免費電子書

學習

matplotlib

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#matplotlib

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1: matplotlib

*matplotlib*Python。API。MATLAB。

JDHunter。BSD。

	Python		
1.3.1	2.6,2.7,3.x		○
1.4.3	2.6,2.7,3.x		2015714
1.5.3	2.7,3.x		2016111
2.X	2.7,3.x		2016725

Examples

matplotlib。matplotlib。

Windowspipmatplotlib。Windowspip 。

OS X.

pipmatplotlib。Python`libfreetype` 。

pip。

Linux

pipmatplotlib`python-matplotlibpip install matplotlib` 。

sudo`--user` `python setup.py install --user` 。matplotlib`~/.local` 。

Debian / Ubuntu

```
sudo apt-get install python-matplotlib
```

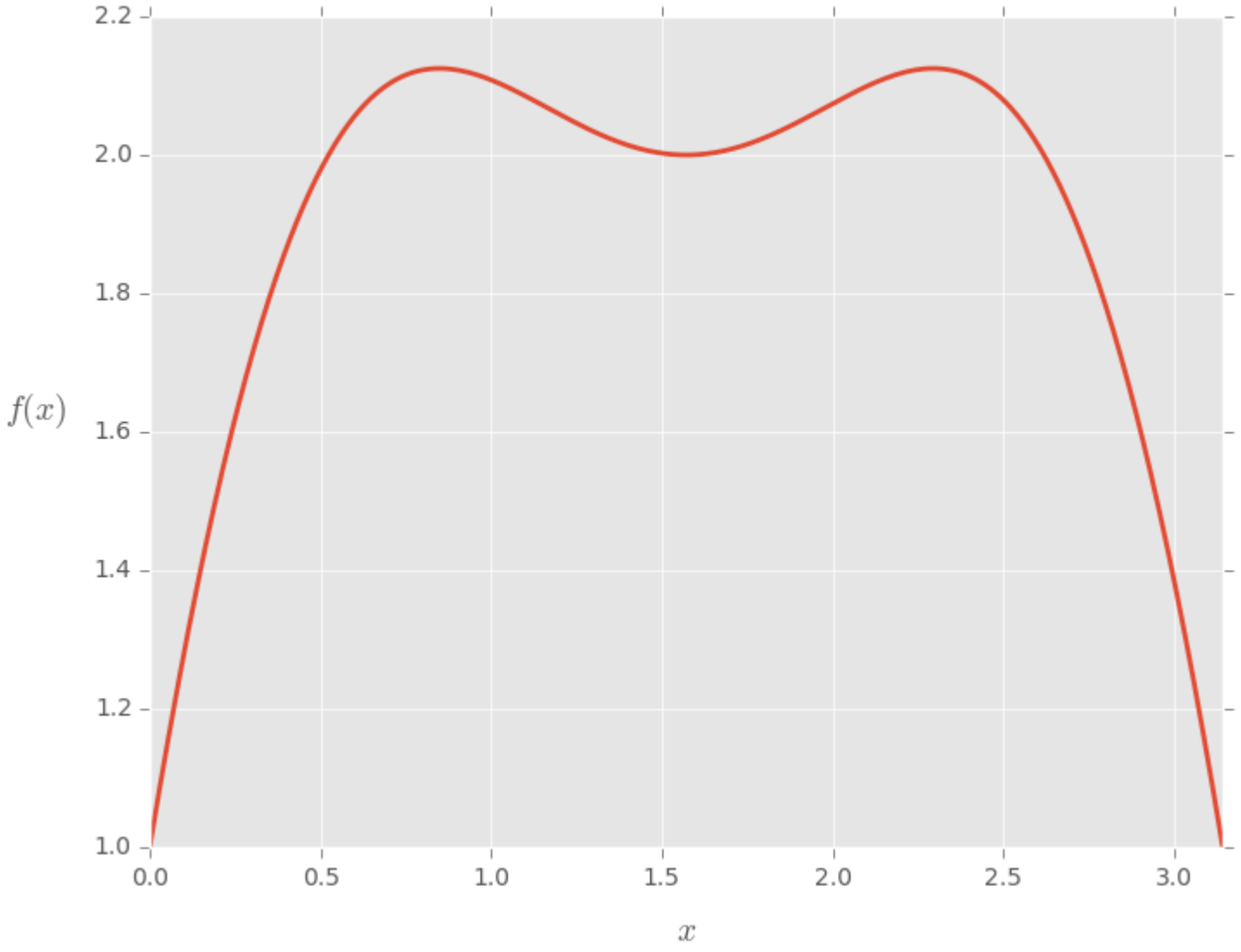
Fedora / Red Hat

```
sudo yum install python-matplotlib
```

