

" USE THE MATPLOTLIB, LUKE "

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A long time ago, in a galaxy far, far away ...



John Hunter

“

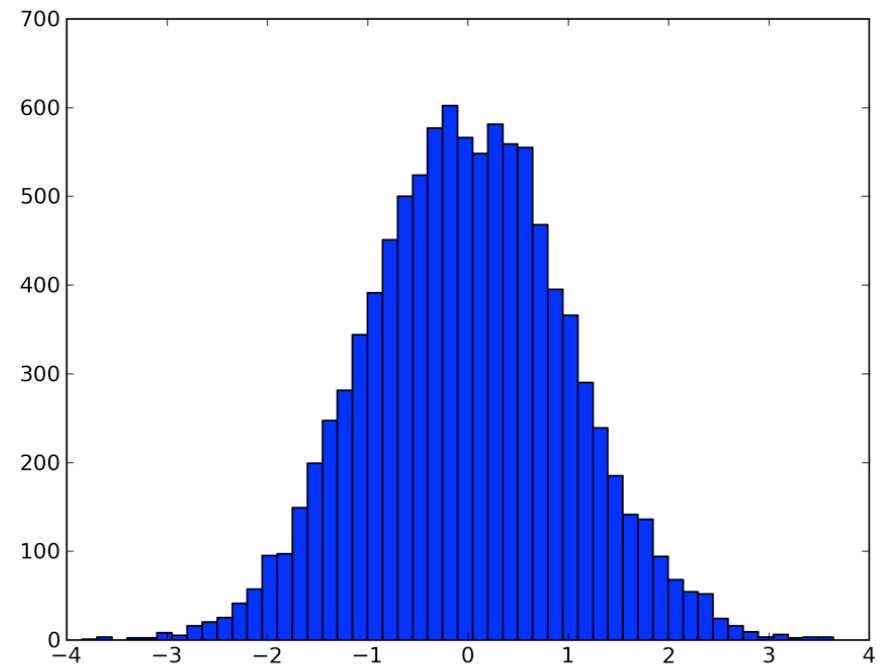
Matplotlib is a Python 2D plotting package which produces publication quality figures in a variety of hardcopy formats and interactive environments across platforms.

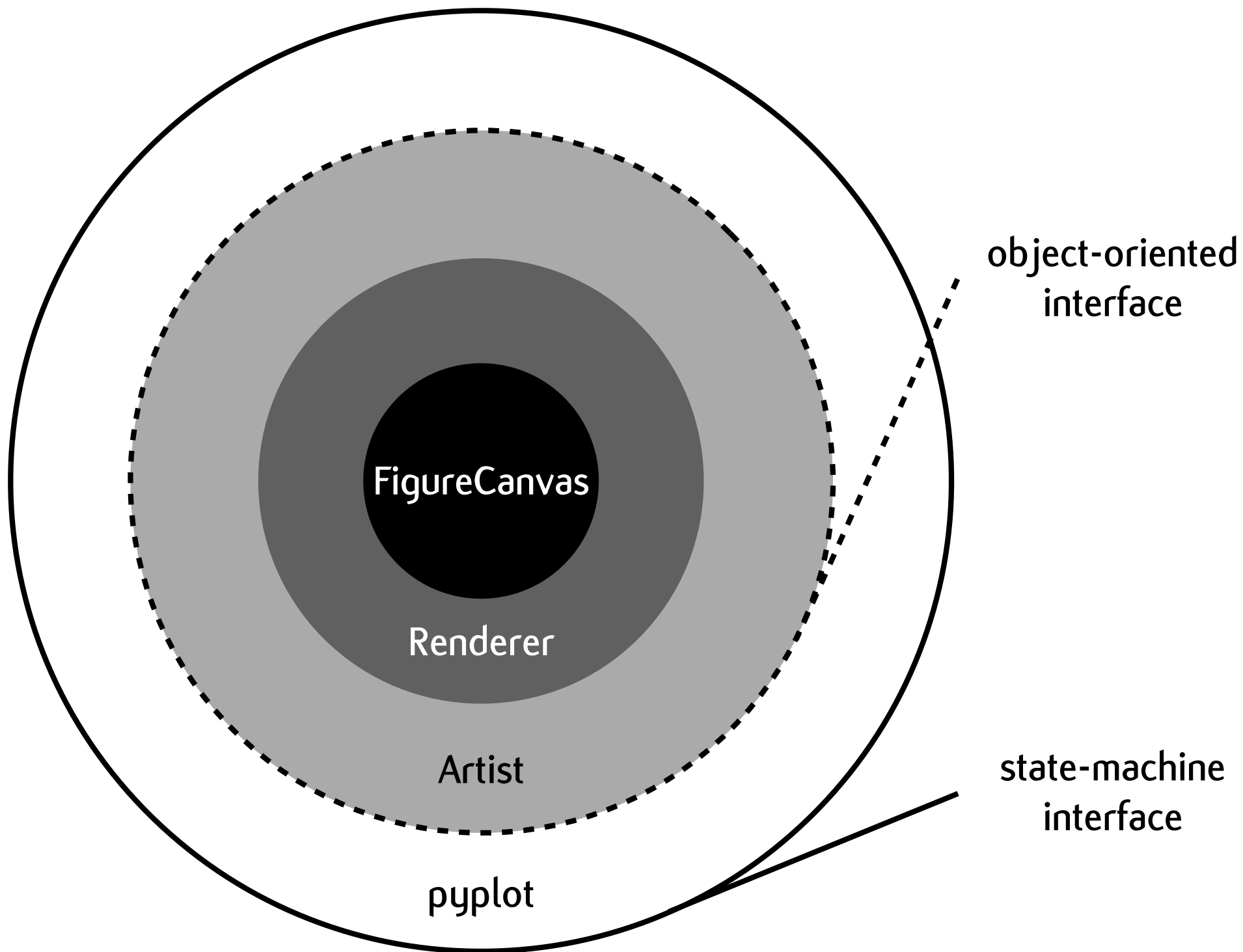
Philosophy

create simple plots with just a few commands, or just one!

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

x = np.random.randn(10000)
plt.hist(x, bins=50)
plt.show()
```





pyplot provides a MATLAB-style state-machine interface to the underlying object-oriented interface in matplotlib

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

x = np.arange(0, 10, 0.1)
y = np.sin(x)
plt.plot(x, y)
plt.show()
```

pylab lumps pyplot together with numpy in a single namespace, making that environment even more MATLAB-like

```
from pylab import *

x = arange(0, 10, 0.1)
y = sin(x)
plot(x, y)
show()
```

Explicit is better than implicit.

preferred style using pyplot convenience functions,
but object-orientation for the rest

