

Quick start

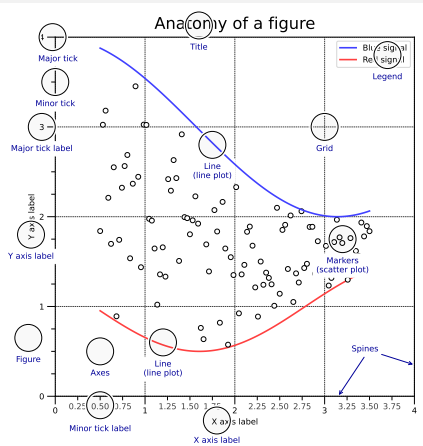
```
import numpy as np
import matplotlib as mpl
import matplotlib.pyplot as plt
```

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

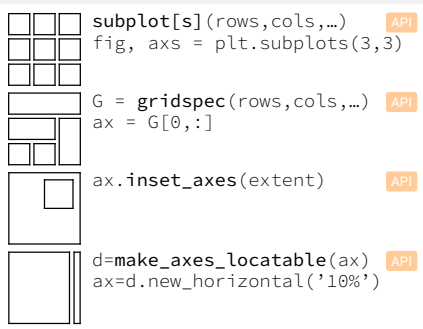
```
fig, ax = plt.subplots()
ax.plot(X,Y,color='C1')
```

