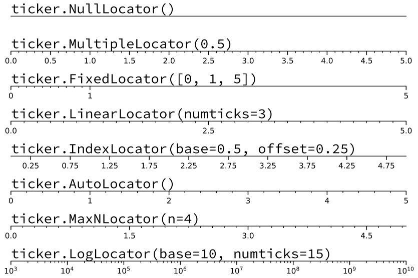
tab10
tab20

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)`

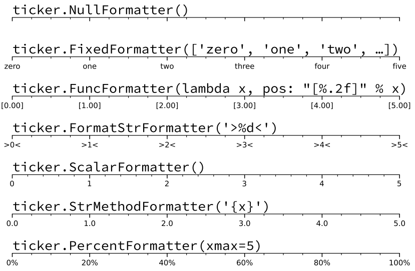
`ticker.AutoLocator()`

`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<')`

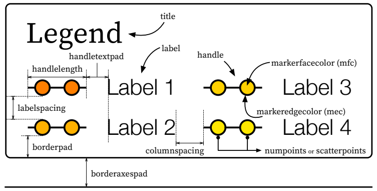
`ticker.ScalarFormatter()`

`ticker.StrMethodFormatter('{x}')`

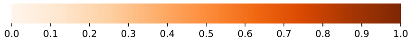
`ticker.PercentFormatter(xmax=5)`

Ornaments

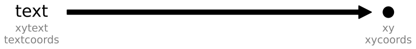
`ax.legend(…)` API
handles, labels, loc, title, frameon



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



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



Event handling API

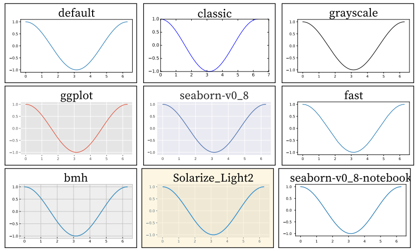
```
fig, ax = plt.subplots()
def on_click(event):
    print(event)
fig.canvas.mpl_connect(
    'button_press_event', on_click)
```

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)`



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

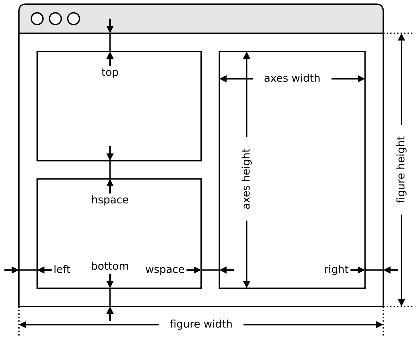
Ten simple rules READ

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

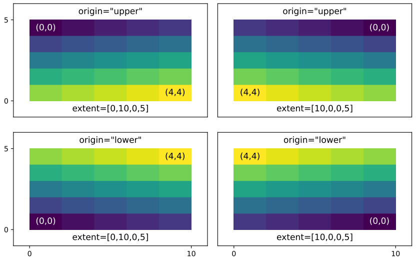
plt.**subplots_adjust**(...)



Extent & origin

API

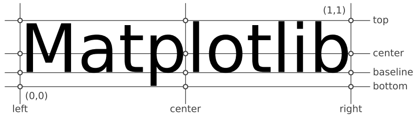
ax.**imshow**(extent=..., origin=...)



Text alignments

API

ax.**text**(..., ha=... , va=..., ...)



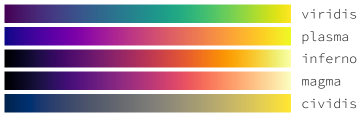
Text parameters

API

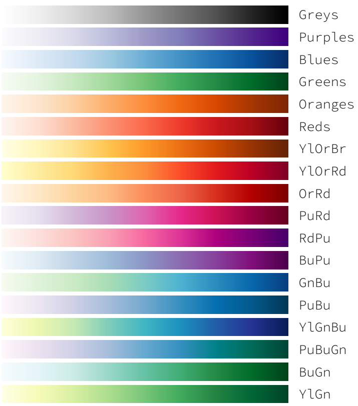
ax.**text**(..., family=..., size=..., weight=...)
ax.**text**(..., fontproperties=...)

