" USE THE MATPLOTLIB, LUKE "

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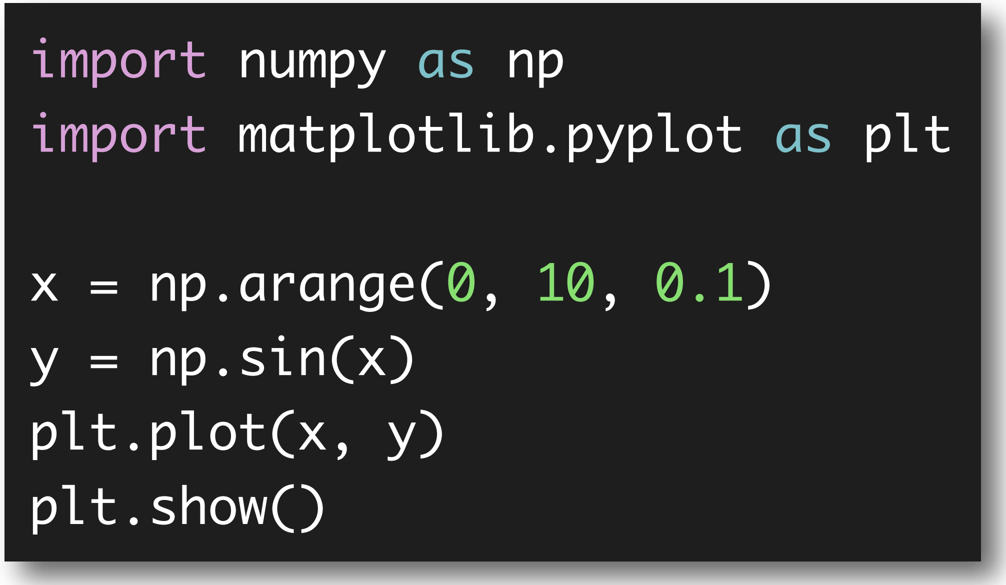
A long time ago, in a galaxy far, far away ...

John Hunter

“

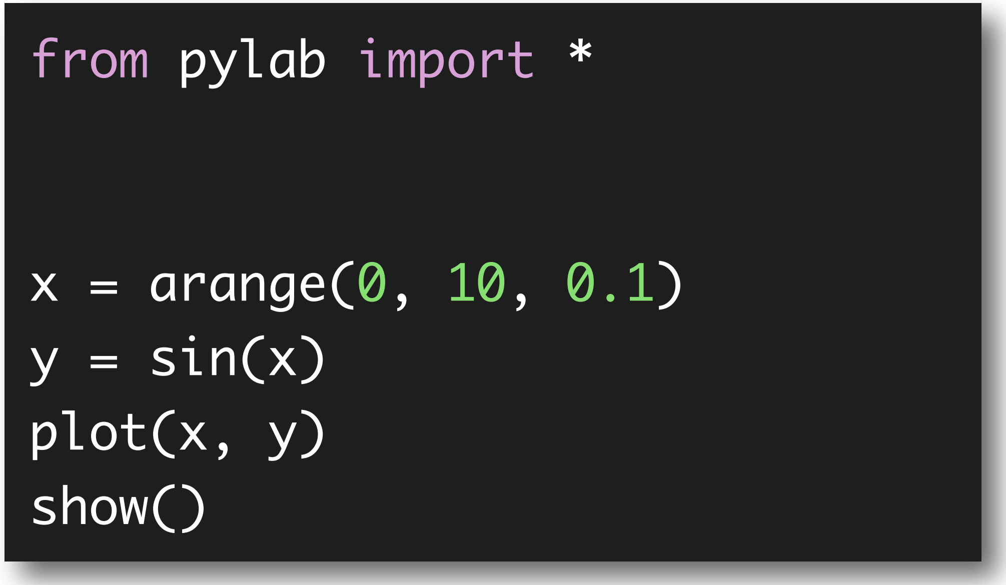
Matplotlib is a Python 2D plotting library which produces publication quality figures in a variety of hardcopy formats and interactive environments across platforms.

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()
```

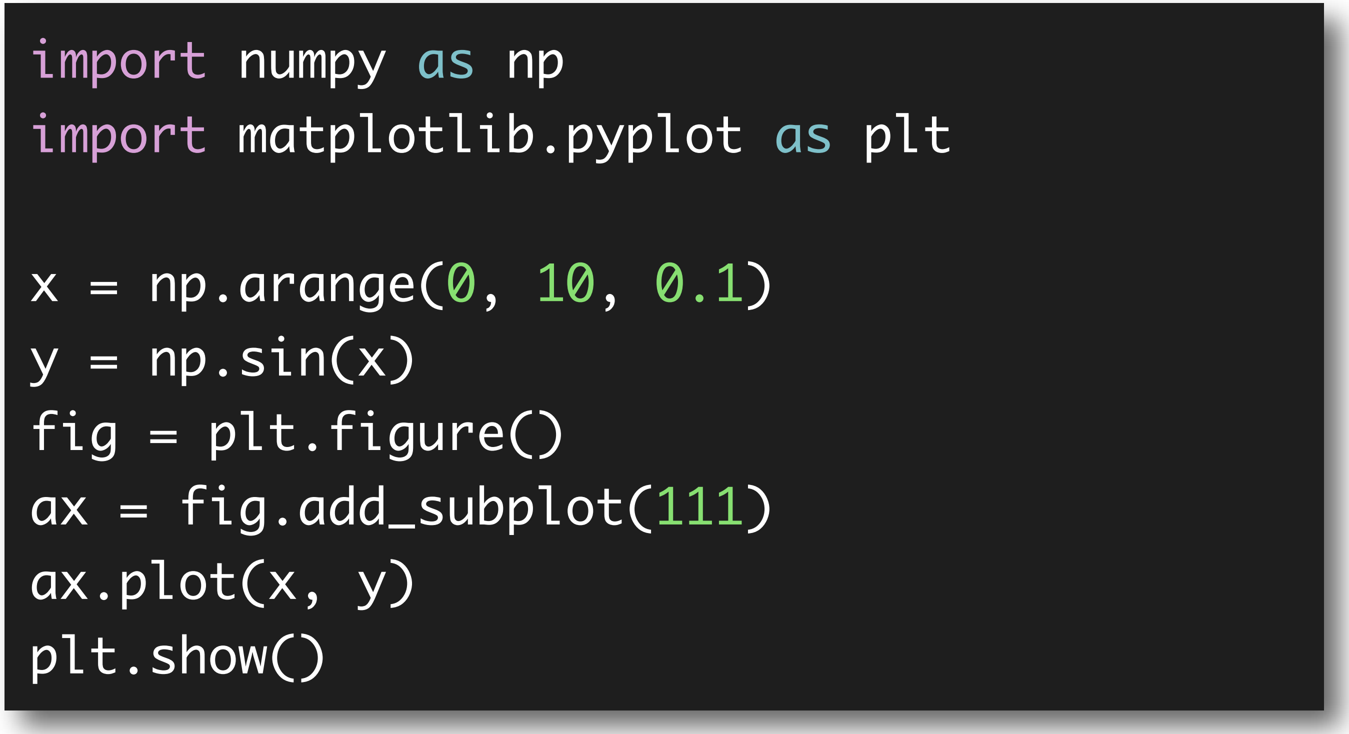
pylab lumps pyplot together with numpy in a single namespace, making that environment even more MATLAB-like



```
from pylab import *


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

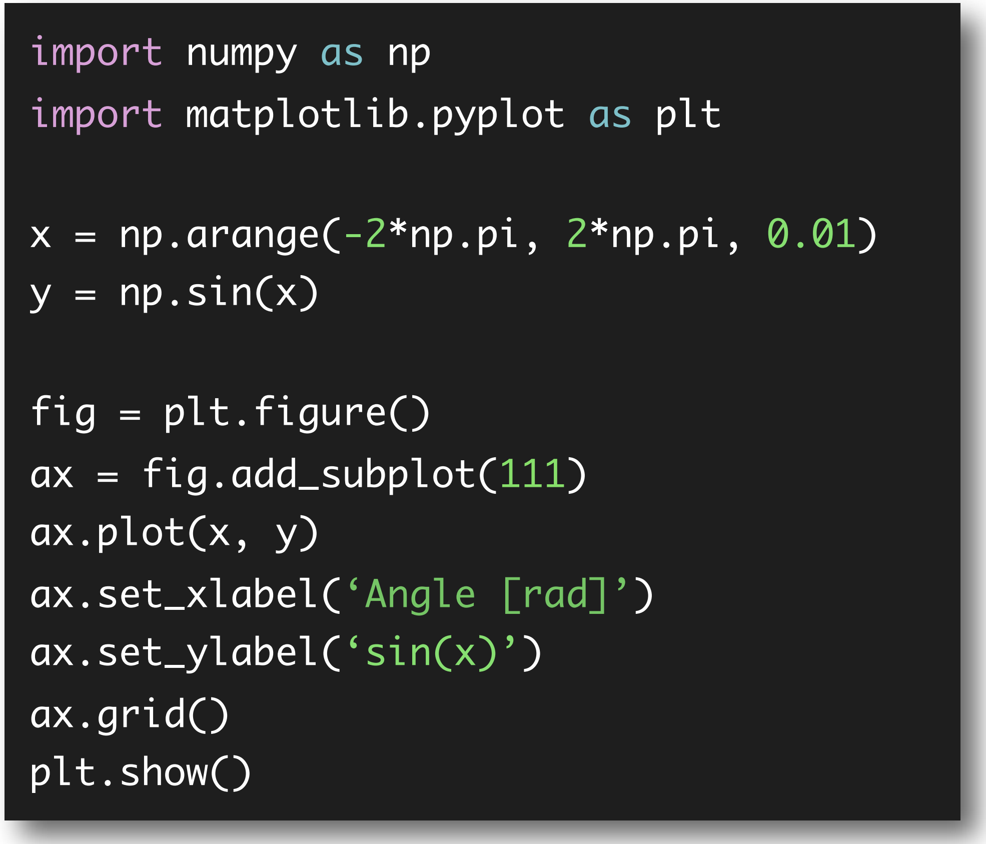
Explicit is better than implicit.

