

# matplotlib

Cheat sheet Version 3.2 API

## 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

## Basic plots

<code>plot([X], Y, [fmt], ...)</code>	<code>API</code>
X, Y, fmt, color, marker, linestyle	

<code>scatter(X, Y, ...)</code>	<code>API</code>
X, Y, [s]izes, [c]olors, marker, cmap	

<code>bar[h](x, height, ...)</code>	<code>API</code>
x, height, width, bottom, align, color	

<code>imshow(Z, [cmap], ...)</code>	<code>API</code>
Z, cmap, interpolation, extent, origin	

<code>contour(f)([X], [Y], Z, ...)</code>	<code>API</code>
X, Y, Z, levels, colors, extent, origin	

<code>quiver([X], [Y], U, V, ...)</code>	<code>API</code>
X, Y, U, V, C, units, angles	

<code>pie(X, [explode], ...)</code>	<code>API</code>
Z, explode, labels, colors, radius	

<code>text(x, y, text, ...)</code>	<code>API</code>
x, y, text, va, ha, size, weight, transform	

<code>fill_between(x)( ... )</code>	<code>API</code>
X, Y1, Y2, color, where	

## Advanced plots

<code>step(X, Y, [fmt], ...)</code>	<code>API</code>
X, Y, fmt, color, marker, where	

<code>boxplot(X, ...)</code>	<code>API</code>
X, notch, sym, bootstrap, widths	

<code>errorbar(X, Y, xerr, yerr, ...)</code>	<code>API</code>
X, Y, xerr, yerr, fmt	

<code>hist(X, bins, ...)</code>	<code>API</code>
X, bins, range, density, weights	

<code>violinplot(D, ...)</code>	<code>API</code>
D, positions, widths, vert	

<code>barbs([X], [Y], U, V, ...)</code>	<code>API</code>
X, Y, U, V, C, length, pivot, sizes	

<code>eventplot(positions, ...)</code>	<code>API</code>
positions, orientation, lineoffsets	

<code>hexbin(X, Y, C, ...)</code>	<code>API</code>
X, Y, C, gridsize, bins	

<code>xcorr(X, Y, ...)</code>	<code>API</code>
X, Y, normed, detrend	

## Basic plots

<code>plot([X], Y, [fmt], ...)</code>	<code>API</code>
X, Y, fmt, color, marker, linestyle	

<code>scatter(X, Y, ...)</code>	<code>API</code>
X, Y, [s]izes, [c]olors, marker, cmap	

<code>bar[h](x, height, ...)</code>	<code>API</code>
x, height, width, bottom, align, color	

<code>imshow(Z, [cmap], ...)</code>	<code>API</code>
Z, cmap, interpolation, extent, origin	

<code>contour(f)([X], [Y], Z, ...)</code>	<code>API</code>
X, Y, Z, levels, colors, extent, origin	

<code>quiver([X], [Y], U, V, ...)</code>	<code>API</code>
X, Y, U, V, C, units, angles	

<code>pie(X, [explode], ...)</code>	<code>API</code>
Z, explode, labels, colors, radius	

<code>text(x, y, text, ...)</code>	<code>API</code>
x, y, text, va, ha, size, weight, transform	

<code>fill_between(x)( ... )</code>	<code>API</code>
X, Y1, Y2, color, where	

## Scales

<code>ax.set_xy scale(scale, ...)</code>	<code>API</code>
linear any values	

<code>log values &gt; 0</code>	
any values	

<code>symlog 0 &lt; values &lt; 1</code>	
any values	

<code>logit 0 &lt; values &lt; 1</code>	
any values	

## Projections

<code>subplot(..., projection=p)</code>	<code>API</code>
p='polar'	

<code>p='3d'</code>	
<code>from cartopy.crs import Cartographic</code>	

## Lines

<code>linestyle or ls</code>	<code>API</code>
"--", ":", "-.", "-.", "(0, (0.01, 2))	

<code>capstyle or dash_capstyle</code>	<code>API</code>
"butt", "round", "projecting"	

## Markers

<code>o, O, s, S, +, P, X, *, x, p, d, D, &lt;, &gt;, ^, v, 1, 2, 3, 4, 5, 6, 7, \$, %, \$S, %S, \$*\$, \$*\$, \$-\$, \$-\$, \$+, \$-, \$0, \$0S, \$0S, \$0\$</code>	<code>API</code>
markerkey	