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

Anatomy of a figure



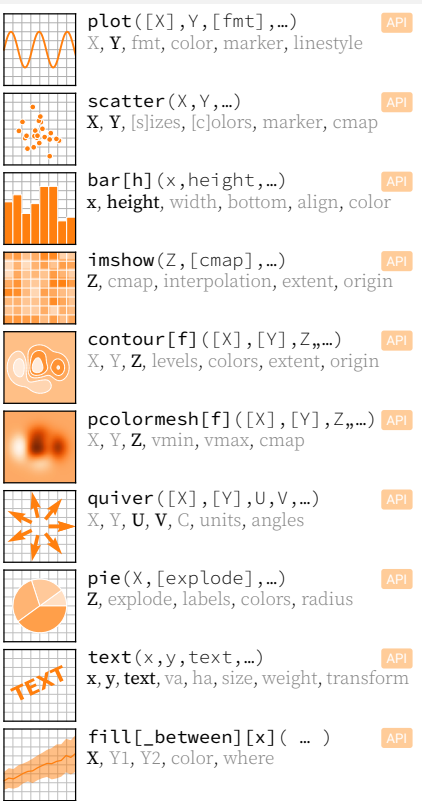
Subplots layout



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

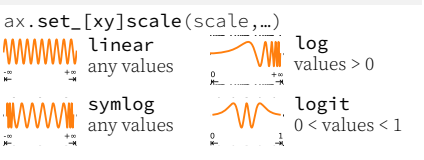
Basic plots



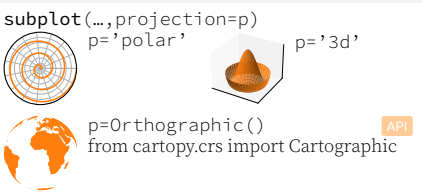
Advanced plots



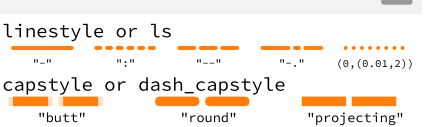
Scales



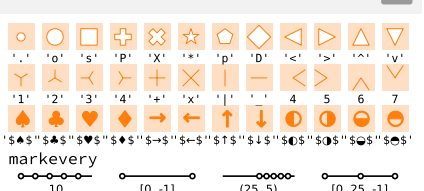
Projections



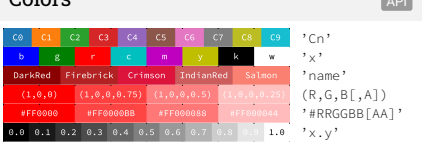
Lines



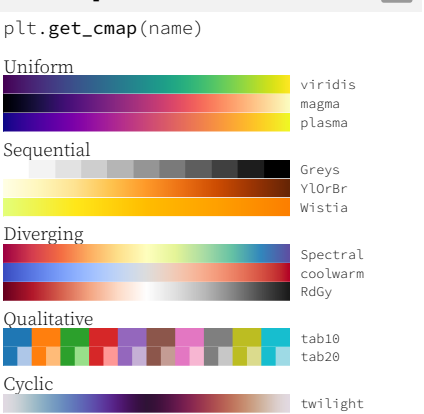
Markers



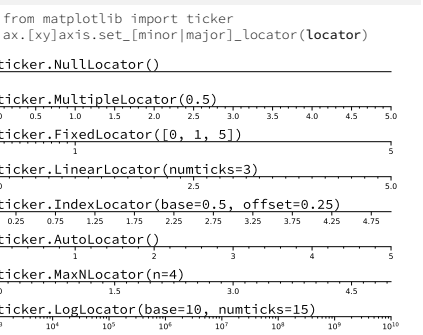
Colors



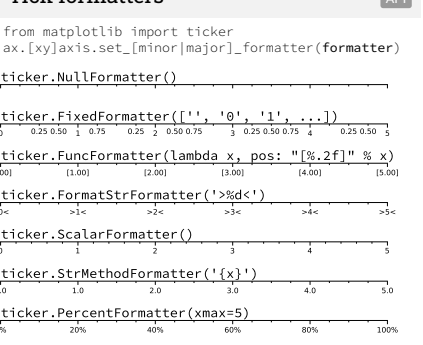
Colormaps



Tick locators

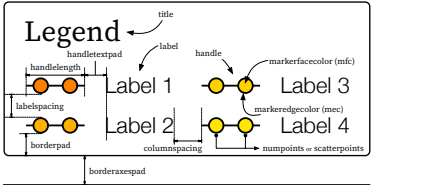


Tick formatters



Ornaments

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



ax.colorbar(...)



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)
```

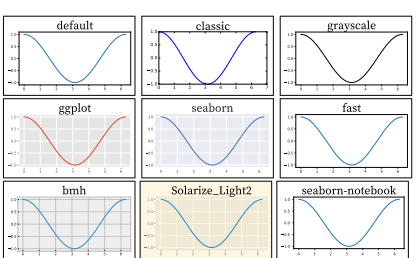
Animation