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

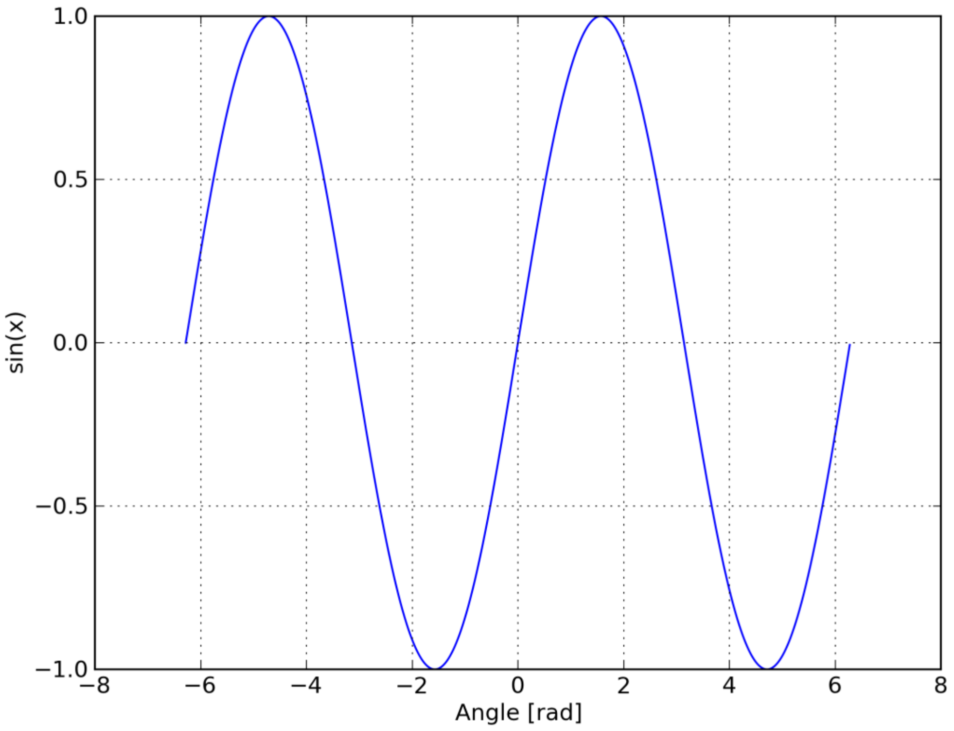


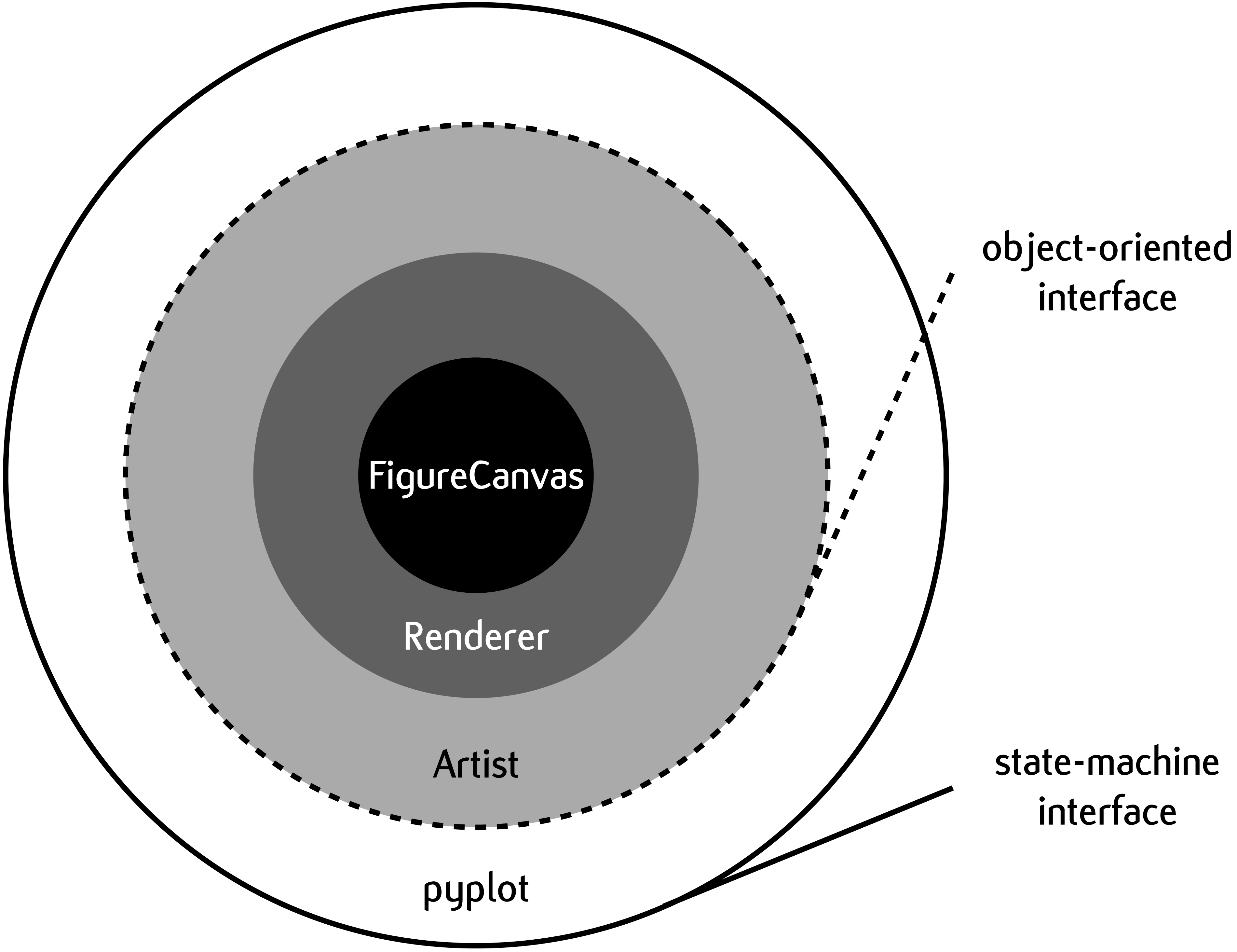
```python
import numpy as np
import matplotlib.pyplot as plt

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()
```

Simple example



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

x = np.arange(-2*np.pi, 2*np.pi, 0.01)
y = np.sin(x)

