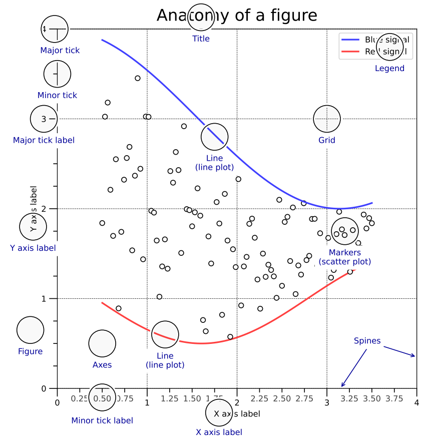
matplotlib Cheat sheet

Version 3.5.0

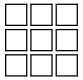
Quick start API

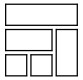
```
import numpy as np
import matplotlib as mpl
import matplotlib.pyplot as plt


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")
fig.show()
```

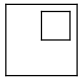
Anatomy of a figure

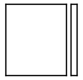


Subplots layout API


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


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

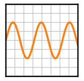

```
ax.inset_axes(extent)
```
API

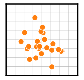

```
d=make_axes_locatable(ax)
ax = d.new_horizontal('10%')
```
API

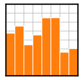
Getting help

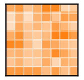
- matplotlib.org
- github.com/matplotlib/matplotlib/issues
- discourse.matplotlib.org
- stackoverflow.com/questions/tagged/matplotlib
- gitter.im/matplotlib
- twitter.com/matplotlib
- Matplotlib users mailing list

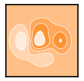
Basic plots


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

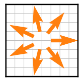

`scatter(X,Y,…)` API
X, **Y**, [s]izes, [c]olors, marker, cmap

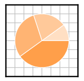

`bar[h](x,height,…)` API
x, **height**, width, bottom, align, color

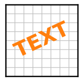

`imshow(Z,…)` API
Z, cmap, interpolation, extent, origin

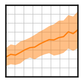

`contour[f]([X],[Y],Z,…)` API
X, Y, **Z**, levels, colors, extent, origin

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

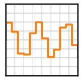

`quiver([X],[Y],U,V,…)` API
X, Y, **U**, **V**, C, units, angles

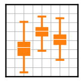

`pie(X,…)` API
Z, explode, labels, colors, radius

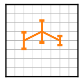

`text(x,y,text,…)` API
x, **y**, **text**, va, ha, size, weight, transform

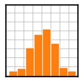

`fill[_between][x](…)` API
X, **Y1**, Y2, color, where

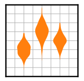
Advanced plots

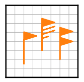

`step(X,Y,[fmt],…)` API
X, **Y**, fmt, color, marker, where

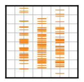

`boxplot(X,…)` API
X, notch, sym, bootstrap, widths

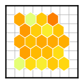

`errorbar(X,Y,xerr,yerr,…)` API
X, **Y**, xerr, yerr, fmt


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


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

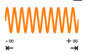

`barbs([X],[Y], U, V, …)` API
X, Y, **U**, **V**, C, length, pivot, sizes


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

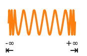

`hexbin(X,Y,C,…)` API
X, **Y**, C, gridsize, bins

Scales API

`ax.set_[xy]scale(scale,…)`


`linear`
any values

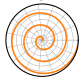
`log`
values > 0

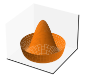

`symlog`
any values

`logit`
0 < values < 1

Projections API

`subplot(…,projection=p)`


p='polar'


p='3d'

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

Lines API

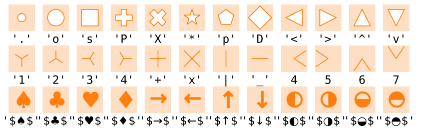
`linestyle or ls`

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

`capstyle or dash_capstyle`

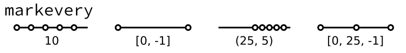
"butt" "round" "projecting"

Markers API



'.' 'o' 's' 'P' 'X' '*' 'p' 'D' '<' '>' '^' 'v'
'1' '2' '3' '4' '+' 'x' '|' '_' 4 5 6 7
'$♠$' '$♣$' '$♥$' '$♦$' '$→$' '$←$' '$↑$' '$↓$' '$◐$' '$◑$' '$◒$' '$◓$'