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

x = np.arange(0, 10, 0.1)
y = np.sin(x)
fig = plt.figure()
ax = fig.add_subplot(111)
ax.plot(x, y)
plt.show()
```

2 types of Artists

- Primitives: Line2D, Rectangle, Text, etc.
- Containers: Figure, Axes, Axis, Tick

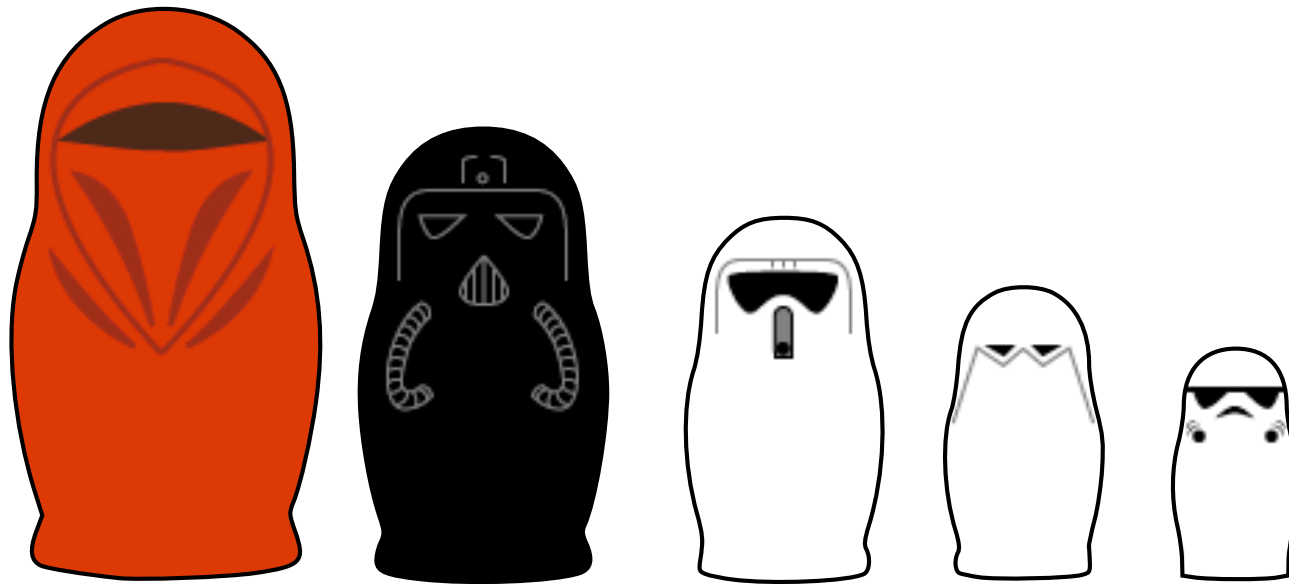