fig = plt.figure()
ax = fig.add_subplot(111)
ax.plot(x, y)
ax.set_xlabel(‘Angle [rad]’)
ax.set_ylabel(‘sin(x)’)
ax.grid()
plt.show()
```




object-oriented interface
state-machine interface
FigureCanvas
Renderer
Artist
pyplot

2 types of Artists

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

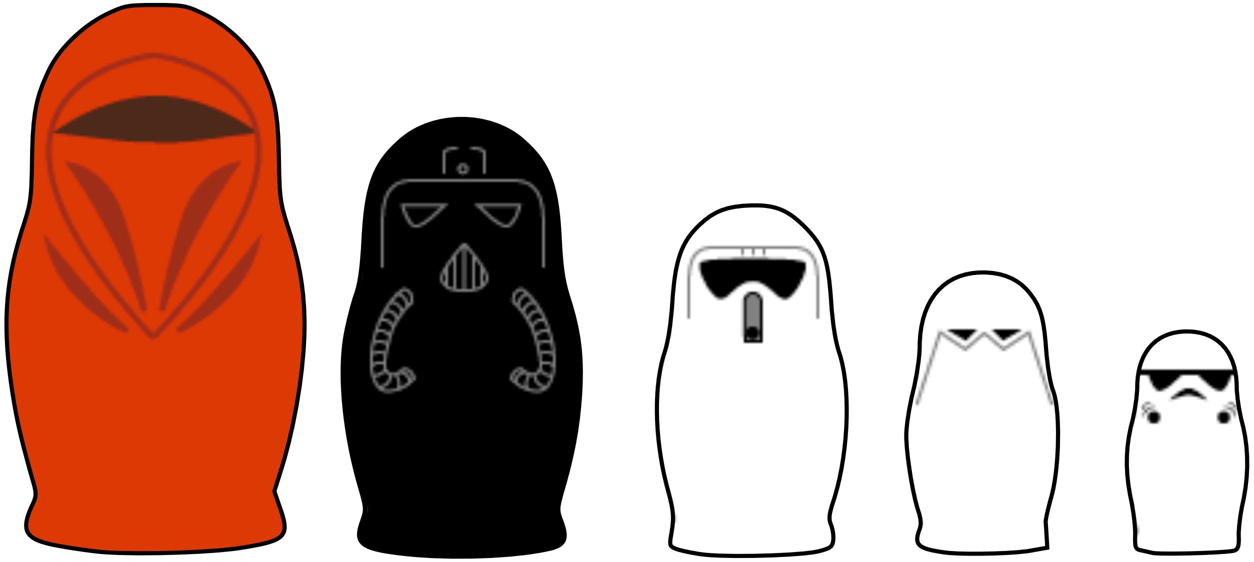
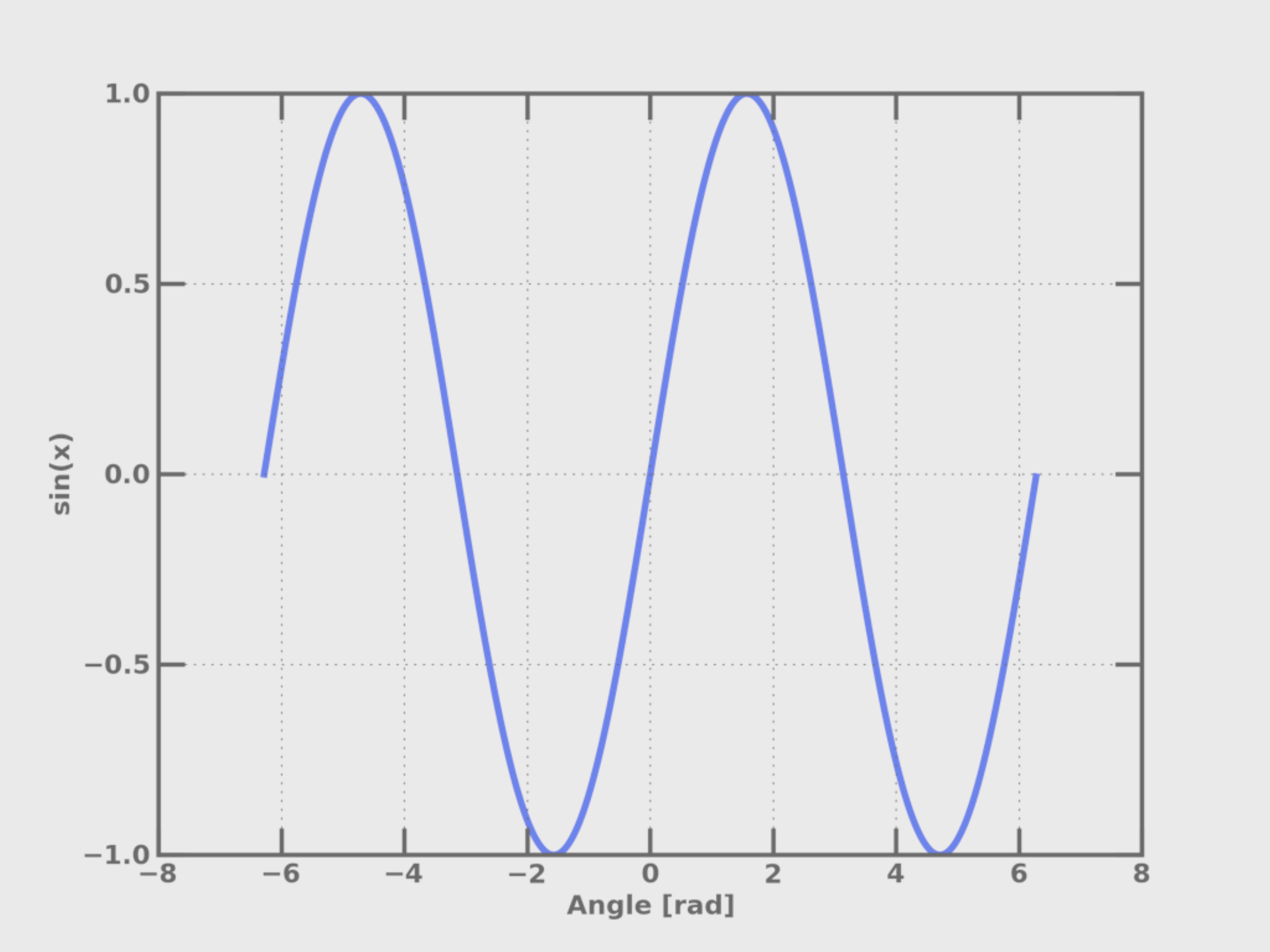


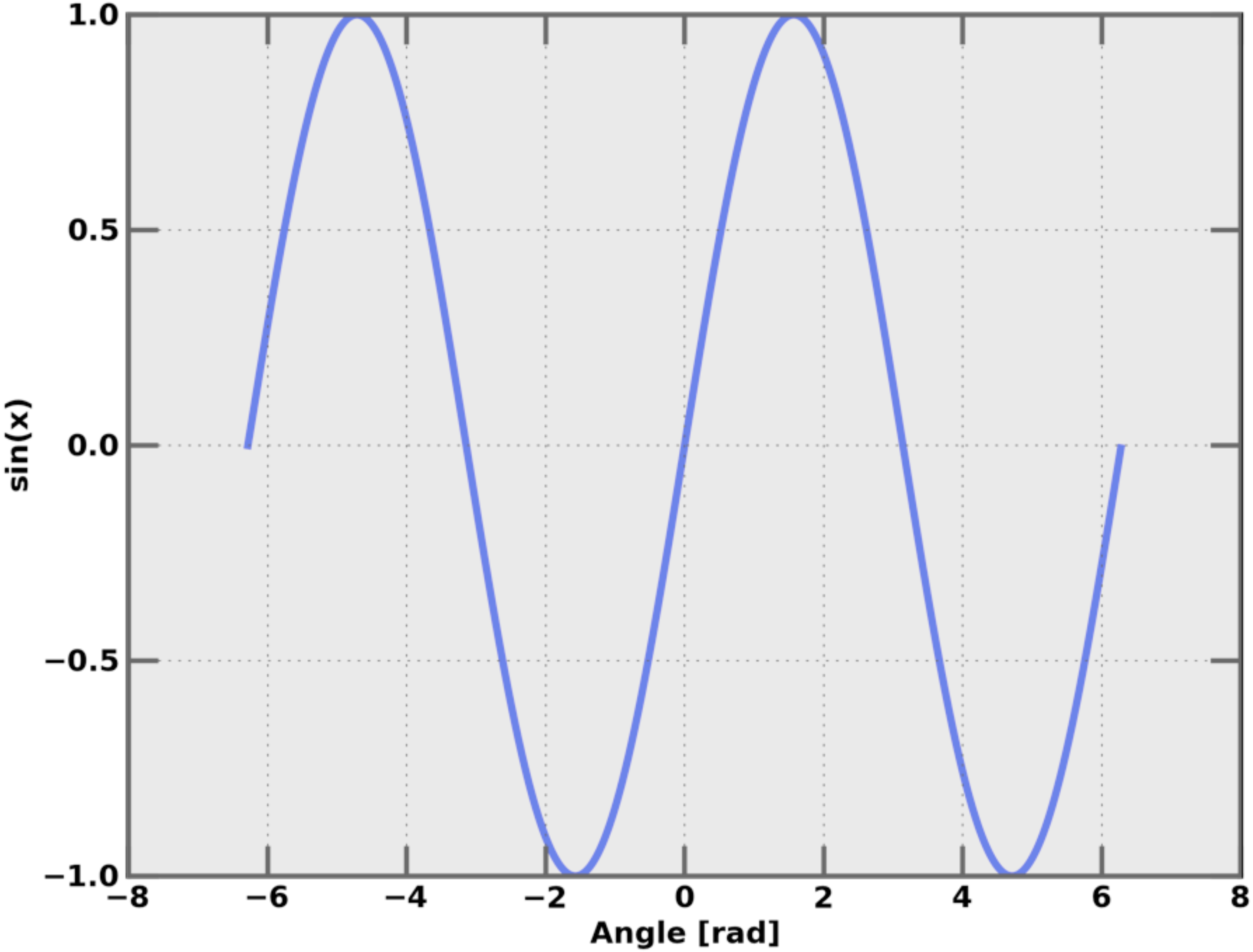
Figure Container

(matplotlib.figure.Figure)