```
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_xlim(vmin, vmax)
ax.set_xlabel(label)
ax.set_xticks(list)
ax.set_xticklabels(list)
ax.set_suprtitle(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'$\frac{-e^{i\pi}}{2\pi}$'
```

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 | y Major grid 0/1 |
| l X axis log/linear | L Y axis log/linear |

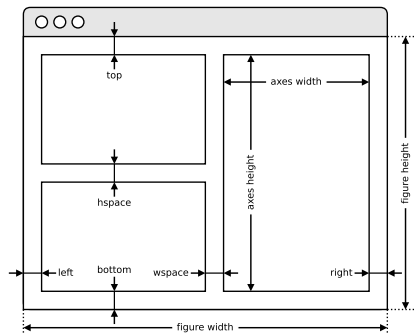
Ten simple rules

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

Axes adjustments

API

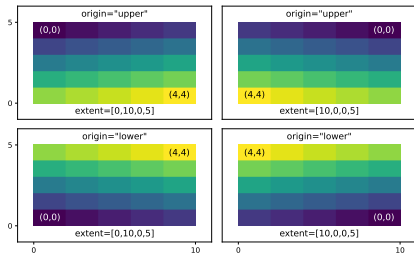
plt.subplots_adjust(...)



Extent & origin

API

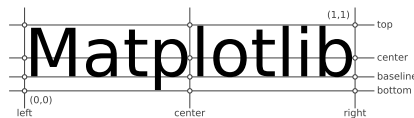
ax.imshow(extent=..., origin=...)



Text alignments

API

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



Text parameters

API

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

ax.text(..., fontproperties=...)

The quick brown fox
The quick brown fox
The quick brown fox
The quick brown fox
The quick brown fox
The quick brown fox
The quick brown fox

xx-large (1.73)
x-large (1.44)
large (1.20)
medium (1.00)
small (0.83)
x-small (0.69)
xx-small (0.58)

The quick brown fox jumps over the lazy dog
The quick brown fox jumps over the lazy dog
The quick brown fox jumps over the lazy dog
The quick brown fox jumps over the lazy dog
The quick brown fox jumps over the lazy dog
The quick brown fox jumps over the lazy dog
The quick brown fox jumps over the lazy dog

black (900)
bold (700)
semibold (600)
normal (400)
ultralight (100)

The quick brown fox jumps over the lazy dog
The quick brown fox jumps over the lazy dog
The quick brown fox jumps over the lazy dog
The quick brown fox jumps over the lazy dog

monospace
serif
sans
cursive

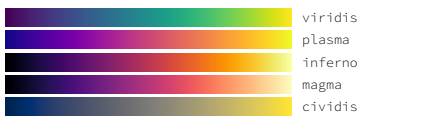
The quick brown fox jumps over the lazy dog
The quick brown fox jumps over the lazy dog
The quick brown fox jumps over the lazy dog

italic
normal

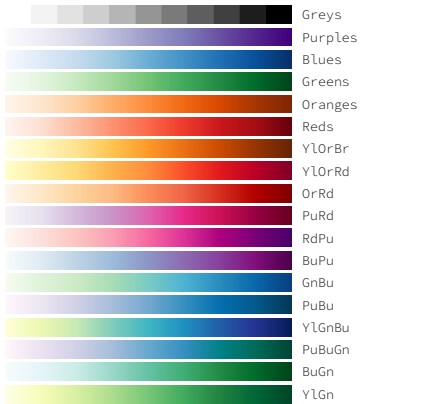
THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG
The quick brown fox jumps over the lazy dog

small-caps
normal

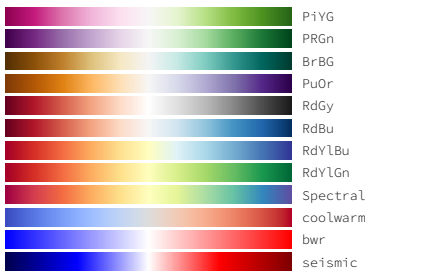
Uniform colormaps



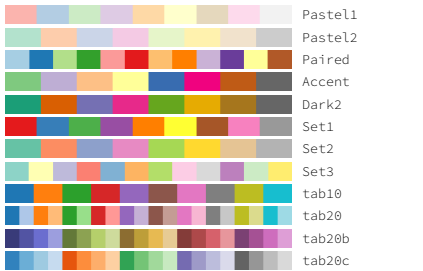
Sequential colormaps



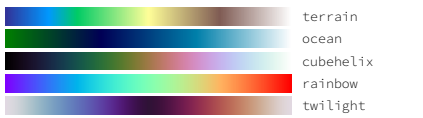
Diverging colormaps



Qualitative colormaps



Miscellaneous colormaps



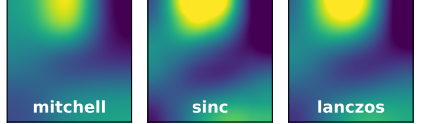
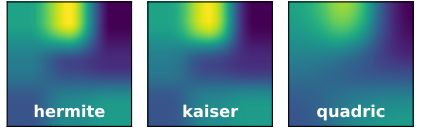
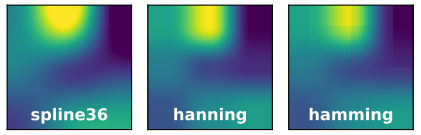
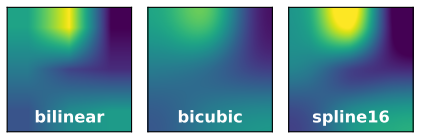
Color names

API

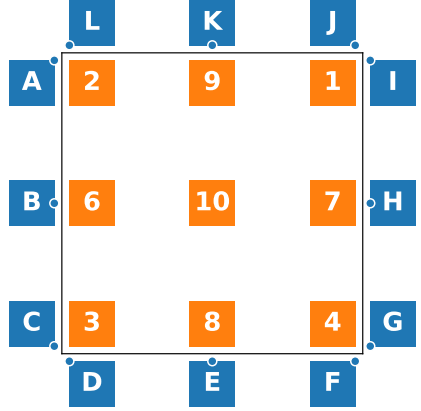


Image interpolation

API



Legend placement



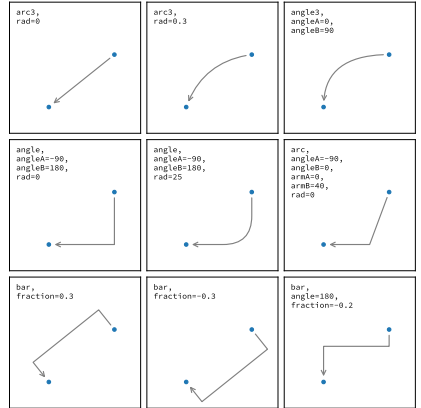
ax.legend(loc="string", bbox_to_anchor=(x,y))

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)

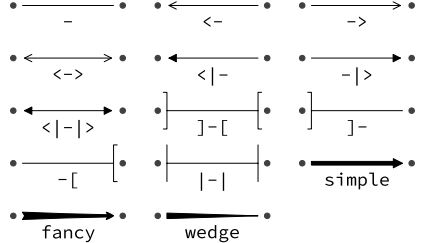
Annotation connection styles

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_xlabel('')
... rotate tick labels?
→ ax.set_xlabel('')
... 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

Matplotlib Cheatsheets
Copyright (c) 2021 Matplotlib Development Team
Released under a CC-BY 4.0 International License

NUMFOCUS
OPEN CODE = BETTER SCIENCE