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

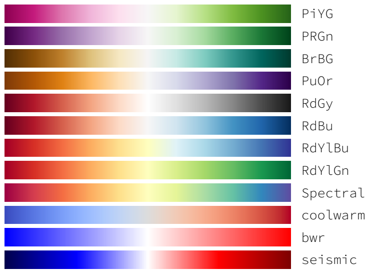
Uniform colormaps



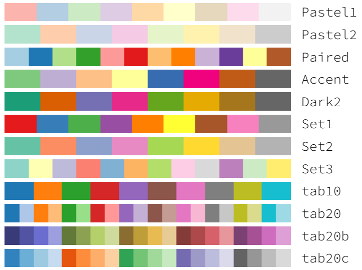
Sequential colormaps



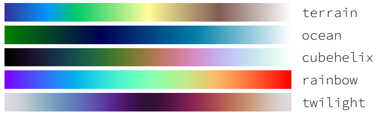
Diverging colormaps



Qualitative colormaps



Miscellaneous colormaps



Color names

API

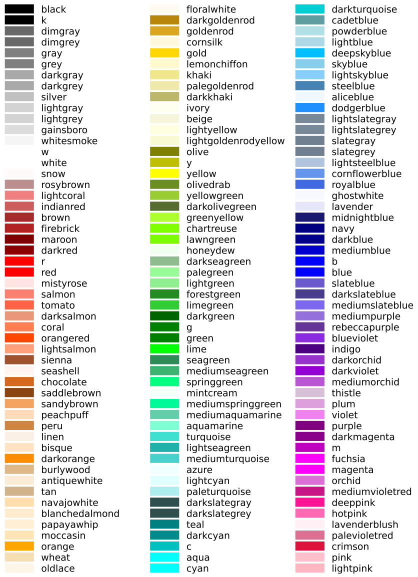
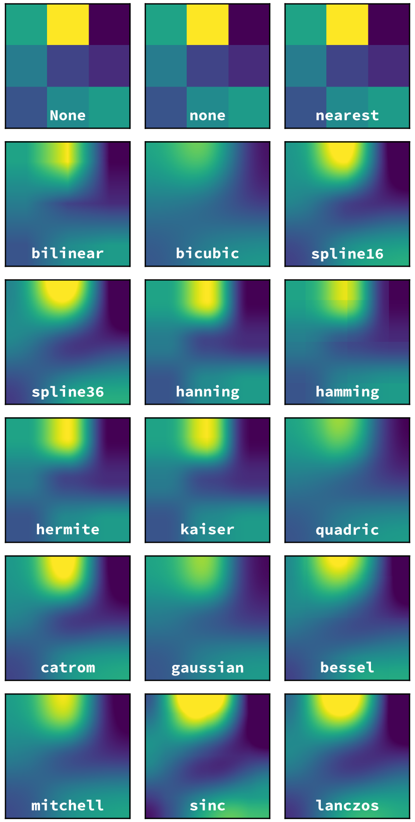
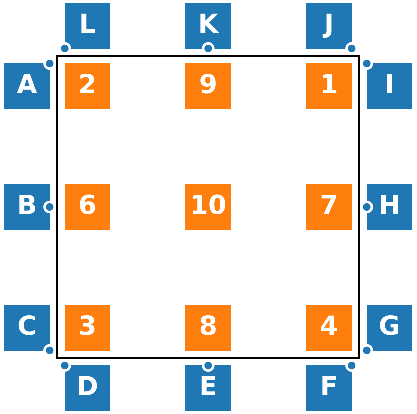


Image interpolation

API



Legend placement



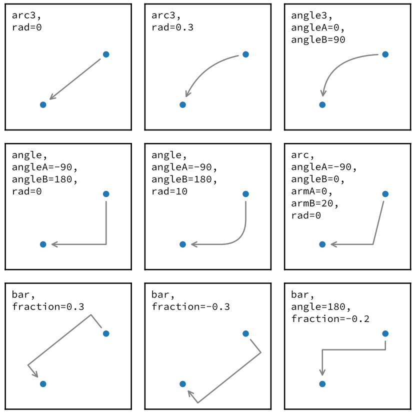
ax.**legend**(loc="string", bbox_to_anchor=(x, y))

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)`

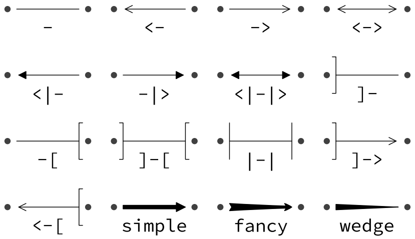
Annotation connection styles

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/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?
→ 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(i, X[i], "o")       slow
plot(X, marker="o", ls="")                  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

Matplotlib Cheatsheets

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