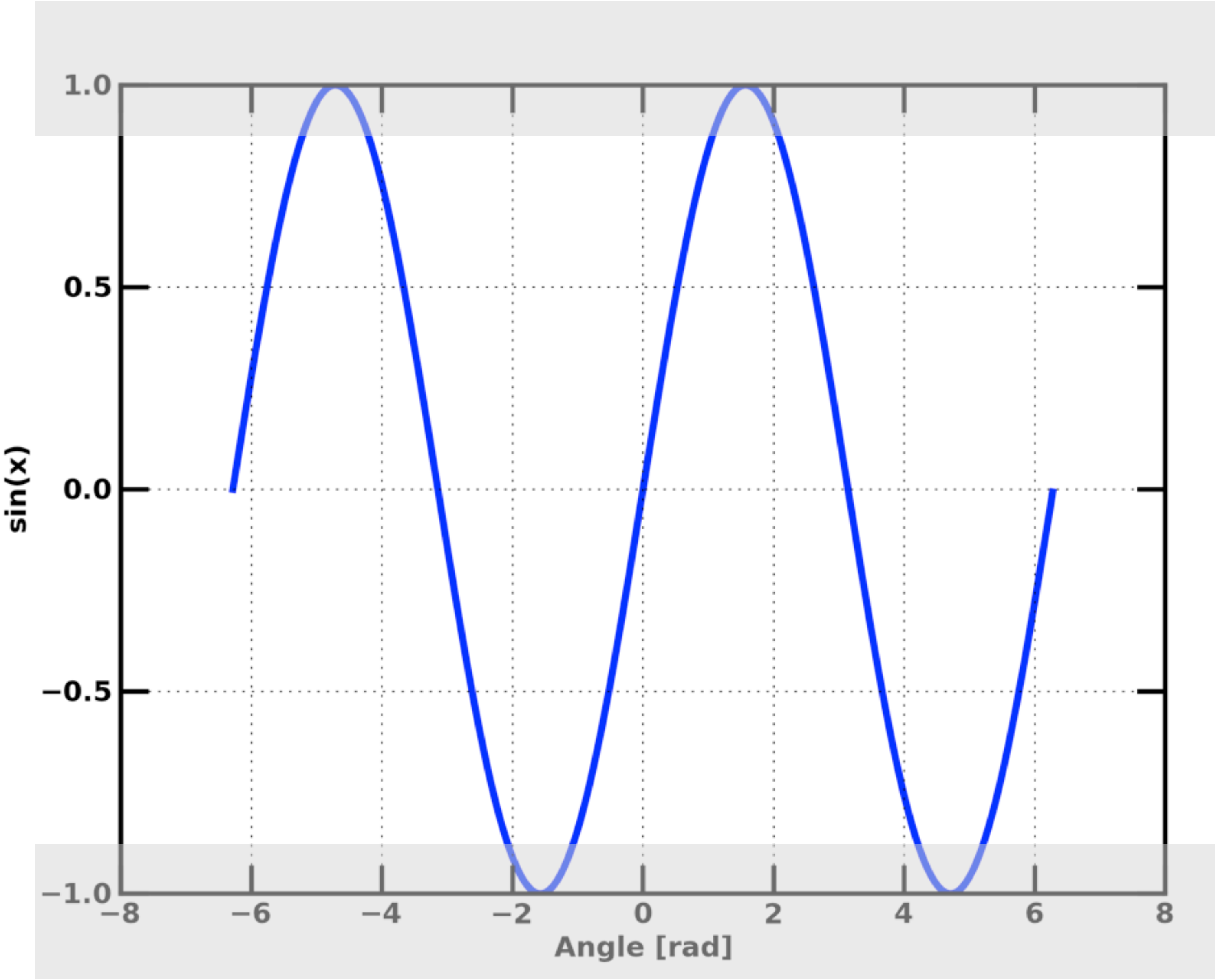
Axes Container

(matplotlib.axes.Axes)



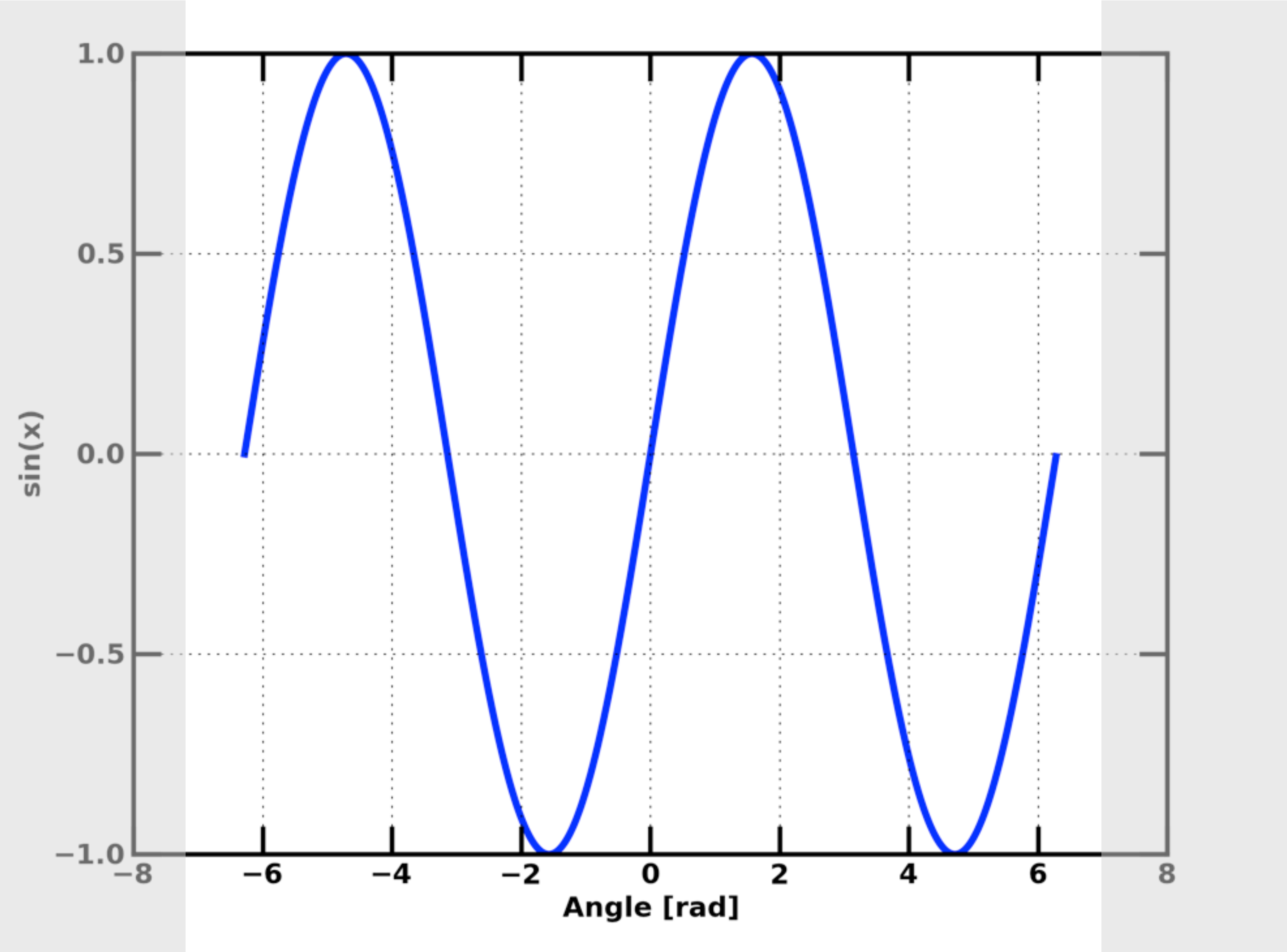
XAxis Container

(matplotlib.axis.Axis)



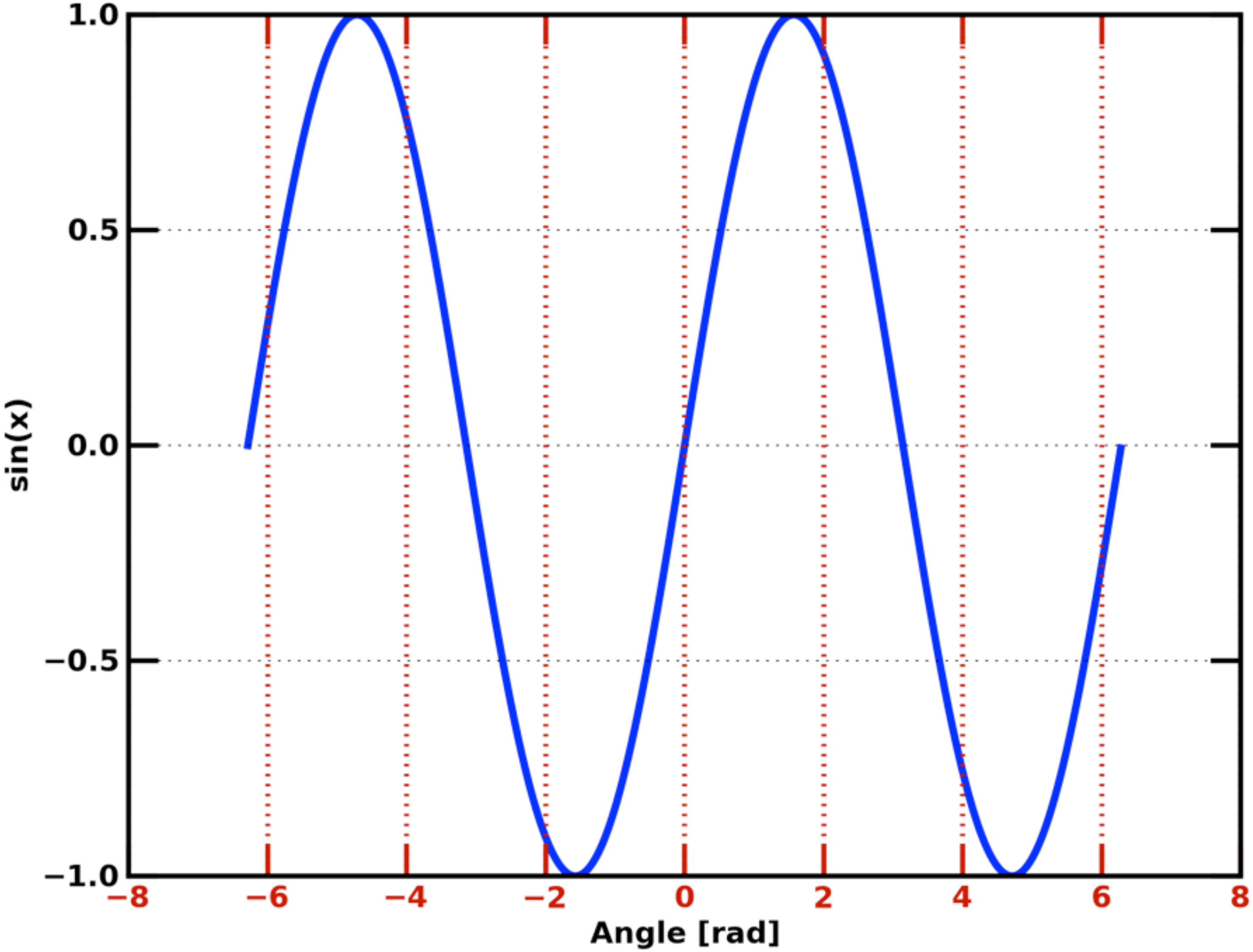
YAxis Container

(matplotlib.axis.Axis)



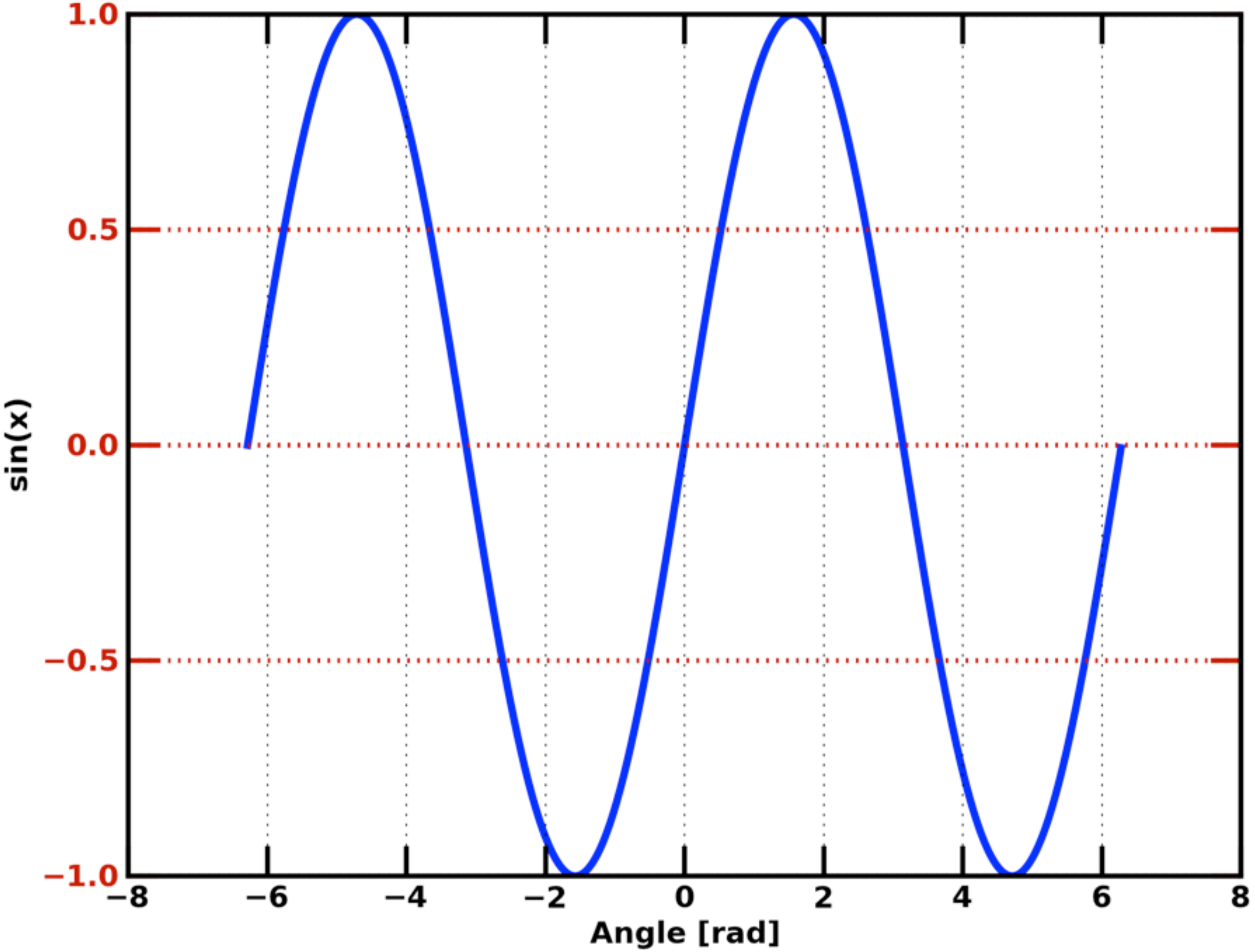
XTick Container

(matplotlib.axis.Tick)



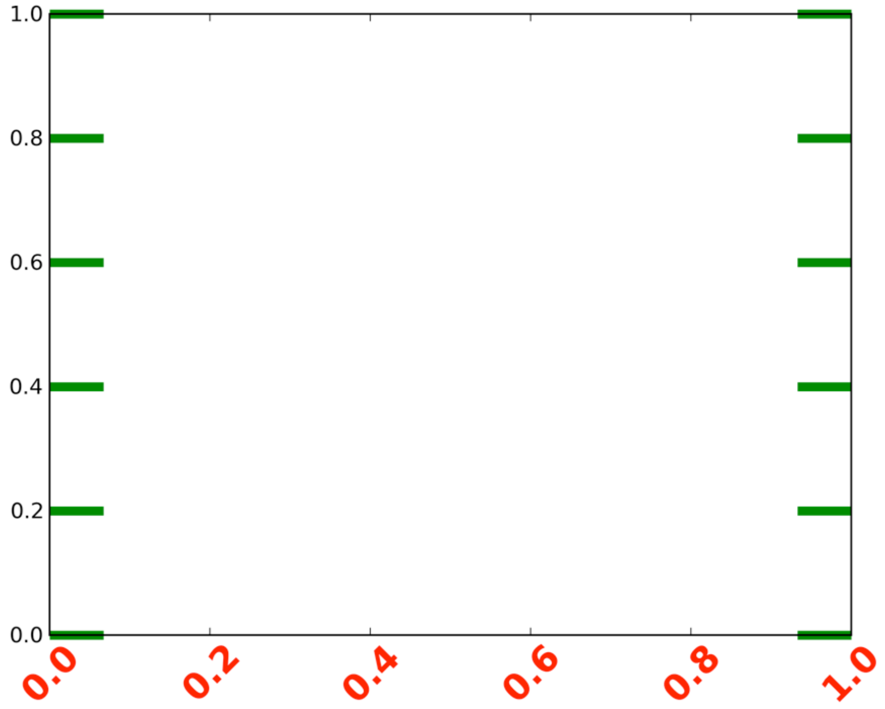
YTick Container

(matplotlib.axis.Tick)



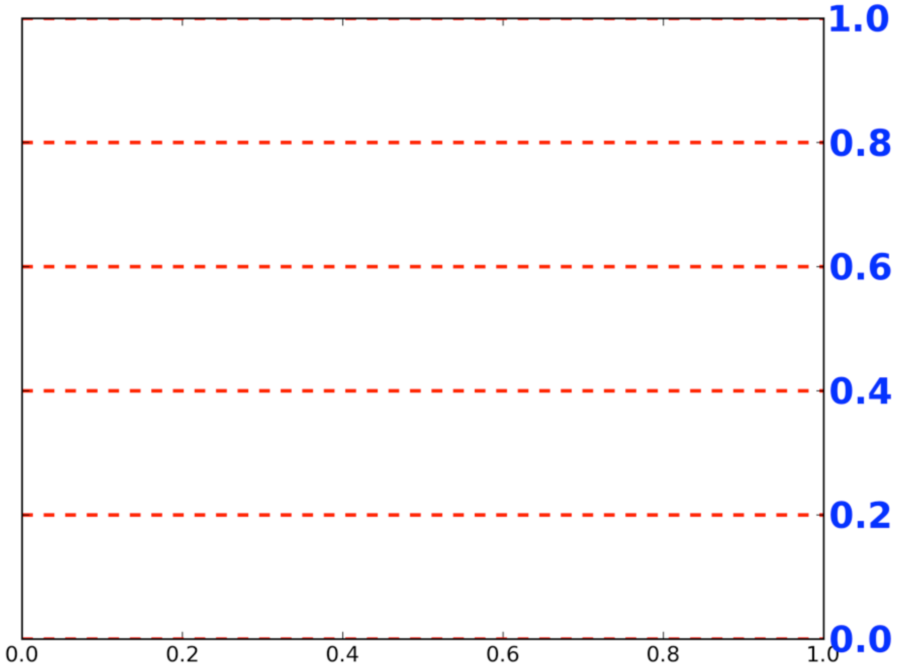
Customizing your objects