`markevery`

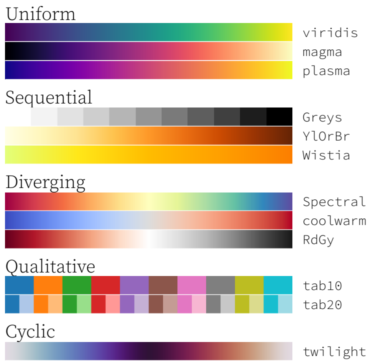


Colors API

C0	C1	C2	C3	C4	C5	C6	C7	C8	C9		'Cn'
b	g	r	c	m	y	k	w				'x'
DarkRed	Firebrick	Crimson	IndianRed	Salmon							'name'
(1,0,0)	(1,0,0,0.75)	(1,0,0,0.5)	(1,0,0,0.25)								(R,G,B[,A])
#FF0000	#FF0000BB	#FF000088	#FF000044								'#RRGGBB[AA]'
0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	'x.y'

Colormaps API

`plt.get_cmap(name)`



Tick locators API

```
from matplotlib import ticker
ax.[xy]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

`ticker.FixedLocator([0, 1, 5])`
0 1 5

`ticker.LinearLocator(numticks=3)`
0.0 2.5 5.0

`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

`ticker.AutoLocator()`
0 1 2 3 4 5

`ticker.MaxNLocator(n=4)`
0.0 1.5 3.0 4.5

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

Tick formatters API

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

`ticker.NullFormatter()`

`ticker.FixedFormatter(['zero', 'one', 'two', …])`
zero one two three four five

`ticker.FuncFormatter(lambda x, pos: "[%.2f]" % x)`
[0.00] [1.00] [2.00] [3.00] [4.00] [5.00]

`ticker.FormatStrFormatter('>%d<')`
>0< >1< >2< >3< >4< >5<

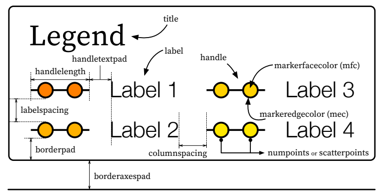
`ticker.ScalarFormatter()`
0 1 2 3 4 5

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

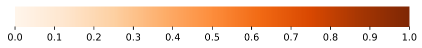
`ticker.PercentFormatter(xmax=5)`
0% 20% 40% 60% 80% 100%

Ornaments

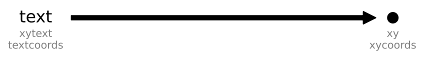
`ax.legend(…)` API
handles, labels, loc, title, frameon



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



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



Event handling API

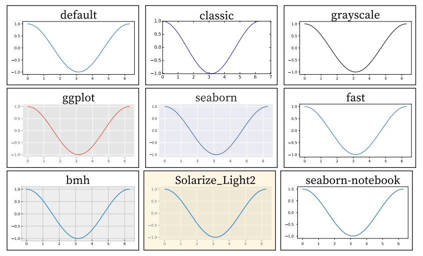
```
fig, ax = plt.subplots()
def on_click(event):
    print(event)
fig.canvas.mpl_connect(
    'button_press_event', on_click)
```

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

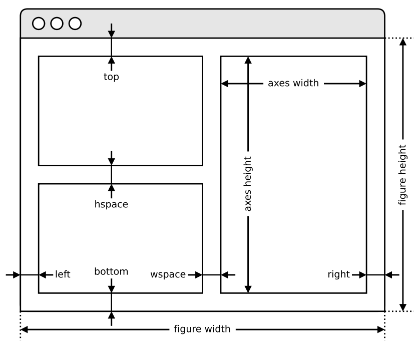