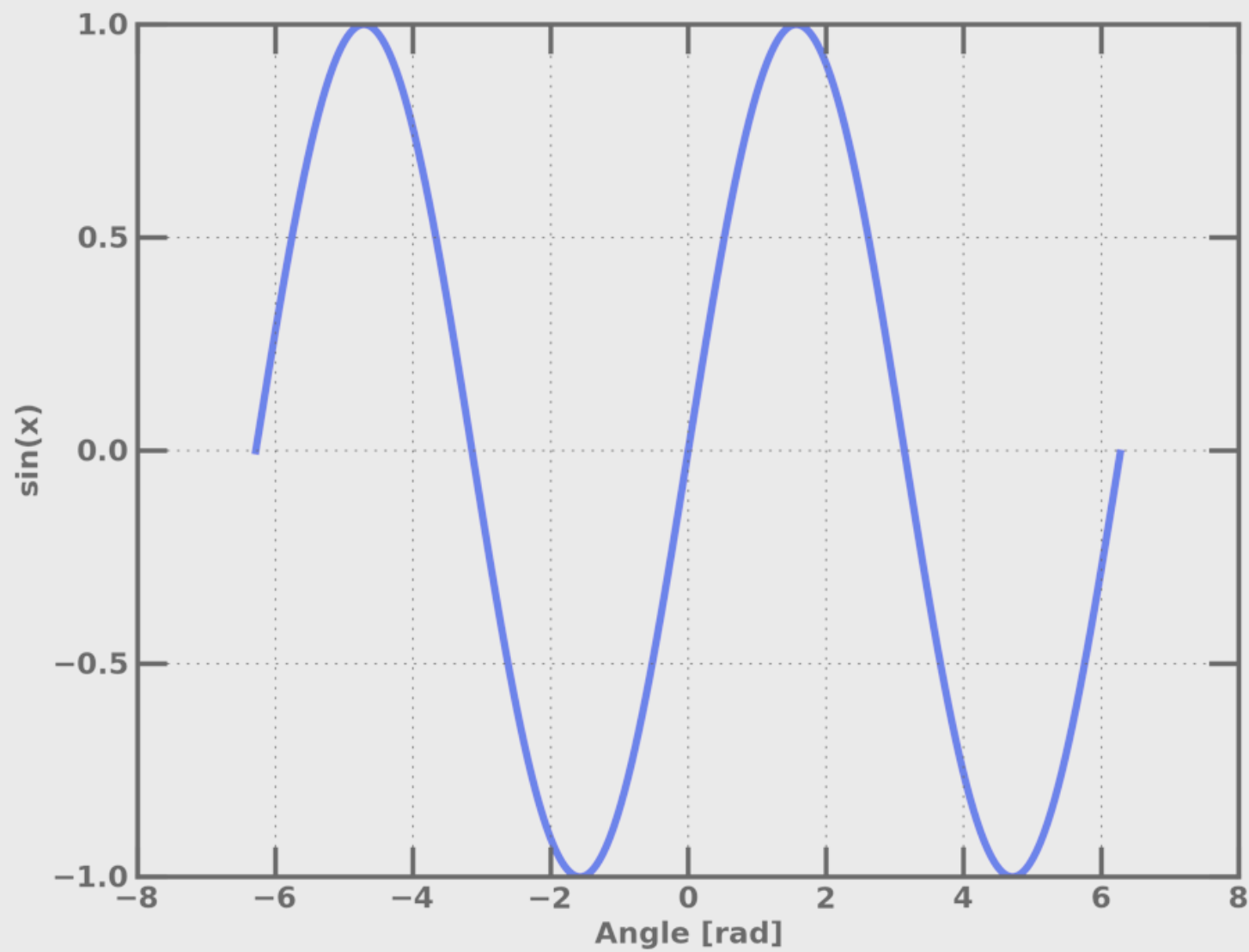


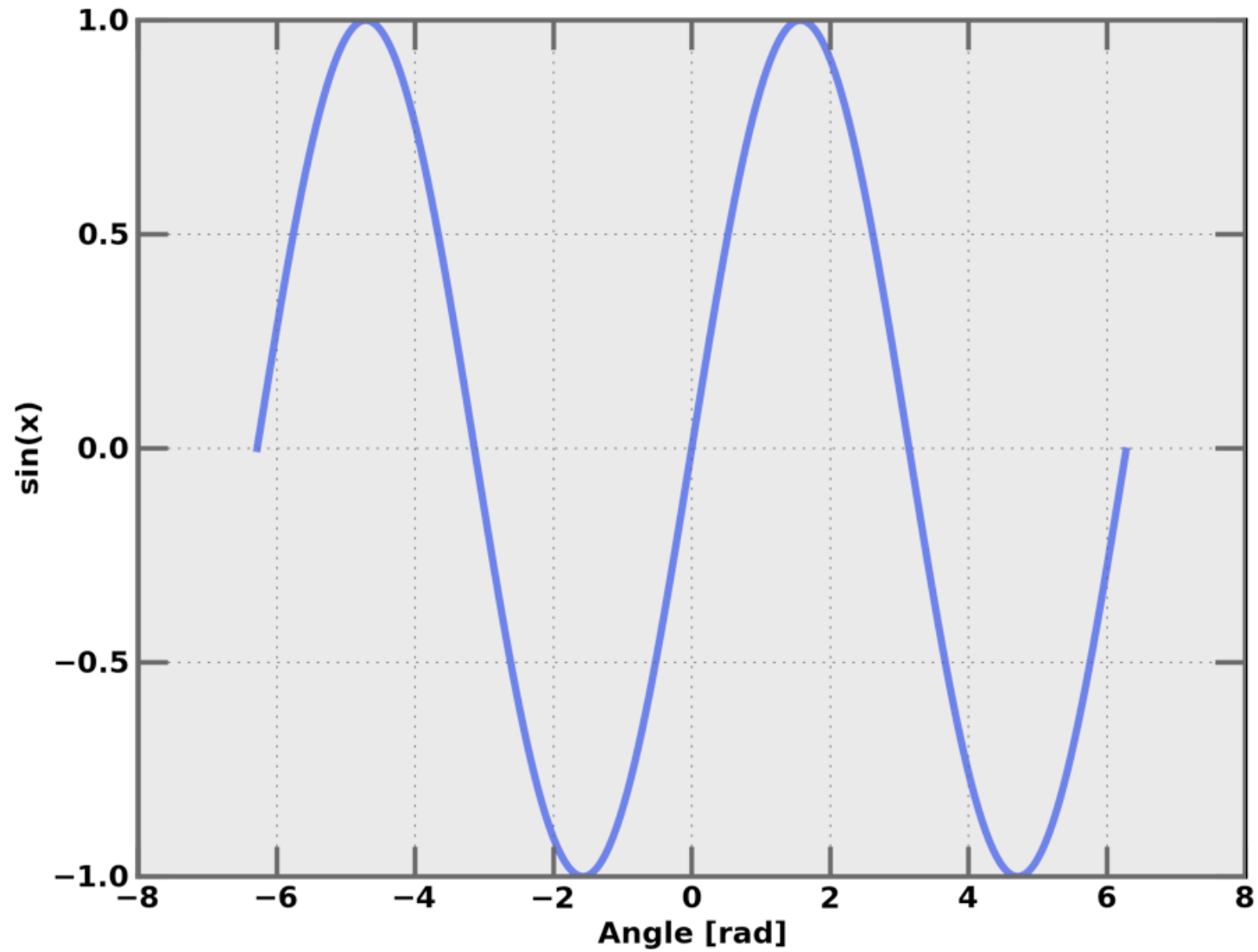
Figure Container

(matplotlib.figure.Figure)



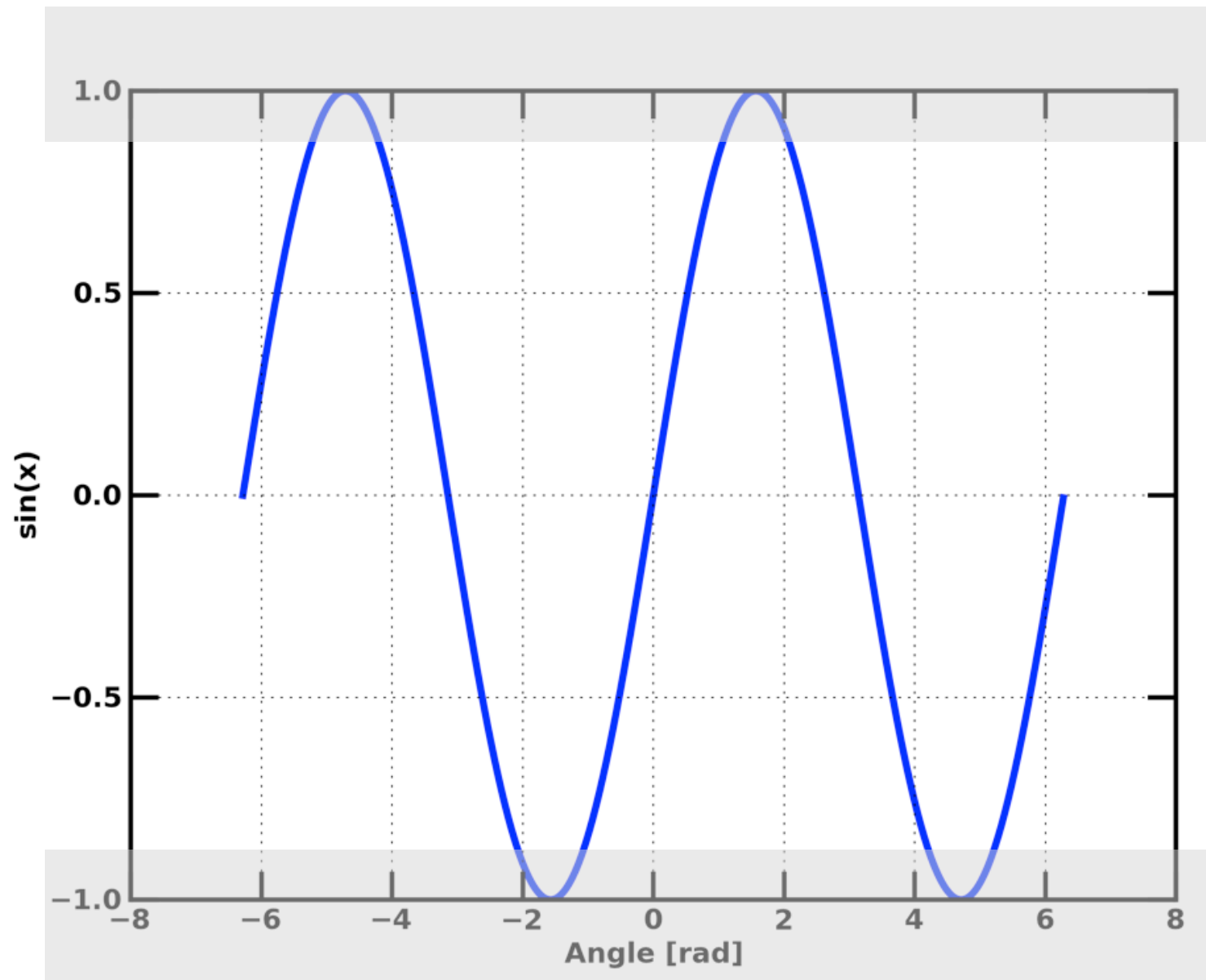
Axes Container

(matplotlib.axes.Axes)



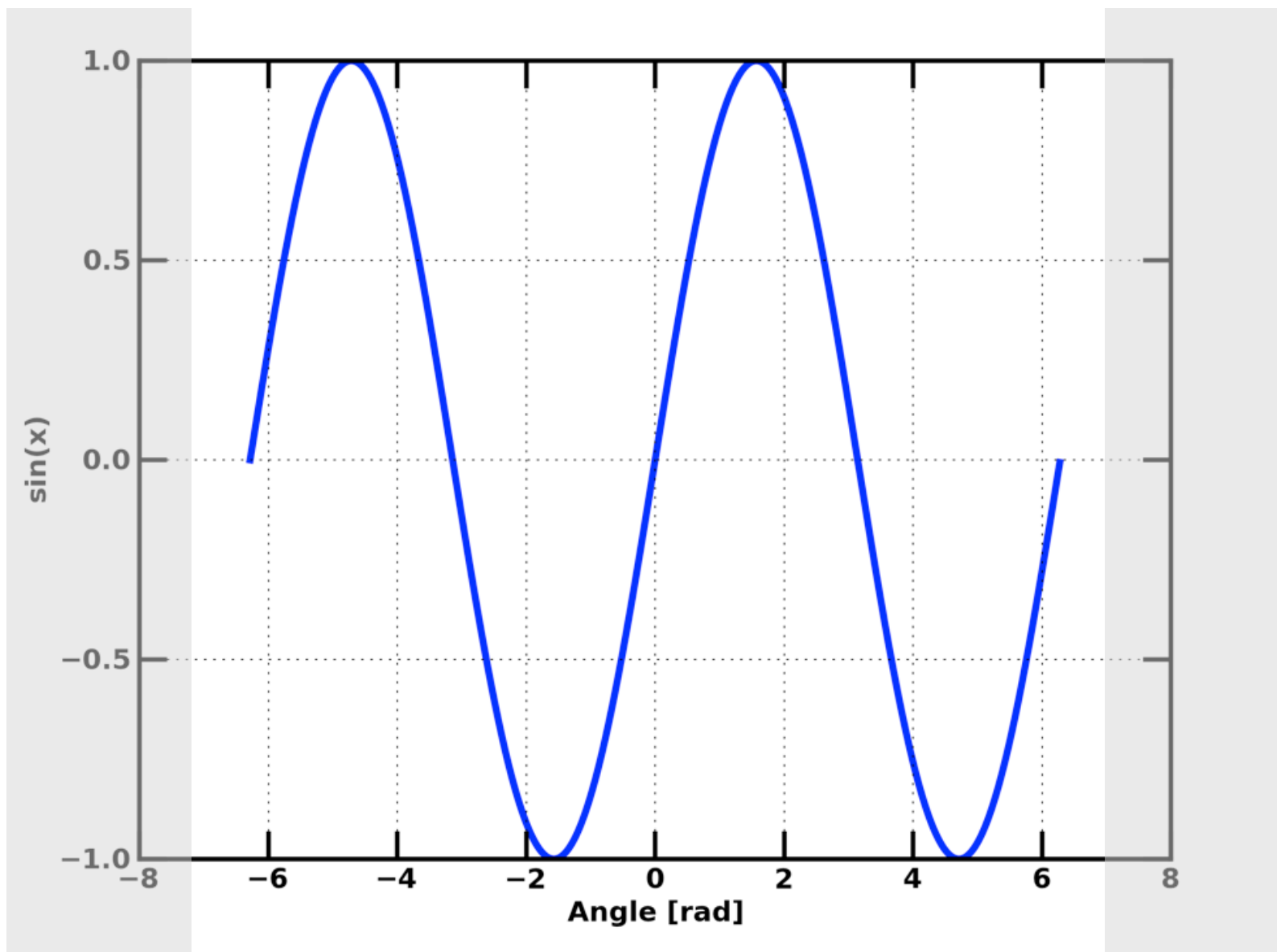
XAxis Container

(matplotlib.axis.Axis)