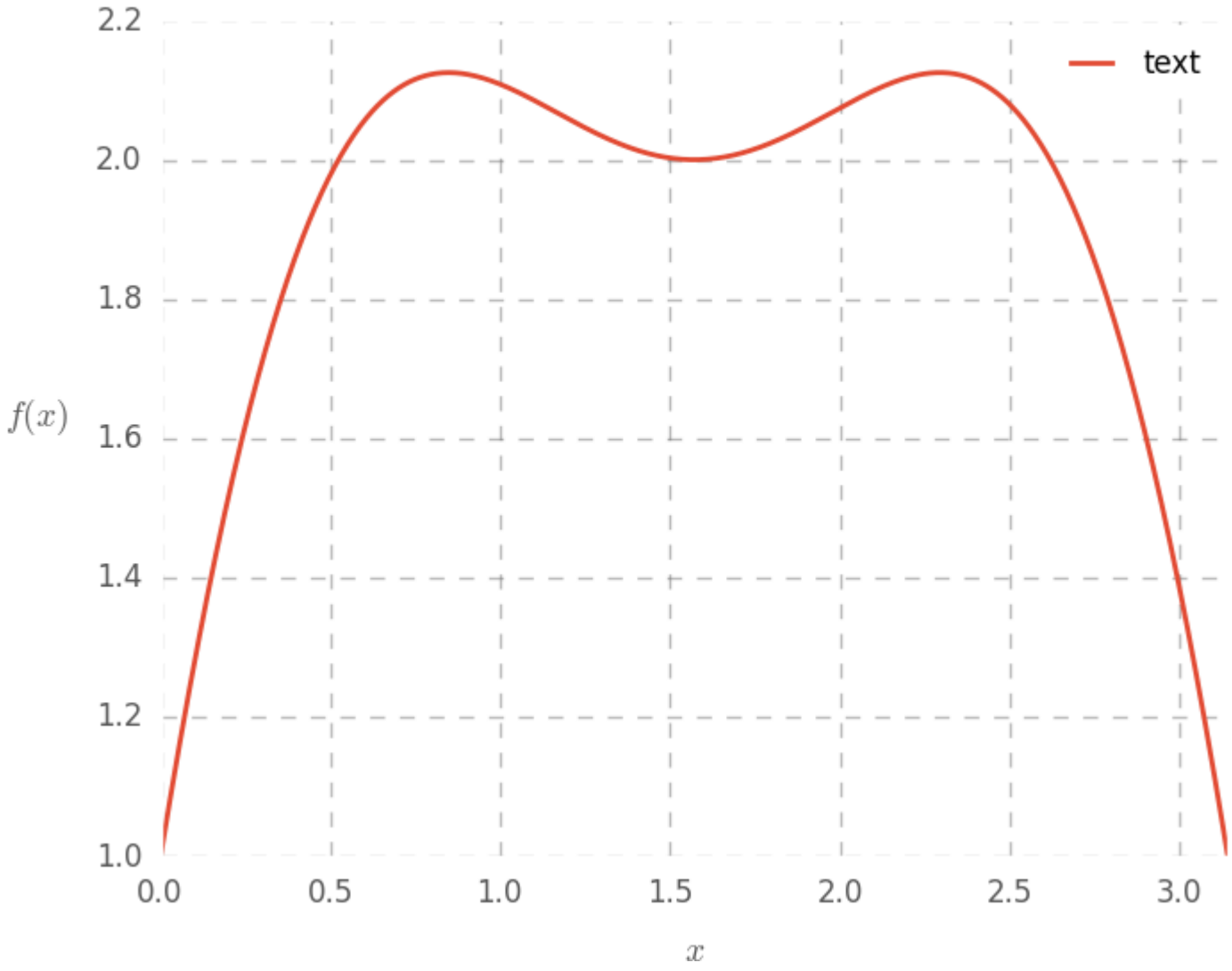
matplotlibmatplotlib 。

matplotlib

```
import pylab as plt
import numpy as np

plt.style.use('ggplot')

fig = plt.figure(1)
ax = plt.gca()

# make some testing data
x = np.linspace( 0, np.pi, 1000 )
test_f = lambda x: np.sin(x)*3 + np.cos(2*x)

# plot the test data
ax.plot( x, test_f(x) , lw = 2)

# set the axis labels
ax.set_xlabel(r'$x$', fontsize=14, labelpad=10)
ax.set_ylabel(r'$f(x)$', fontsize=14, labelpad=25, rotation=0)

# set axis limits
ax.set_xlim(0,np.pi)

plt.draw()
```




```
# Customize the plot
ax.grid(1, ls='--', color='#777777', alpha=0.5, lw=1)
ax.tick_params(labelsize=12, length=0)
ax.set_axis_bgcolor('w')
# add a legend
leg = plt.legend( ['text'], loc=1 )
fr = leg.get_frame()
fr.set_facecolor('w')
fr.set_alpha(.7)
plt.draw()
```



