# matplotlib Cheat sheet

Version 3.10.8

## Quick start

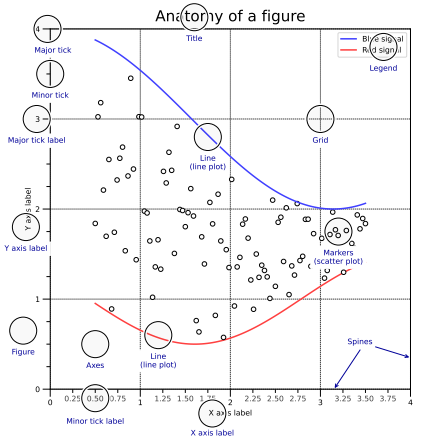
```
import numpy as np
import matplotlib as mpl
import matplotlib.pyplot as plt


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

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

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

## Anatomy of a figure




## Subplots layout

`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
- discourse.matplotlib.org
- stackoverflow.com/questions/tagged/matplotlib

## 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

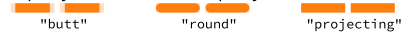
`p=ccrs.Orthographic()` API
`import cartopy.crs as ccrs`

## Lines

API

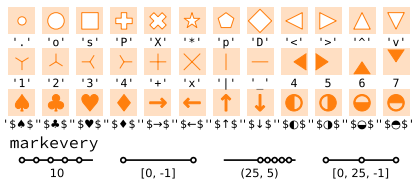
`linestyle or ls`


`capstyle or dash_capstyle`




## Markers

API



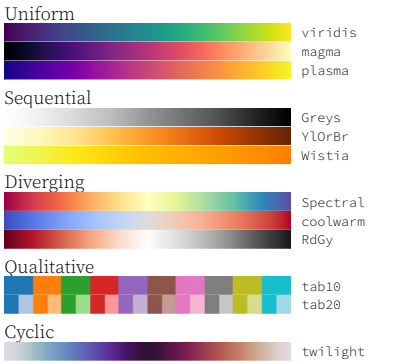

## Colors

API


## Colormaps

API

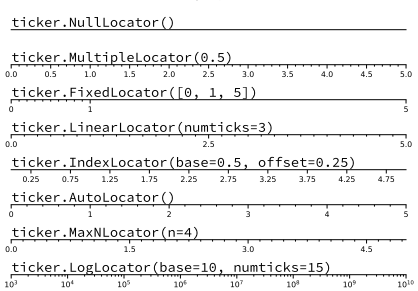
`plt.get_cmap(name)`




## Tick locators

API

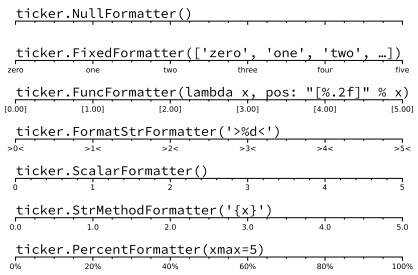
```
from matplotlib import ticker
ax.[xy]axis.set_[minor|major]_locator(locator)
```




## Tick formatters

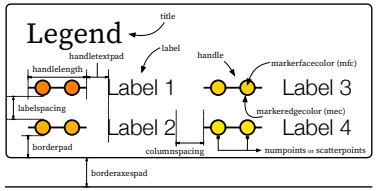
API

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

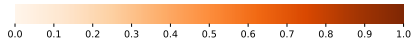



## Ornaments

`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

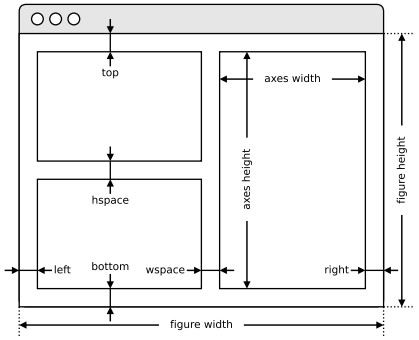
READ

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

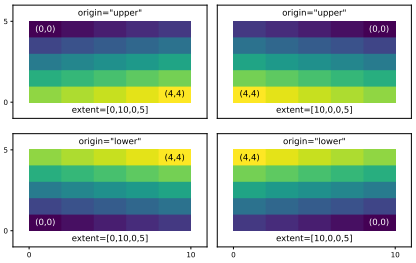
plt.**subplots_adjust**( ... )




## Extent & origin

API

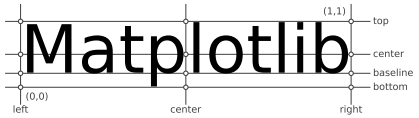
ax.**imshow**( extent=..., origin=... )