```
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()
```

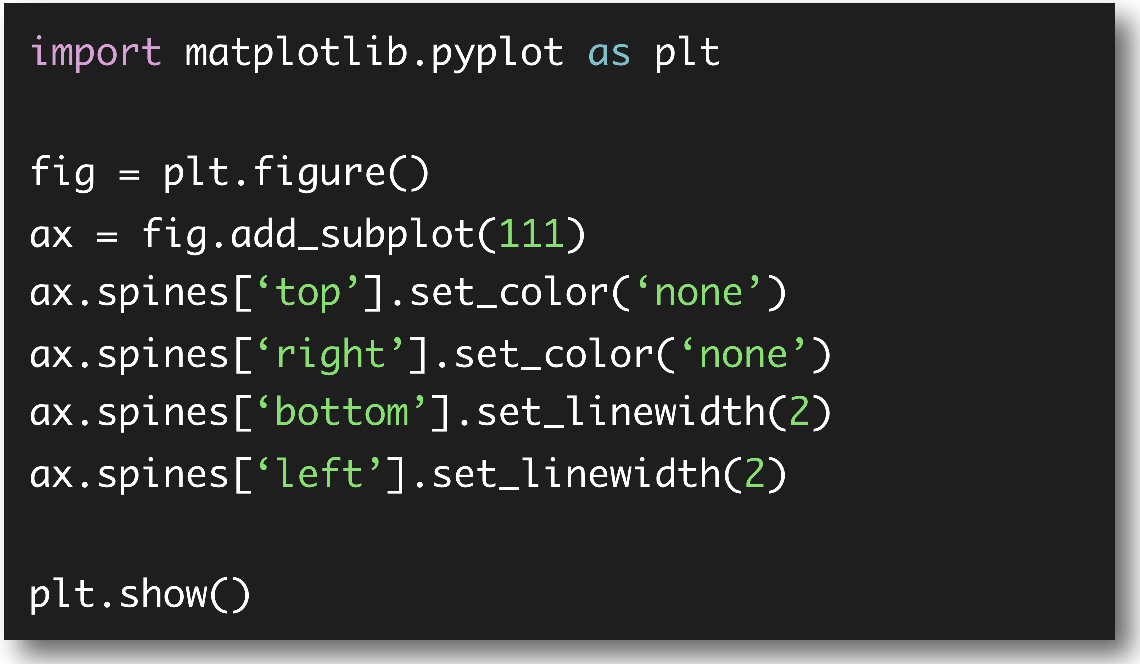


Customizing your objects

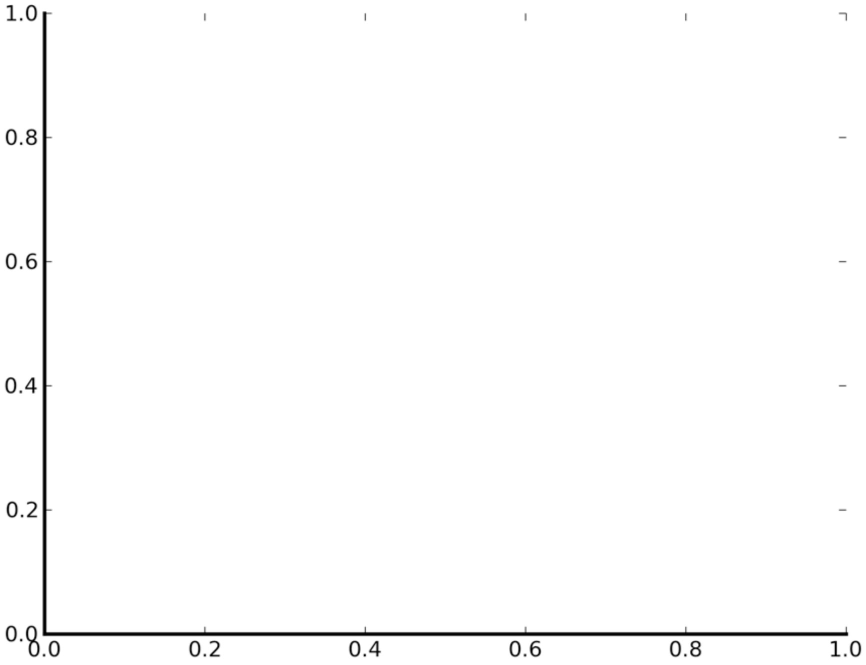
```
import matplotlib.pyplot as plt