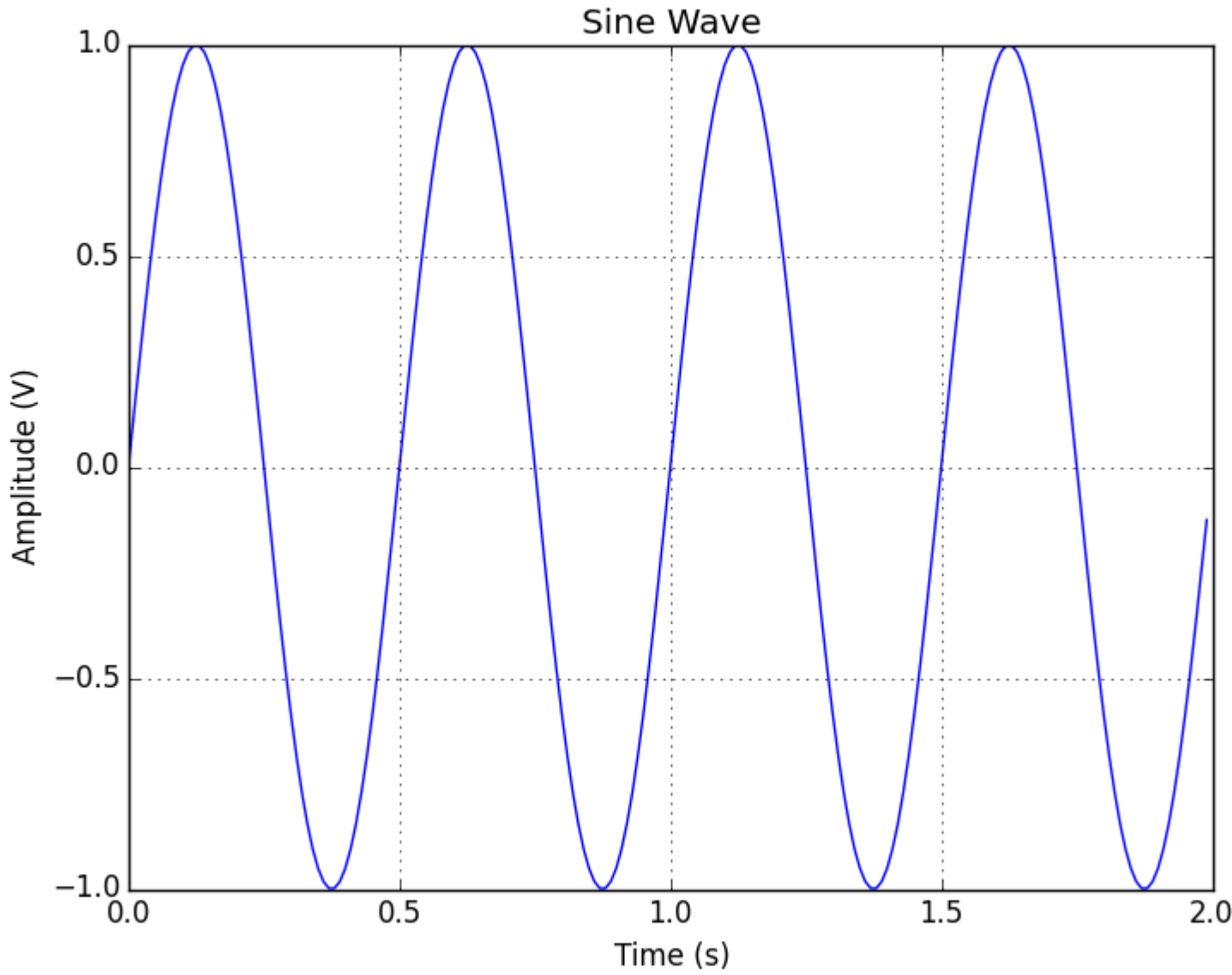
Matplotlib。Matlab。

“”Matlab。。Pythonpythonic。Matlab“”。。

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

t = np.arange(0, 2, 0.01)
y = np.sin(4 * np.pi * t)

# Imperative syntax
plt.figure(1)
plt.clf()
plt.plot(t, y)
plt.xlabel('Time (s)')
plt.ylabel('Amplitude (V)')
plt.title('Sine Wave')
plt.grid(True)