## Text alignments

API

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




## Text parameters

API

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

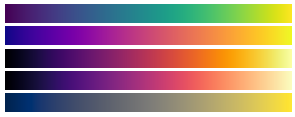
The quick brown fox — xx-large (1.73)
The quick brown fox — x-large (1.44)
The quick brown fox — large (1.20)
The quick brown fox — medium (1.00)
The quick brown fox — small (0.83)
The quick brown fox — x-small (0.69)
The quick brown fox — xx-small (0.58)

**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)

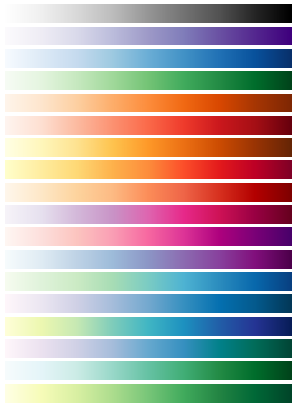
The quick brown fox jumps over the lazy dog — monospace
The quick brown fox jumps over the lazy dog — serif
The quick brown fox jumps over the lazy dog — sans
*The quick brown fox jumps over the lazy dog* — cursive

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

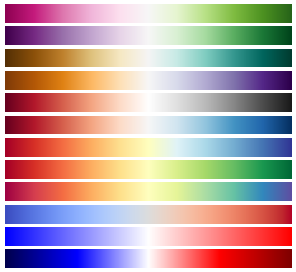
## Uniform colormaps



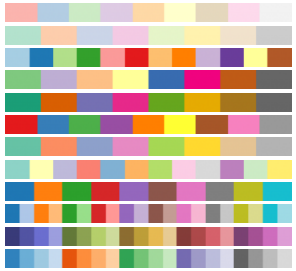

## Sequential colormaps



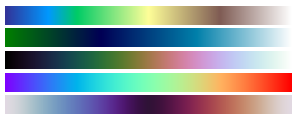

## Diverging colormaps




## Qualitative colormaps




## Miscellaneous colormaps

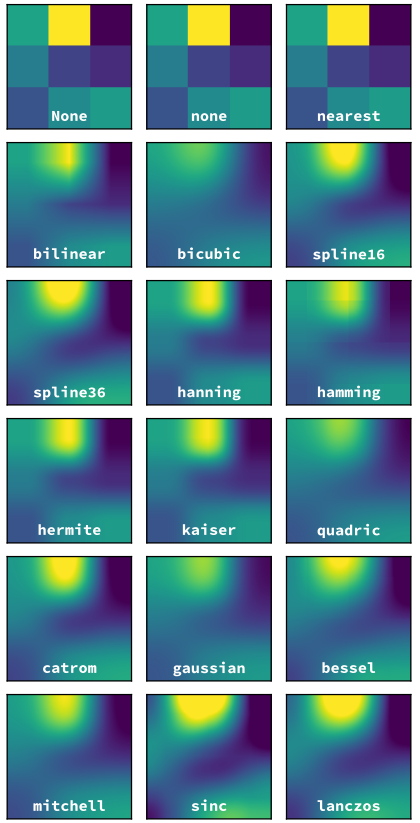



## Color names

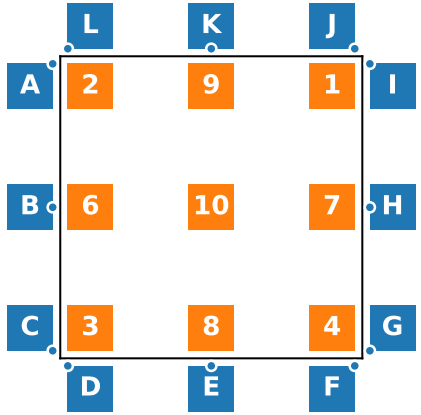
API


## Image interpolation

API




## Legend placement



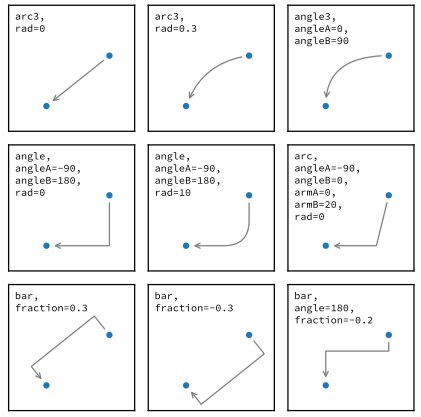

ax.**legend**(loc="string", bbox_to_anchor=(x, y))

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)`

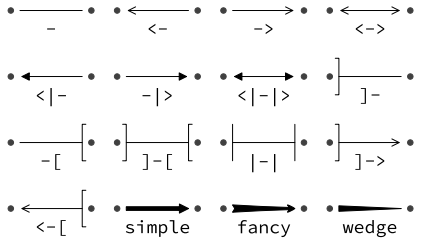
## Annotation connection styles

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



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