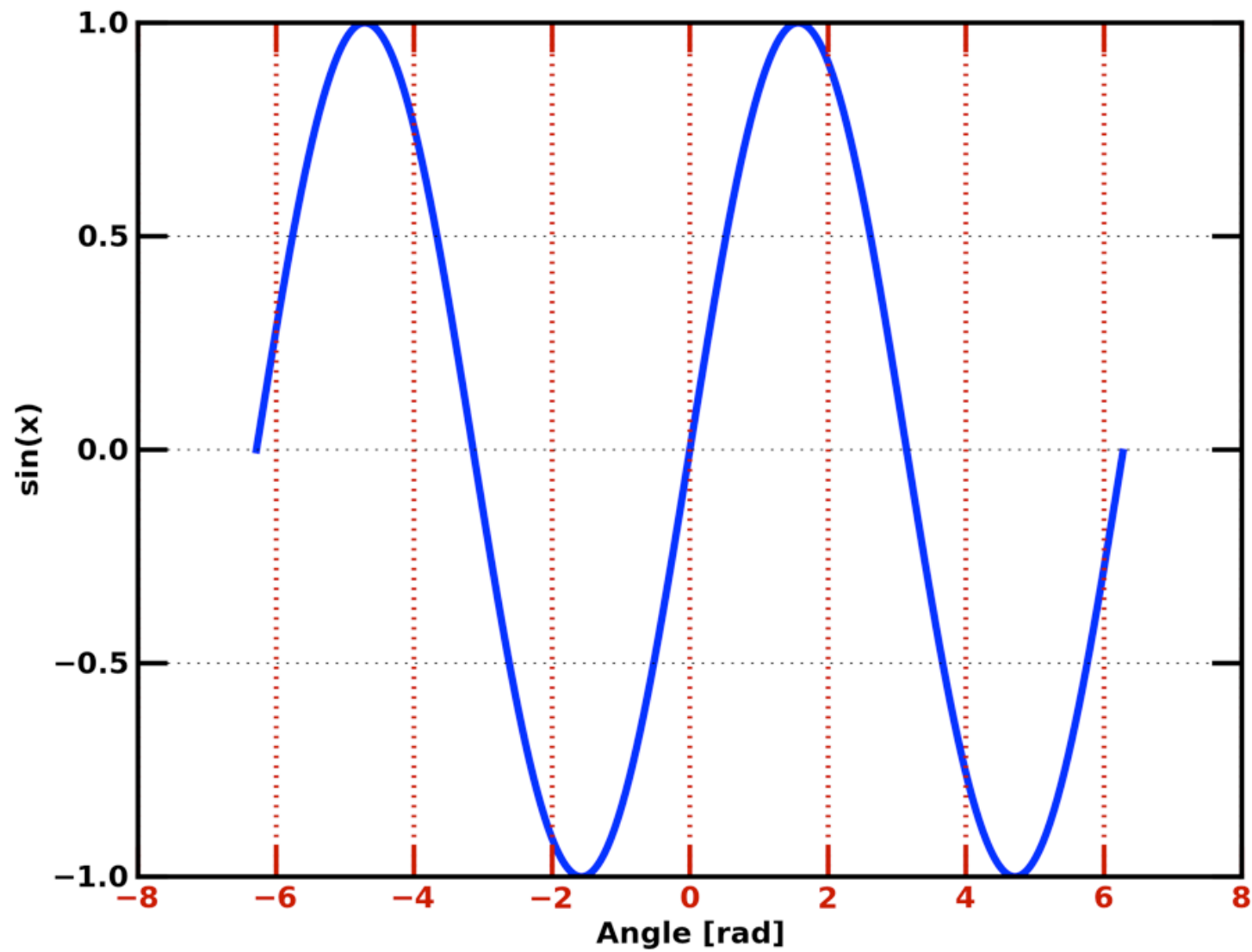
YAxis Container

(matplotlib.axis.Axis)



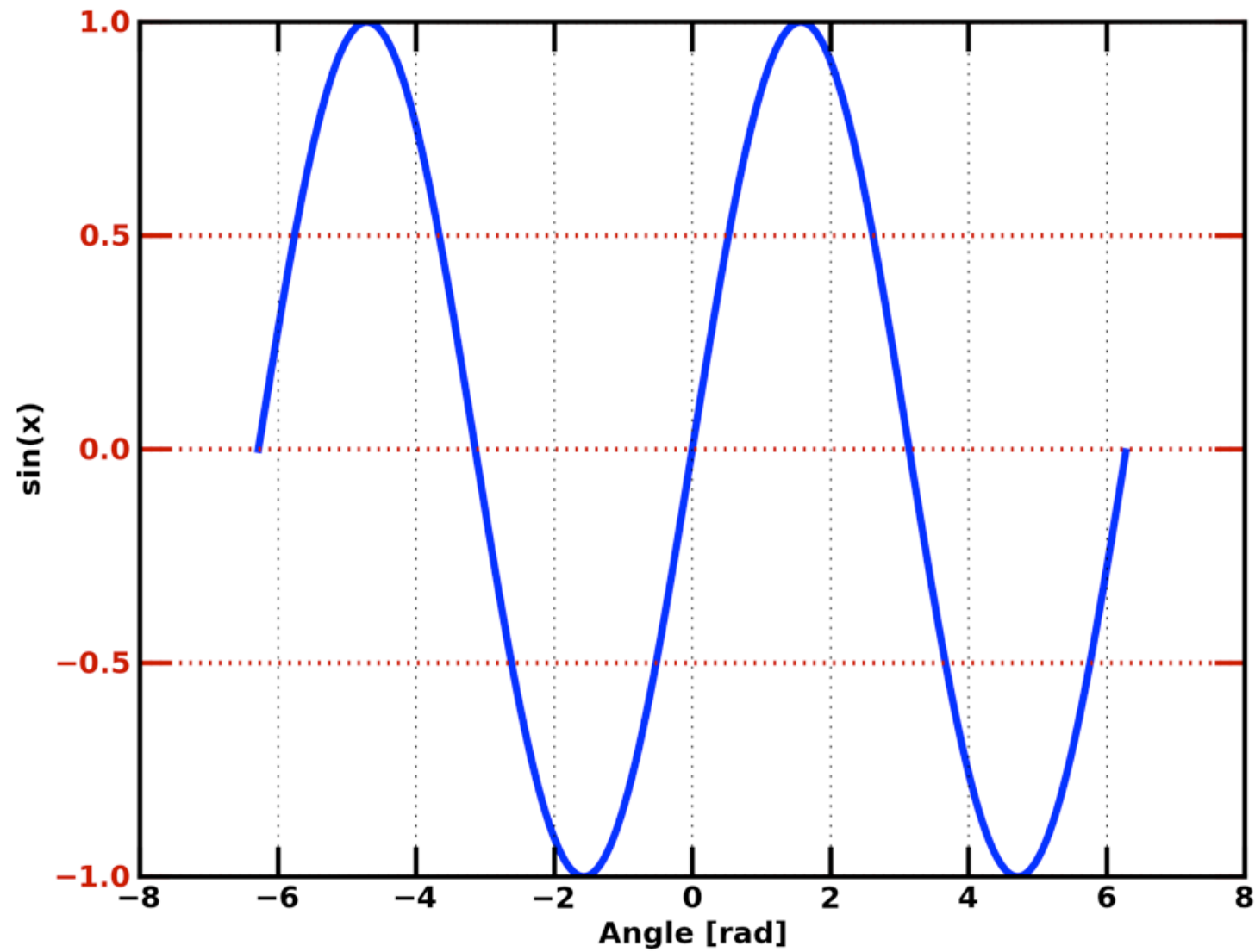
XTick Container

(matplotlib.axis.Tick)



YTick Container

(matplotlib.axis.Tick)



Customizing your objects

each of the properties is accessed with an old-fashioned setter or getter