10	(0, -1)	(25, 5)	(0, 25, -1)	
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## Colors

C0, C1, C2, C3, C4, C5, C6, C7, C8, C9	'Cn'
b, g, r, c, m, y, k, w	'x', 'name', '(R, G, B, [A])', '#RRGGBB[AA]', 'x.y'

DarkRed, Firebrick, Crimson, IndianRed, Salmon	
(1,0,0), (1,0,0,0.75), (1,0,0,0.5), (1,0,0,0.25)	
#FF0000, #FF0000BB, #FF000088, #FF000044	

## Colormaps

<code>plt.get_cmap(name)</code>	<code>API</code>
Uniform	viridis magma plasma

Sequential	Greys YlOrBr Wistia
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Diverging	Spectral coolwarm RdGy
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Qualitative	tab10 tab20
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Cyclic	twilight
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## Tick locators

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

ticker.NullLocator()

ticker.MultipleLocator(0.5)
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
0 1 2 3 4 5

ticker.FixedLocator([0, 1, 5])
0.0 0.25 0.5 0.75 1 2.5 3.25 3.75 4.25 4.75
0 1 2 3 4 5

ticker.IndexLocator(base=0.5, offset=0.25)
0.25 0.75 1.25 1.75 2.25 2.75 3.25 3.75 4.25 4.75
0.0 0.5 1 2 3 4 5

ticker.AutoLocator()
0.0 0.5 1 2 3 4 5

ticker.MaxNLocator(n=4)
0.0 1.5 3.0 4.5
0 1 2 3 4 5

ticker.LogLocator(base=10, numticks=15)
10^1 10^2 10^3 10^4 10^5 10^6 10^7 10^8 10^9
1 2 3 4 5 6 7 8 9
```

## Tick formatters

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

ticker.NullFormatter()

ticker.FixedFormatter(['', '0', '1', '2', '3', '4'])
0.25 0.50 0.75 1 0.25 0.50 0.75 3 0.25 0.50 0.75 4 0.25 0.50 0.75
0.001 [1.000] [2.000] [3.000] [4.000] [5.000]

ticker.FuncFormatter(lambda x, pos: "%.%f" % x)
0.001 [1.000] [2.000] [3.000] [4.000] [5.000]

ticker.FormatStrFormatter('%.%d')
1>1 2>2 3>3 4>4 5>5

ticker.ScalarFormatter()
0 1 2 3 4 5

ticker.StrMethodFormatter('{x}')
0.0 1.0 2.0 3.0 4.0 5.0

ticker.PercentFormatter(xmax=5)
0% 20% 40% 60% 80% 100%
```

## Styles

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

default	classic	grayscale
ggplot	seaborn	fast
bmh	Solarize_Light2	seaborn-notebook

## 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()
```

## 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()
```

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

## Keyboard shortcuts

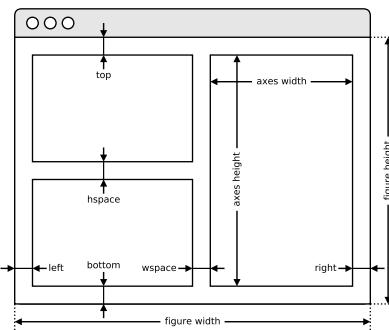
<code>ctrl+s</code> Save	<code>ctrl+w</code> Close plot
<code>r</code> Reset view	<code>f</code> Fullscreen 0/1
<code>f</code> View forward	<code>b</code> View back
<code>p</code> Pan view	<code>o</code> Zoom to rect
<code>x</code> X pan/zoom	<code>y</code> Y pan/zoom
<code>g</code> Minor grid 0/1	<code>G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