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

for tick in ax.yaxis.get_major_ticks():
    tick.label1On = False
    tick.label2On = True
    tick.label2.set_color('blue')
    tick.label2.set_fontsize(20)
    tick.label2.set_fontweight('bold')

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

plt.show()
```



Customizing your objects



```
import matplotlib.pyplot as plt

fig = plt.figure()
ax = fig.add_subplot(111)
ax.spines[‘top’].set_color(‘none’)
ax.spines[‘right’].set_color(‘none’)
ax.spines[‘bottom’].set_linewidth(2)
ax.spines[‘left’].set_linewidth(2)

plt.show()
```



Find all objects in a figure of a certain type

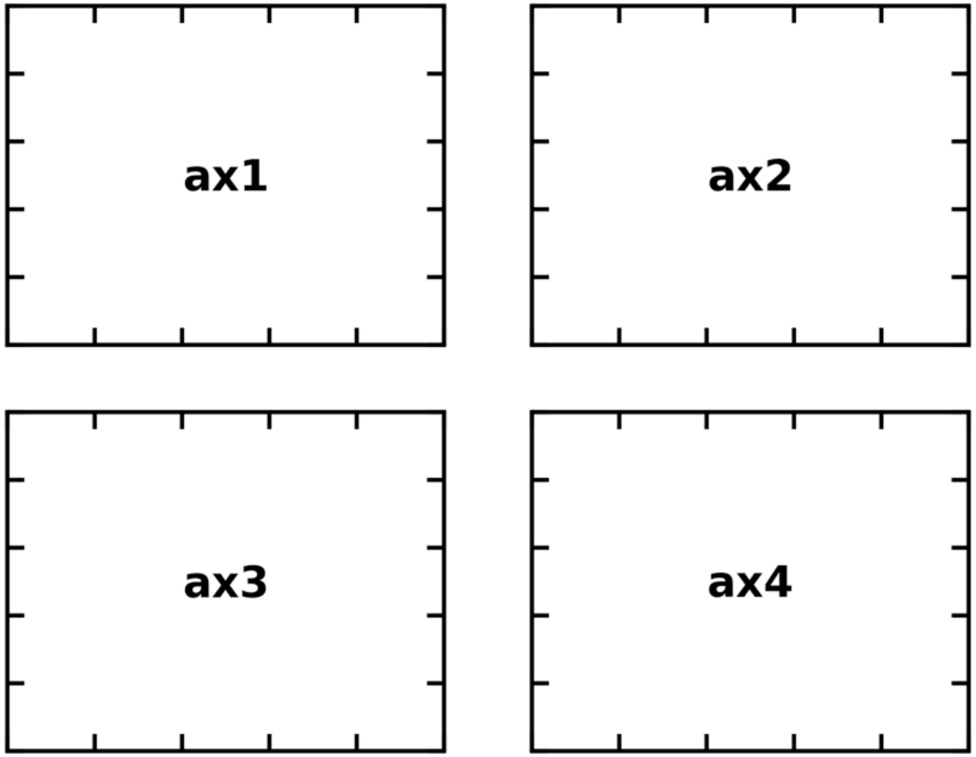
Find every object in the figure which has a set_color property and makes the object blue

```
def myfunc(x):
    return hasattr(x, ‘set_color’)

for o in fig.findobj(myfunc):
    o.set_color(‘blue’)
```

Filter on class instances

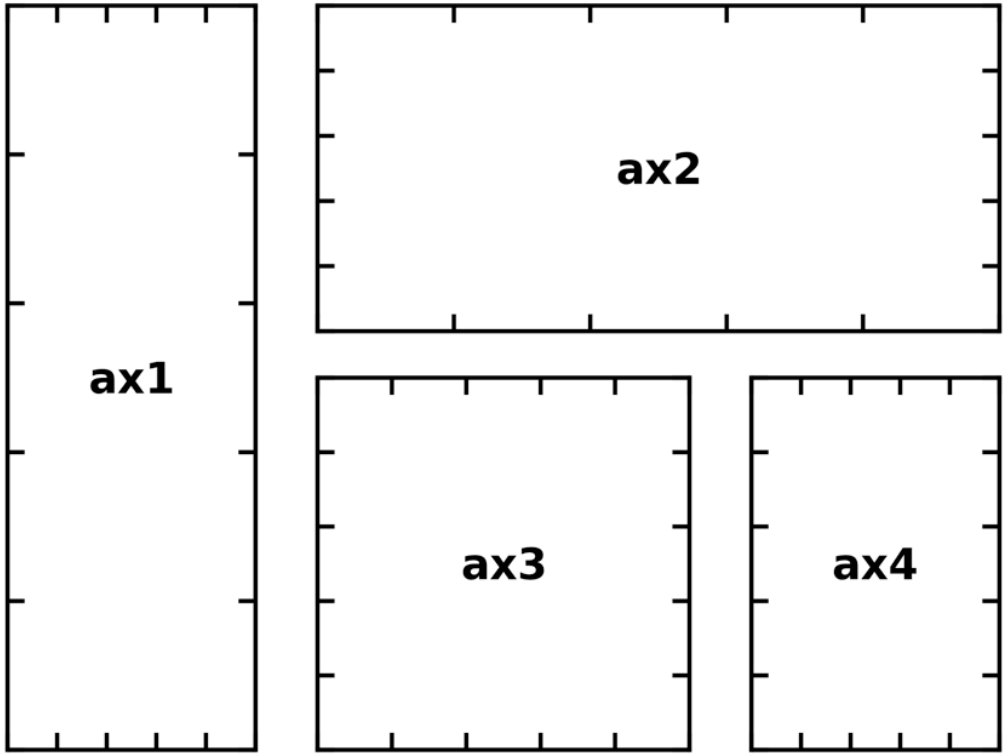
```
import matplotlib.text as text

for o in fig.findobj(text.Text):
    o.set_fontstyle(‘italic’)
```

Customizing location of Axes



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

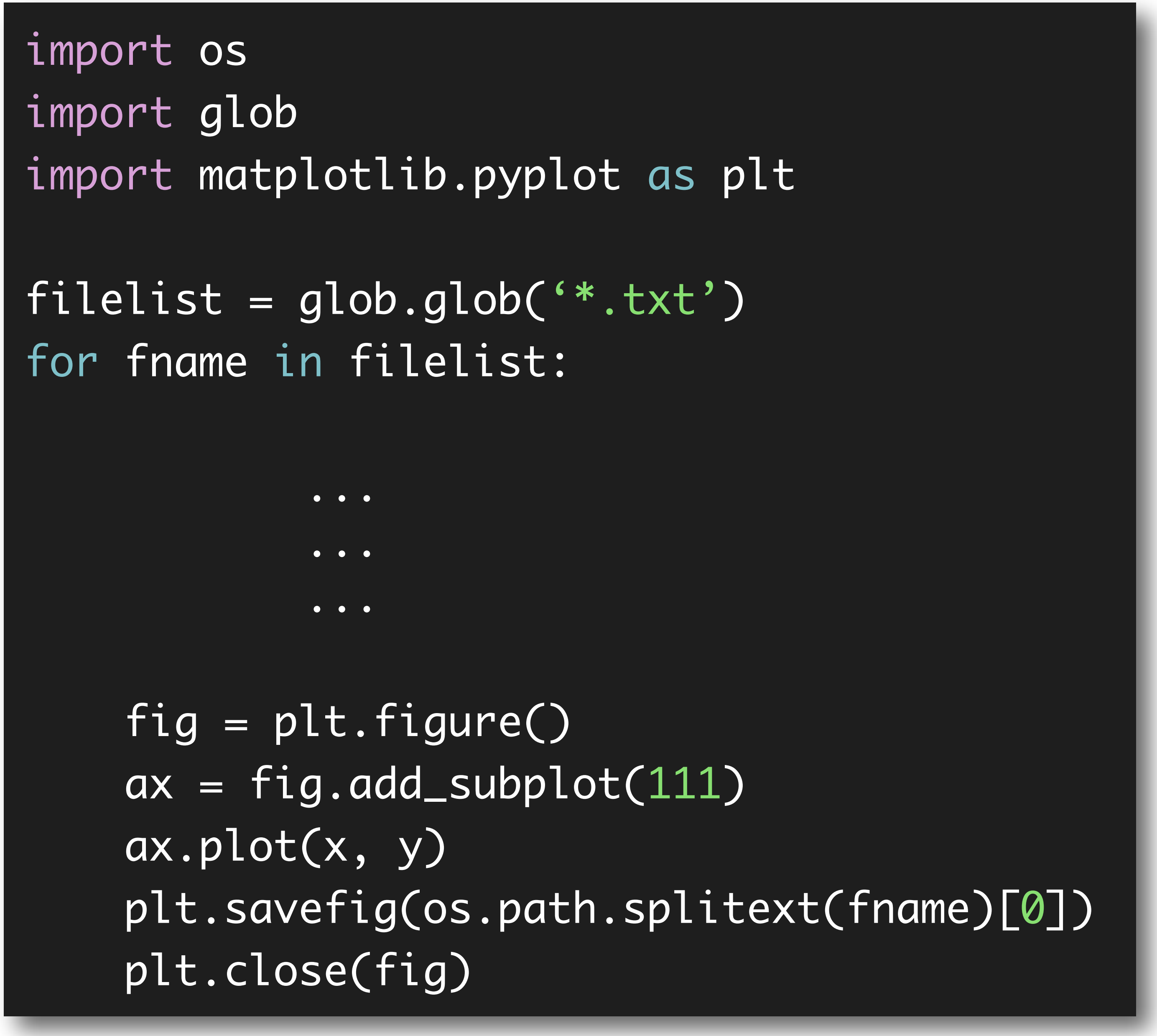
Customizing location of Axes