```
a = o.get_alpha()  
o.set_alpha(0.5*a)
```

set a number of properties at once

```
o.set(alpha=0.5, zorder=2)
```

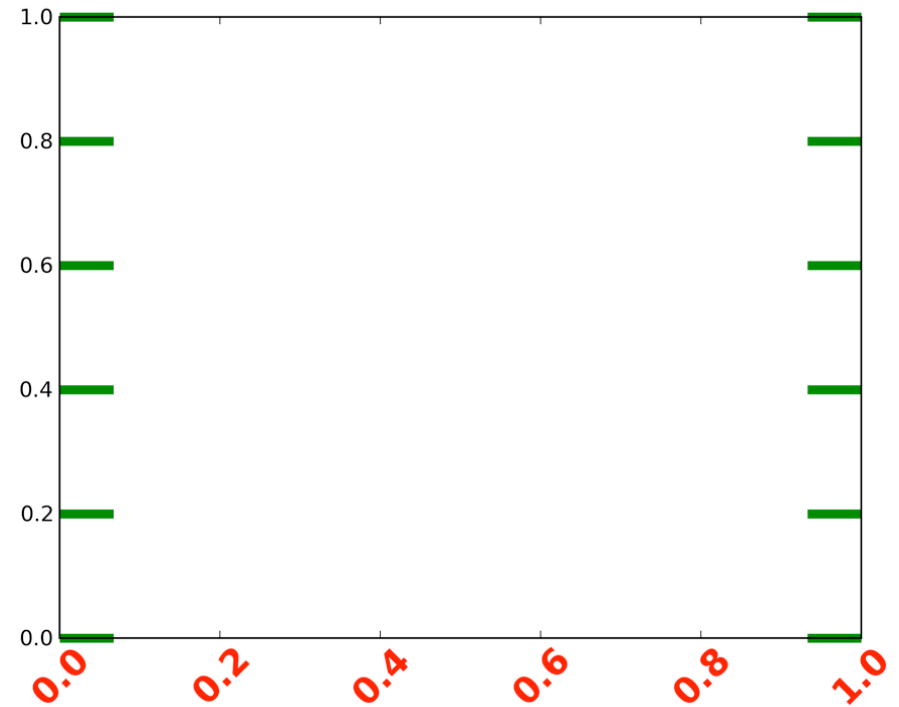
```
import matplotlib.pyplot as plt

fig = plt.figure()
ax = fig.add_subplot(111)

for label in ax.xaxis.get_ticklabels():
    # label is a Text instance
    label.set_color('red')
    label.set_rotation(45)
    label.set_fontsize(20)
    label.set_fontweight('bold')

for line in ax.yaxis.get_ticklines():
    # line is a Line2D instance
    line.set_color('green')
    line.set_markersize(30)
    line.set_markeredgewidth(5)

plt.show()
```



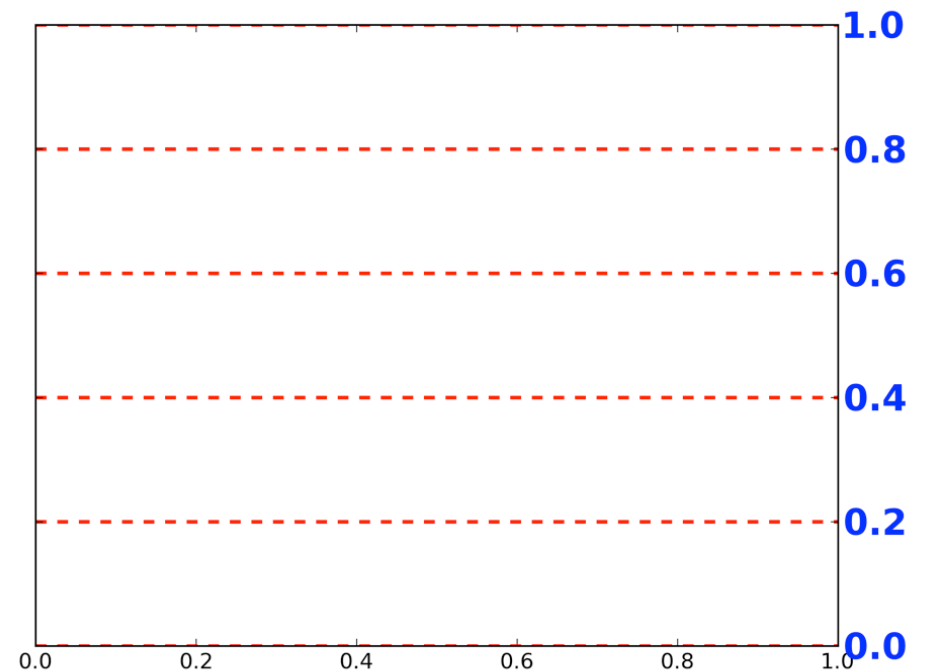
```
import matplotlib.pyplot as plt

fig = plt.figure()
ax = fig.add_subplot(111)

for tick in ax.yaxis.get_major_ticks():
    tick.label10n = False
    tick.label20n = True
    tick.label2.set_color('blue')
    tick.label2.set_fontsize(20)
    tick.label2.set_fontweight('bold')