Ten simple rules READ

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

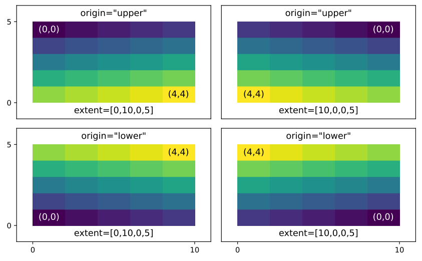
plt.subplots_adjust(...)



Extent & origin

API

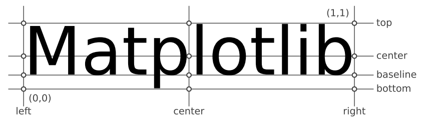
ax.imshow(extent=..., origin=...)



Text alignments

API

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



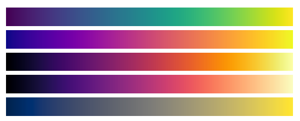
Text parameters

API

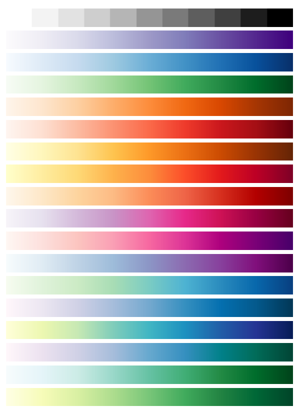
ax.text(..., family=..., size=..., weight=...)
ax.text(..., fontproperties=...)

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

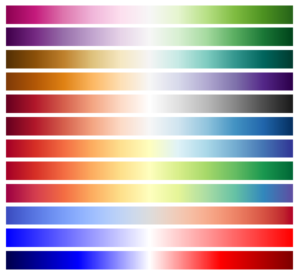
Uniform colormaps



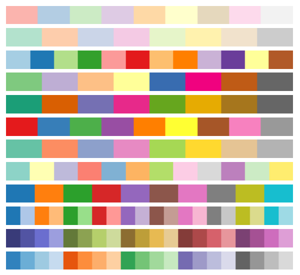
Sequential colormaps



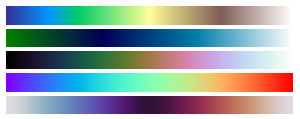
Diverging colormaps



Qualitative colormaps



Miscellaneous colormaps



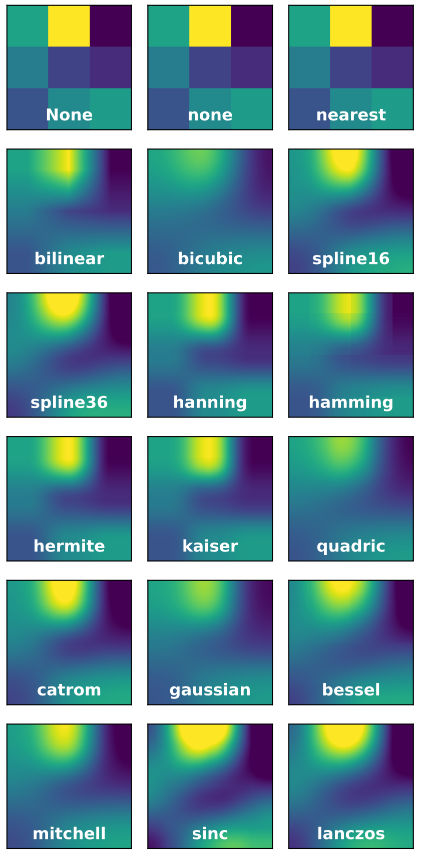
Color names

API

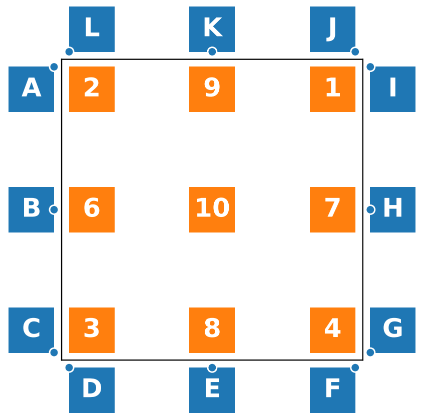
black	floralwhite	darkturquoise
k	darkgoldenrod	cadetblue
dimgray	goldenrod	powderblue
dimgrey	cornsilk	lightblue
gray	gold	deepskyblue
grey	lemonchiffon	skyblue
darkgray	khaki	lightskyblue
darkgrey	palegoldenrod	steelblue
silver	darkkhaki	aliceblue
lightgray	ivory	dodgerblue
lightgrey	beige	lightslategray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

Image interpolation

API



Legend placement



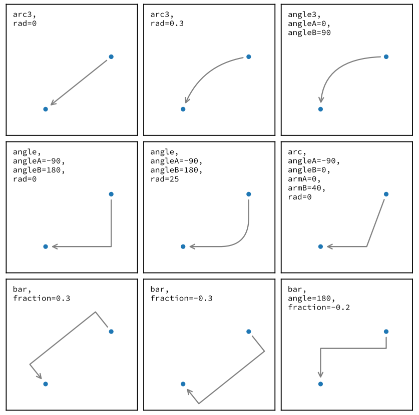
ax.legend(loc="string", bbox_to_anchor=(x,y))

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)`

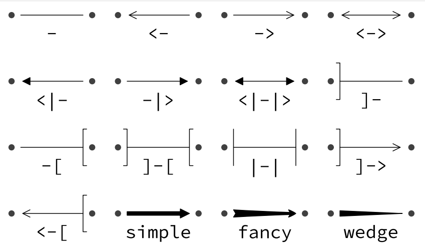
Annotation connection styles

API


arc3, rad=0
arc3, rad=0.3
angle3, angleA=0, angleB=90
angle, angleA=-90, angleB=180, rad=0
angle, angleA=-90, angleB=180, rad=25
arc, angleA=-90, angleB=0, armA=0, armB=40, rad=0
bar, fraction=0.3
bar, fraction=-0.3
bar, angle=180, fraction=-0.2

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.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