```
# 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))
```

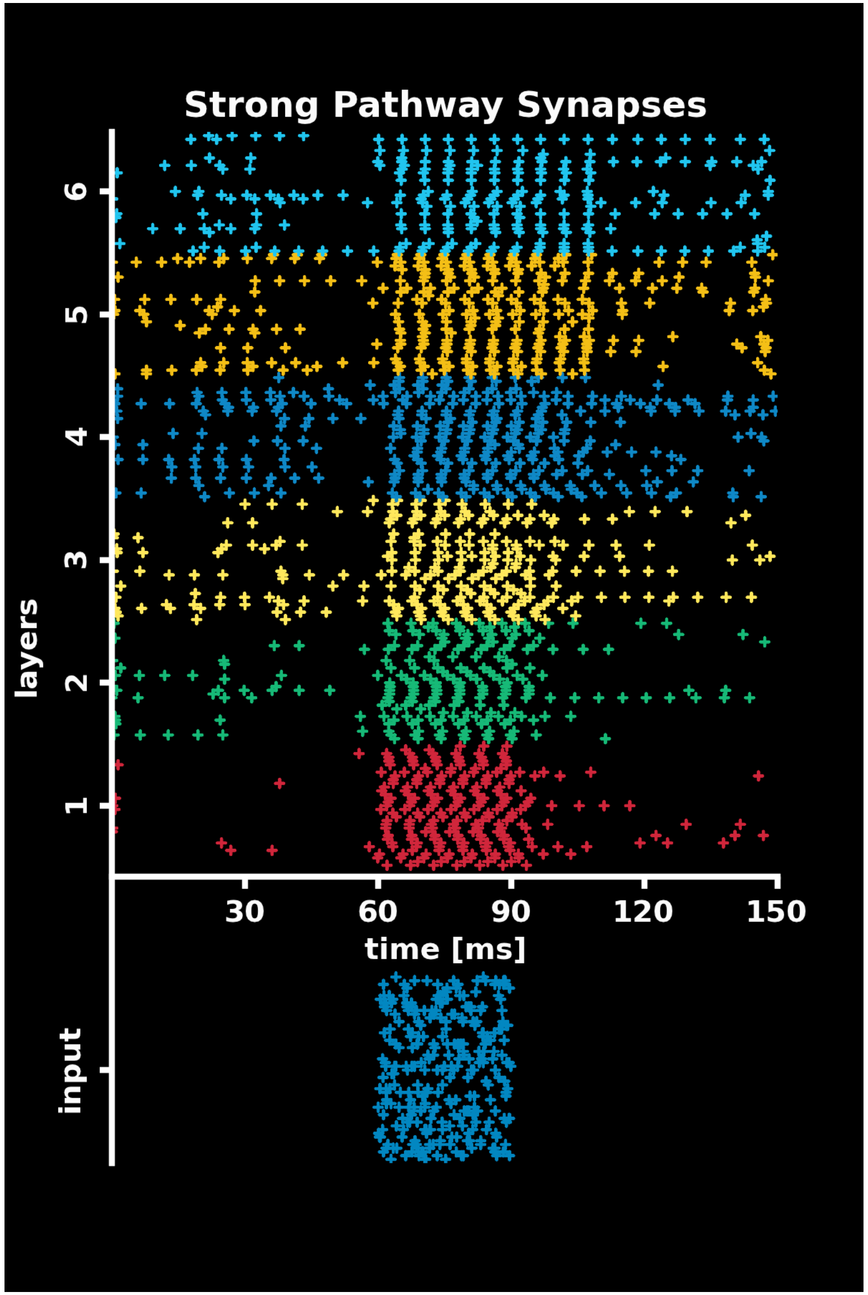
FREE!

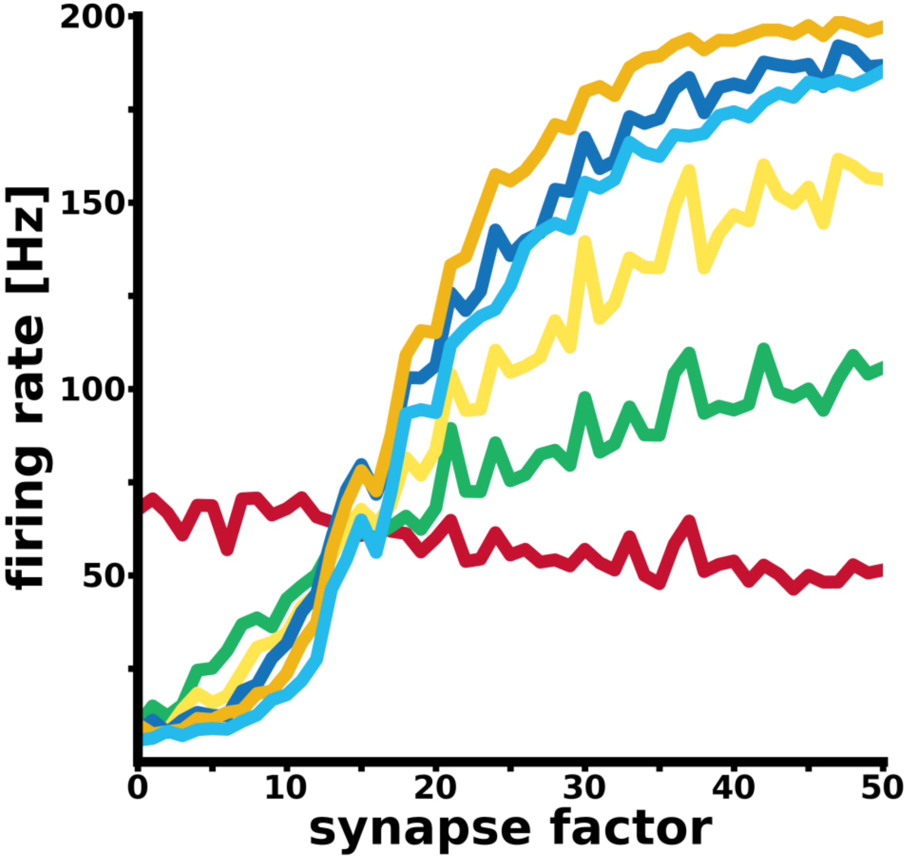
The memory required for a figure is not completely released until the figure is explicitly closed with close().



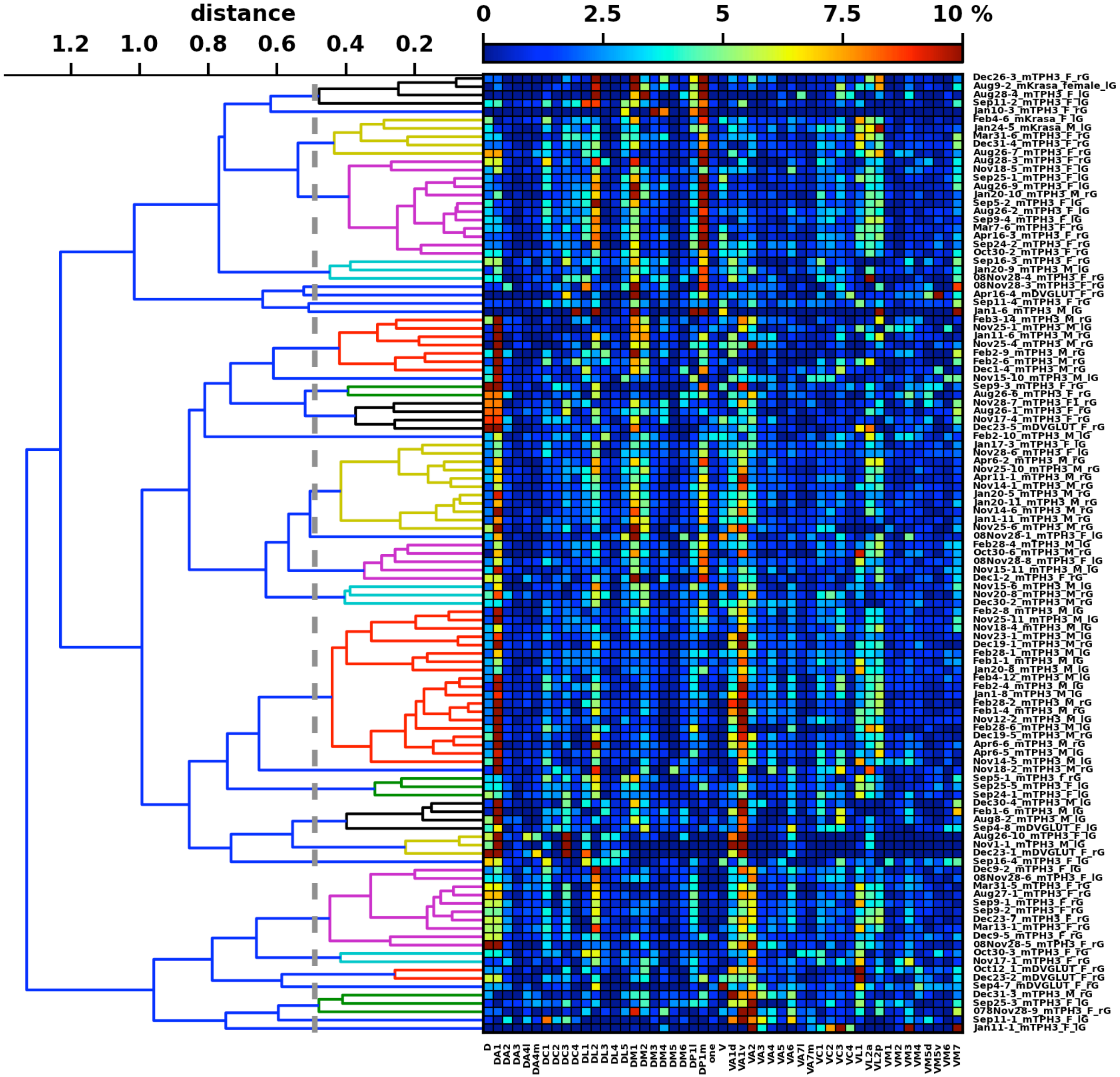
```
import os
import glob
import matplotlib.pyplot as plt