    tick.grid0n = True
    tick.gridline.set_color('red')
    tick.gridline.set_linewidth(2)
    tick.gridline.set_linestyle('--')

plt.show()
```



```
import matplotlib.pyplot as plt

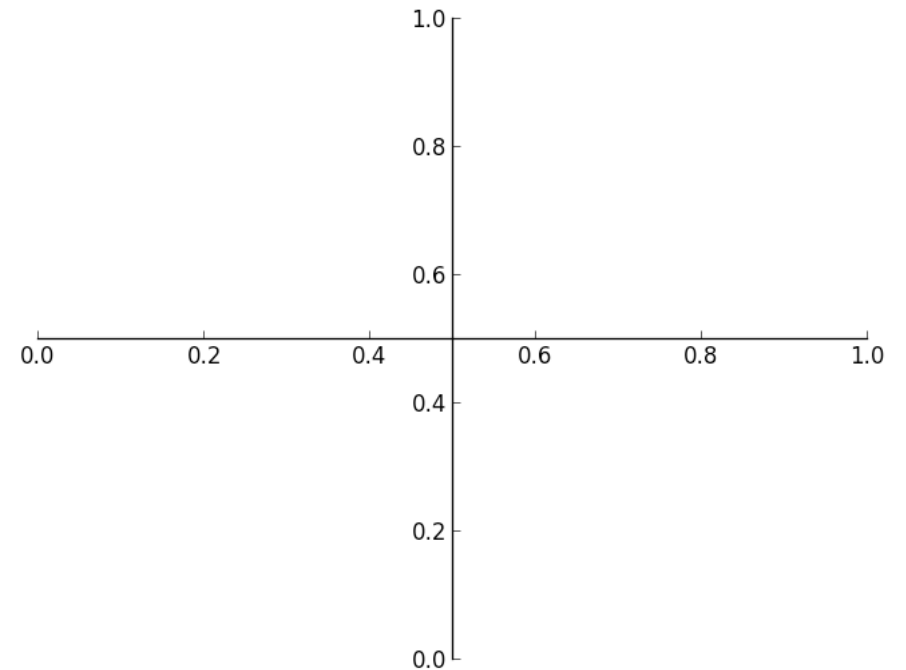
fig = plt.figure()
ax = fig.add_subplot(111)

ax.spines['top'].set_visible(False)
ax.spines['right'].set_visible(False)
ax.spines['bottom'].set_position('center')
ax.spines['left'].set_position('center')

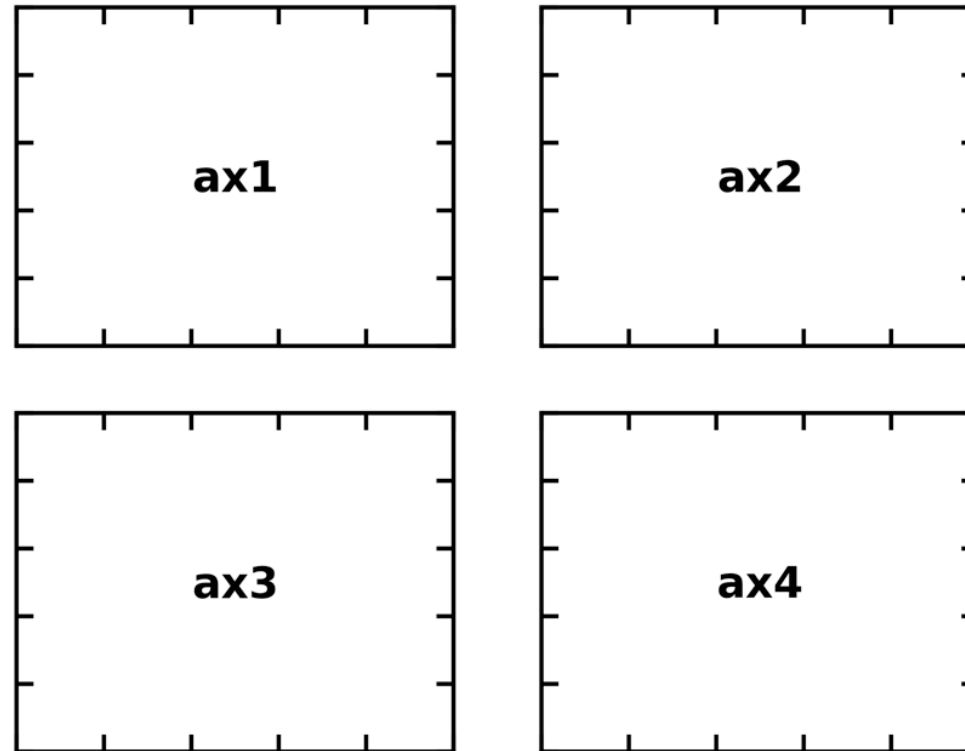
for tick in ax.xaxis.get_major_ticks():
    tick.tick2on = False

for tick in ax.yaxis.get_major_ticks():
    tick.tick2on = False

plt.show()
```

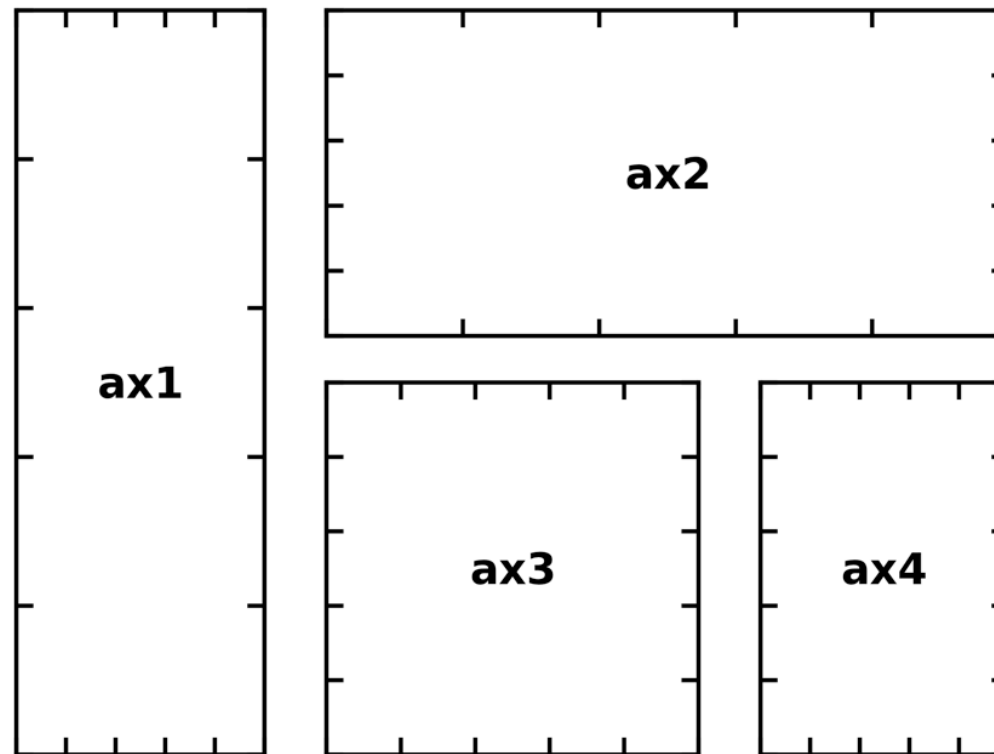


Customizing location of Axes