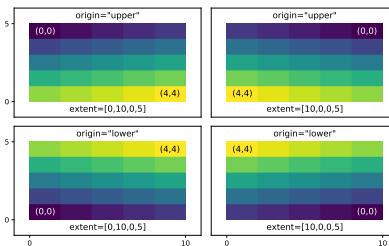
## Axes adjustments

API

`plt.subplot_adjust( ... )`

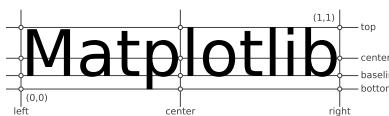
## Extent & origin

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

serif

The quick brown fox jumps over the lazy dog sans

sans

The quick brown fox jumps over the lazy dog cursive

cursive

The quick brown fox jumps over the lazy dog italic

italic

The quick brown fox jumps over the lazy dog normal

normal

The quick brown FOX JUMPS OVER THE LAZY DOG small-caps

small-caps

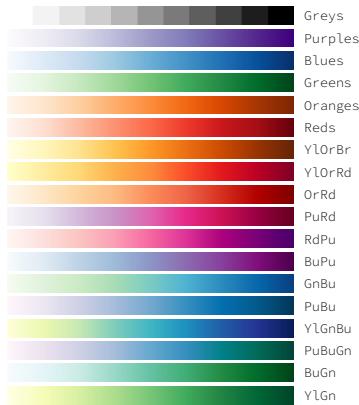
The quick brown fox jumps over the lazy dog normal

normal

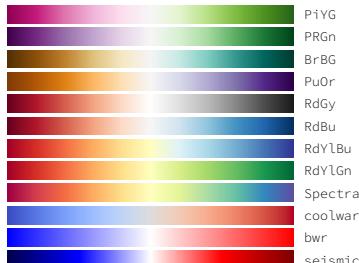
## Uniform colormaps



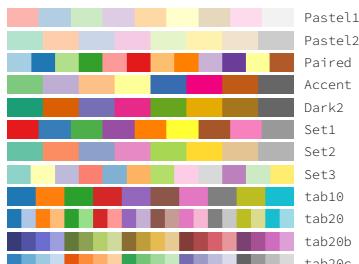
## Sequential colormaps



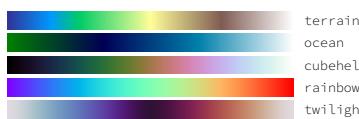
## Diverging colormaps



## Qualitative colormaps



## Miscellaneous colormaps



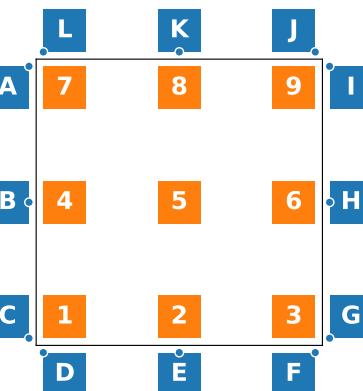
## Color names

API



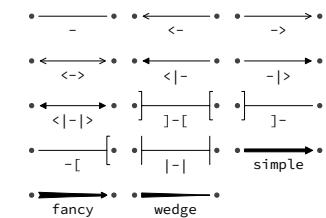
## Legend placement

API

`ax.legend(loc="string", bbox_to_anchor=(x,y))`1: lower left      2: lower center      3: lower right  
4: center left      5: center      6: center right  
7: upper left      8: upper center      9: upper rightA: upper right / B: center right /  
(-.1,.9)      (-.1,.5)C: lower right / D: upper left / (.1,-.1)  
(-.1,.1)E: upper center / F: upper right /  
(.5,-.1)      (.9,-.1)G: lower left / H: center left /  
(1.1,.1)      (1.1,.5)I: upper left / (1.1,.9)      J: lower right /  
(.9,1.1)K: lower center / L: lower left / (.1,1.1)  
(.5,1.1)

## Annotation arrow styles

API

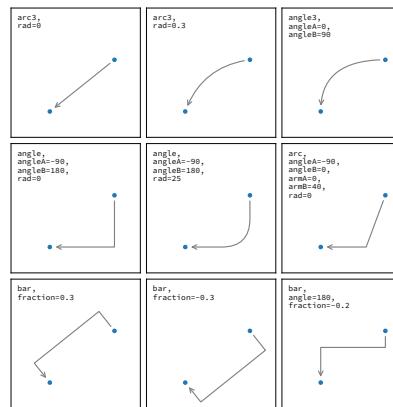


## How do I ...

- ... 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)`

## Annotation connection styles

API



## Performance tips

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