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)
```

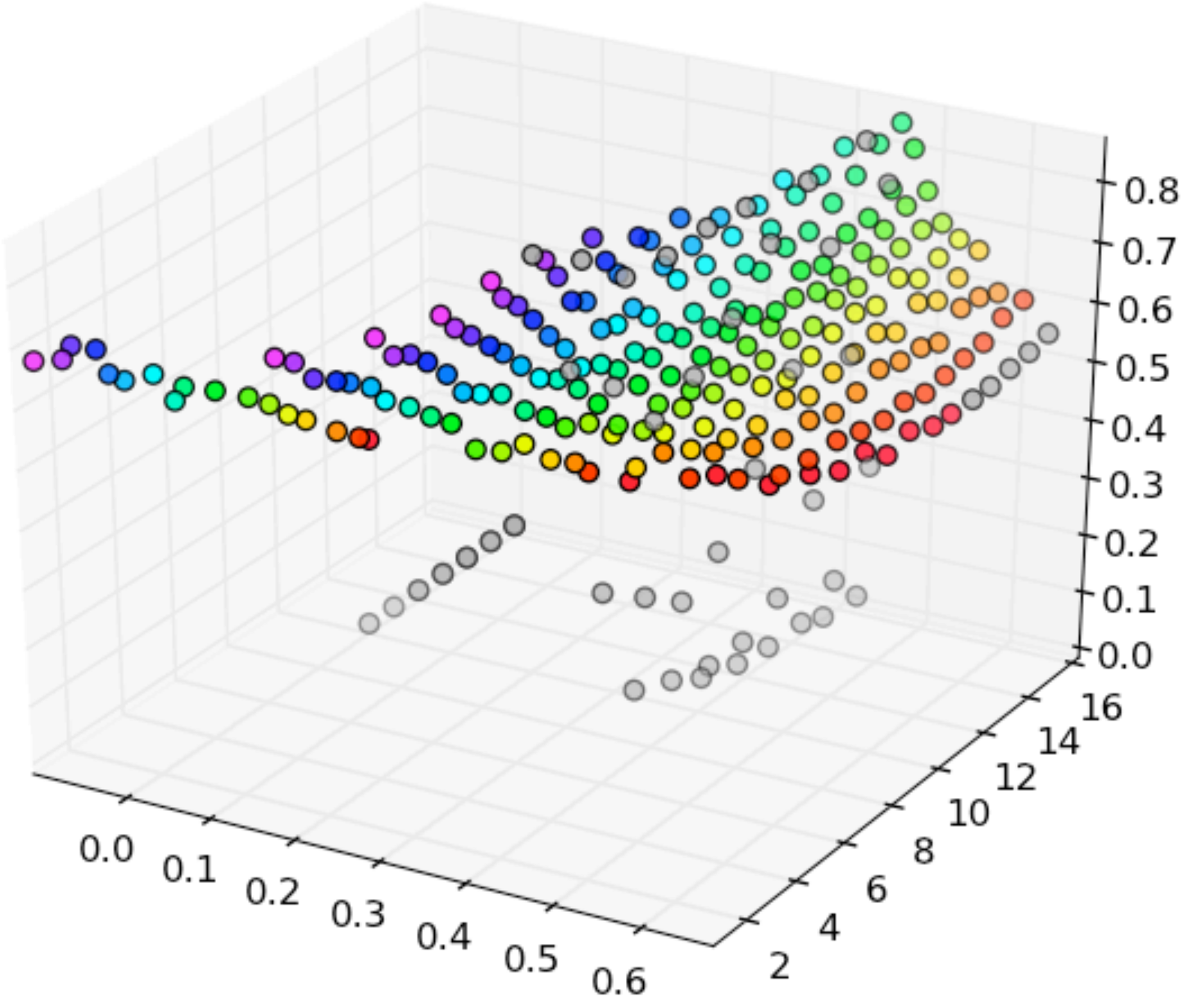
Signal propagation

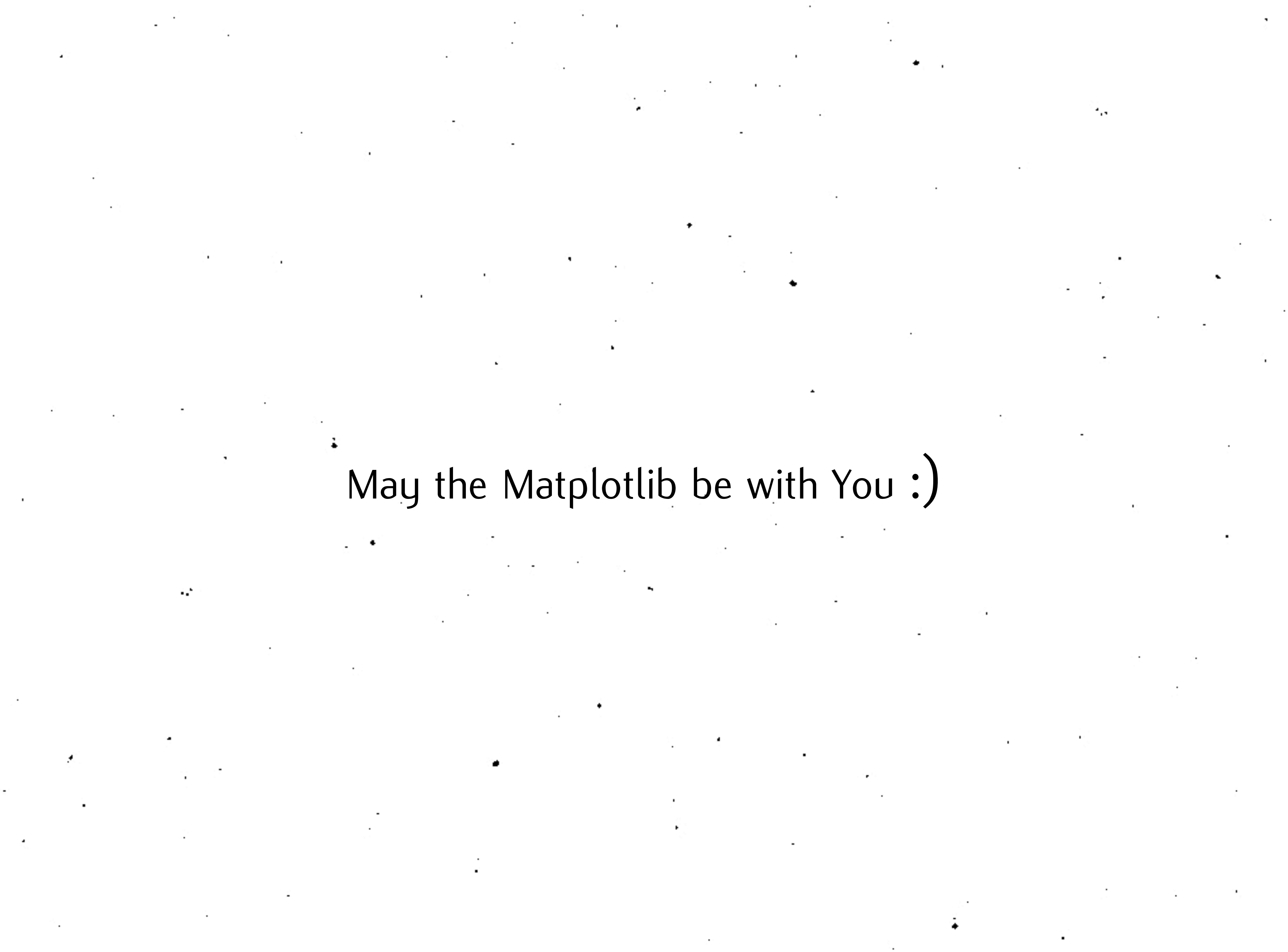




Hierarchical clustering




0.0
0.1
0.2
0.3
0.4
0.5
0.6
2
4
6
8
10
12
14
16
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8



May the Matplotlib be with You :)