```
ax1 = fig.add_subplot(221)  
ax2 = fig.add_subplot(222)  
ax3 = fig.add_subplot(223)  
ax4 = fig.add_subplot(224)
```

Customizing location of Axes



```
# add_axes((left, bottom, width, height))  
  
ax1 = fig.add_axes((0.1, 0.1, 0.2, 0.8))  
ax2 = fig.add_axes((0.35, 0.55, 0.55, 0.35))  
ax3 = fig.add_axes((0.35, 0.1, 0.3, 0.4))  
ax4 = fig.add_axes((0.7, 0.1, 0.2, 0.4))
```

A close-up, black and white comic book illustration of a man's face. He has a determined, shouting expression with his mouth wide open, showing teeth. His eyes are squeezed shut, and several sweat drops are flying off his forehead and cheeks. The word "FREE!" is written in a large, bold, sans-serif font across the center of the image. The background is plain white.

FREE!

The memory required for a figure is not completely released until the figure is explicitly closed with `close()`.

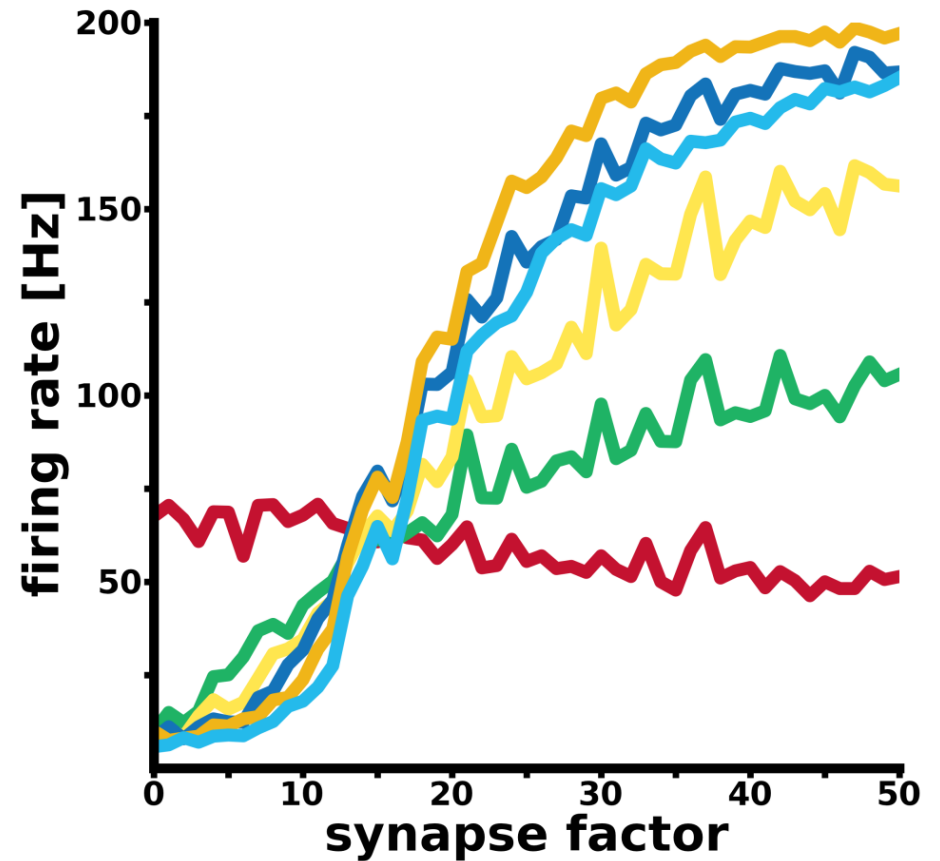
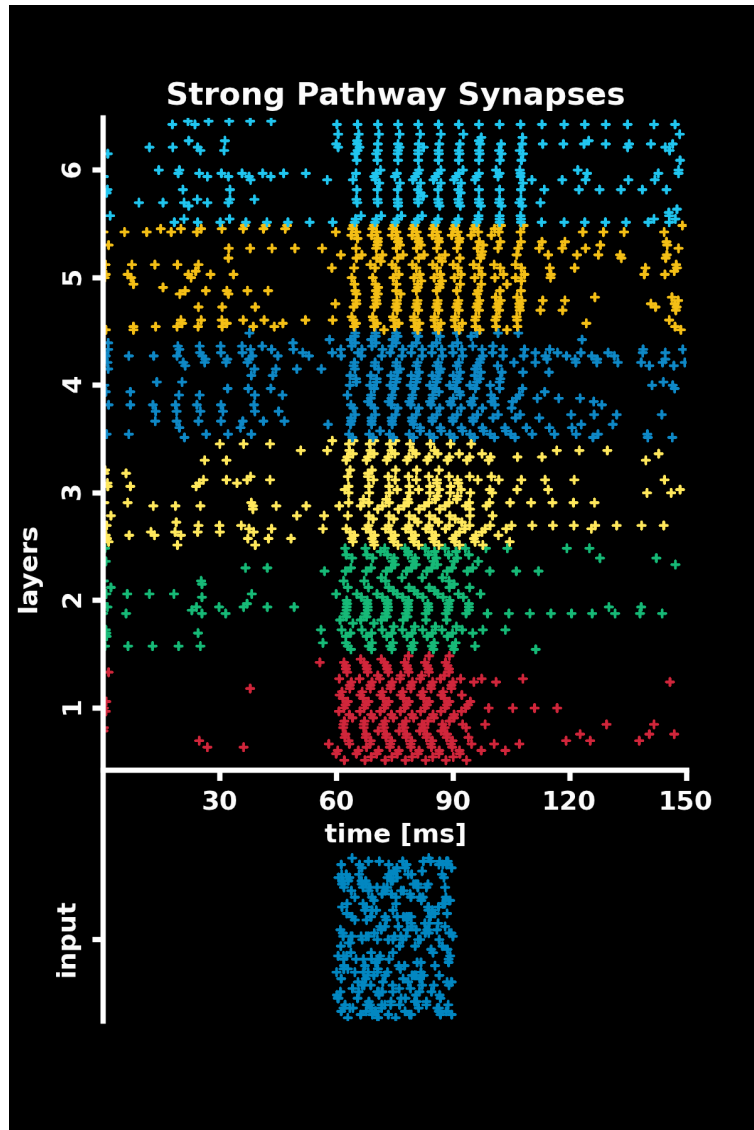
```
import os
import glob
import matplotlib.pyplot as plt

filelist = glob.glob('*.txt')
for fname in filelist:

    ...
    ...
    ...

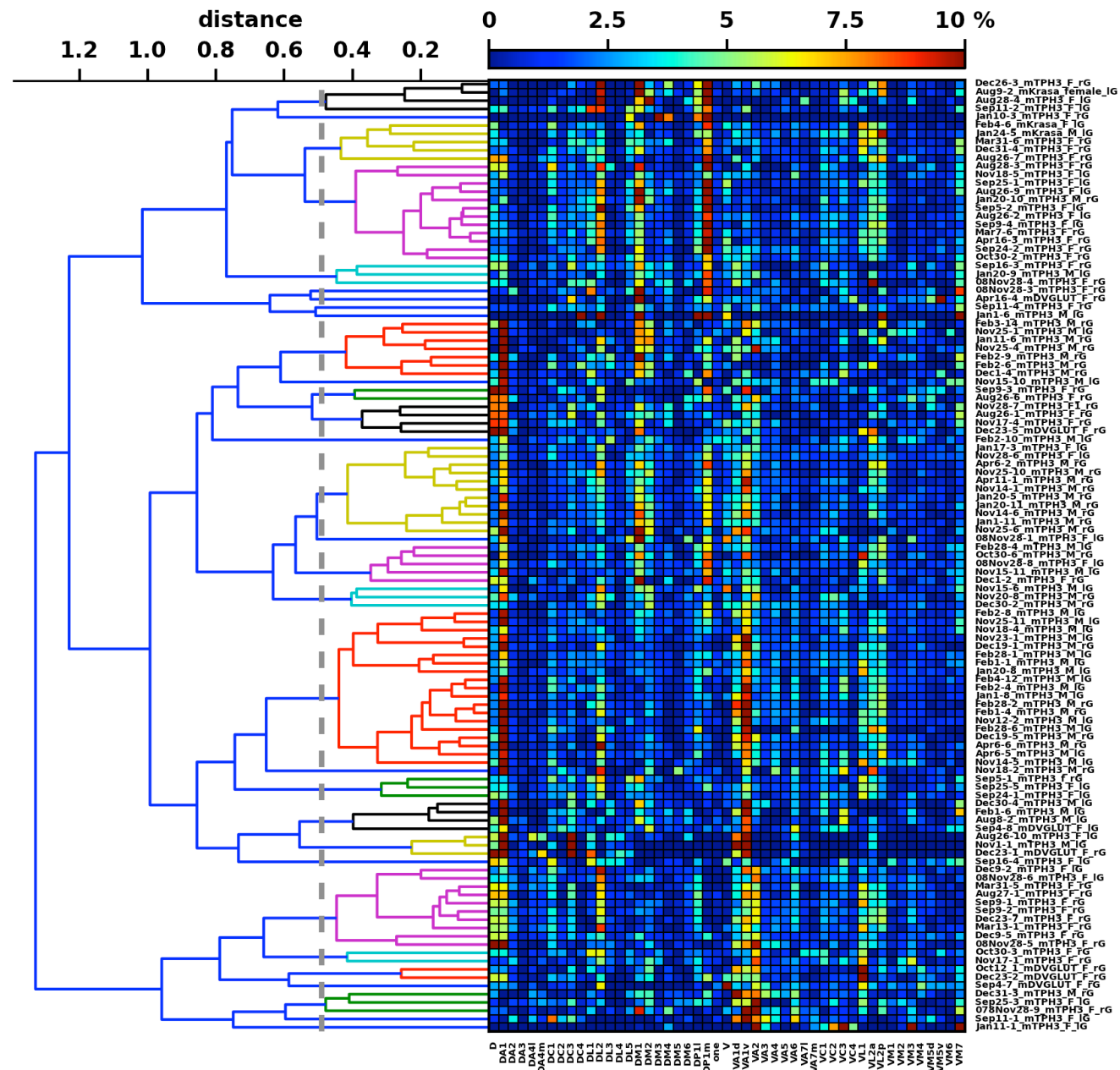
    fig = plt.figure()
    ax = fig.add_subplot(111)
    ax.plot(x, y)
    plt.savefig(os.path.splitext(fname)[0])
    plt.close(fig)
```


Signal propagation

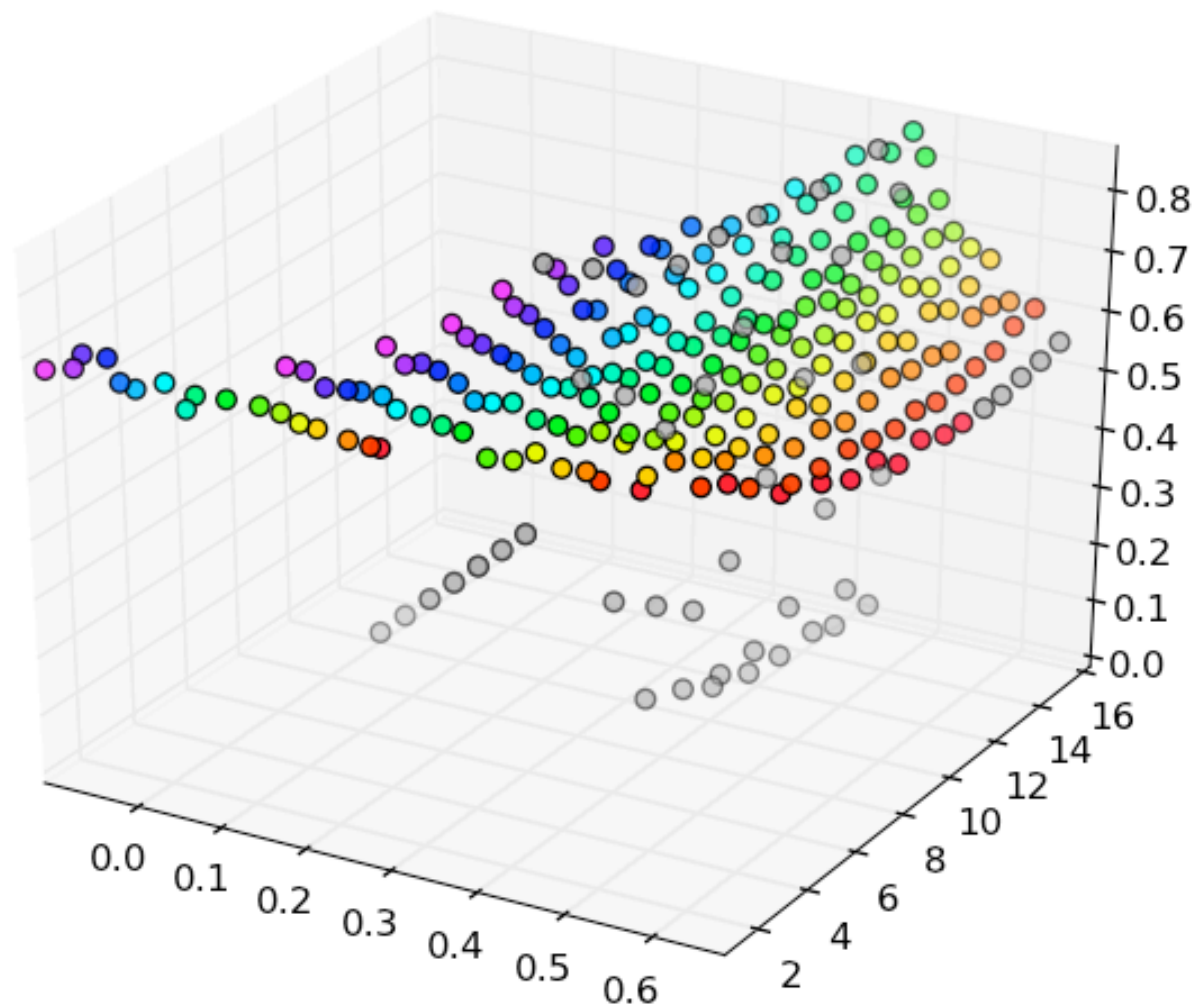


- Vogels TP, Abbott LF (2005) Signal propagation and logic gating in networks of integrate-and-fire neurons. *J Neurosci* 25: 10786-10795.
- Brian: a simulator for spiking neural networks in Python (<http://briansimulator.org>)

Hierarchical clustering



`mpl_toolkits.mplot3d`
provides some basic 3D plotting tools



May the Matplotlib be with You :)

Find all objects in a figure of a certain type

Find every object in the figure which has a `set_color` property and makes the object blue

```
def myfunc(x):  
    return hasattr(x, 'set_color')  
  
for o in fig.findobj(myfunc):  
    o.set_color('blue')
```

Filter on class instances

```
import matplotlib.text as text  
  
for o in fig.findobj(text.Text):  
    o.set_fontstyle('italic')
```