# Object oriented syntax
fig = plt.figure(2)
fig.clf()
```

```
ax = fig.add_subplot(1,1,1)
ax.plot(t, y)
ax.set_xlabel('Time (s)')
ax.set_ylabel('Amplitude (V)')
ax.set_title('Sine Wave')
ax.grid(True)
```

。

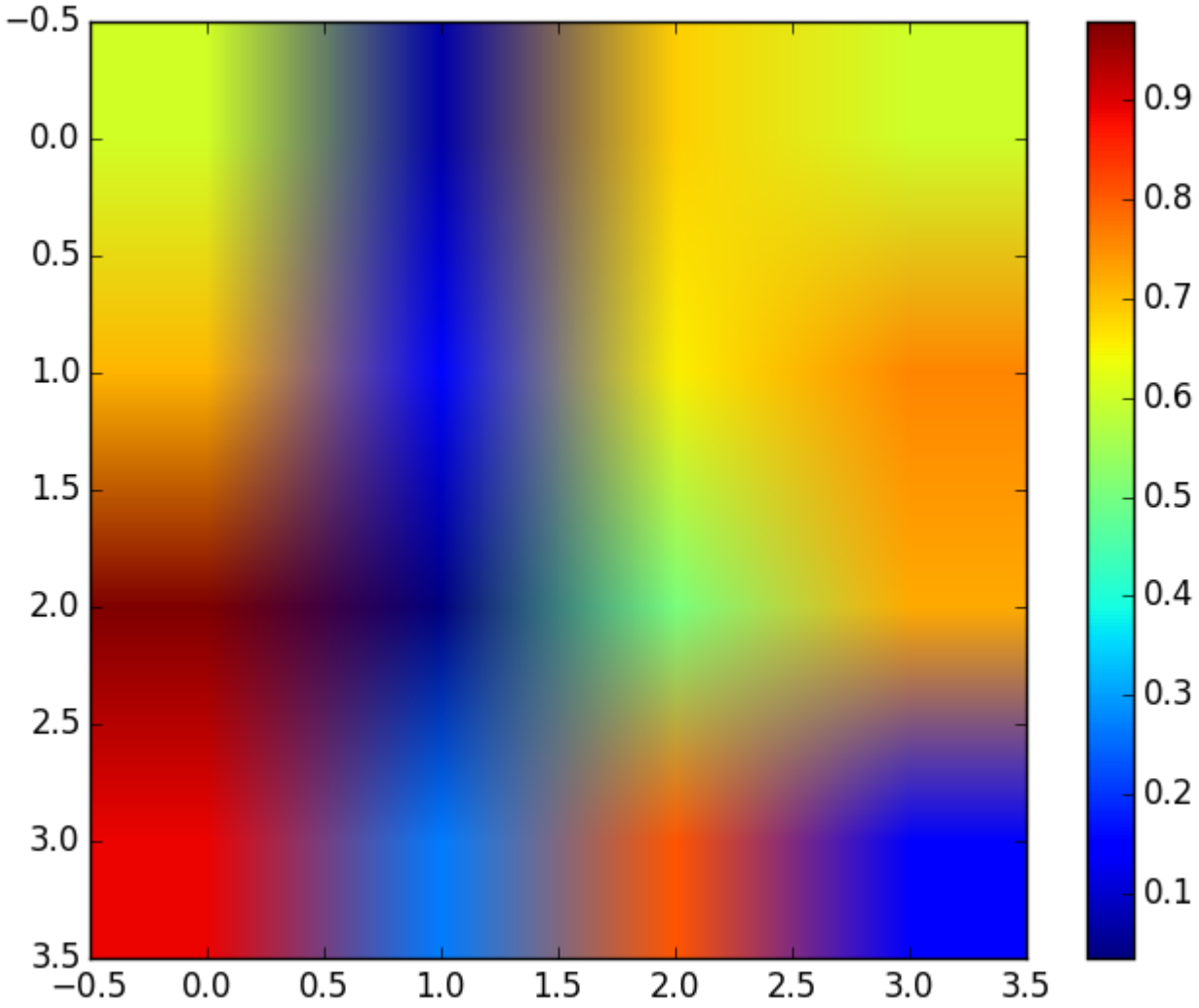


2D

2D。

```
import numpy as np
from matplotlib.pyplot import imshow, show, colorbar

image = np.random.rand(4,4)
imshow(image)
colorbar()
```

```
show()
```



matplotlib https://riptutorial.com/zh-TW/matplotlib/topic/881/matplotlib

2: LogLog

LogLog。

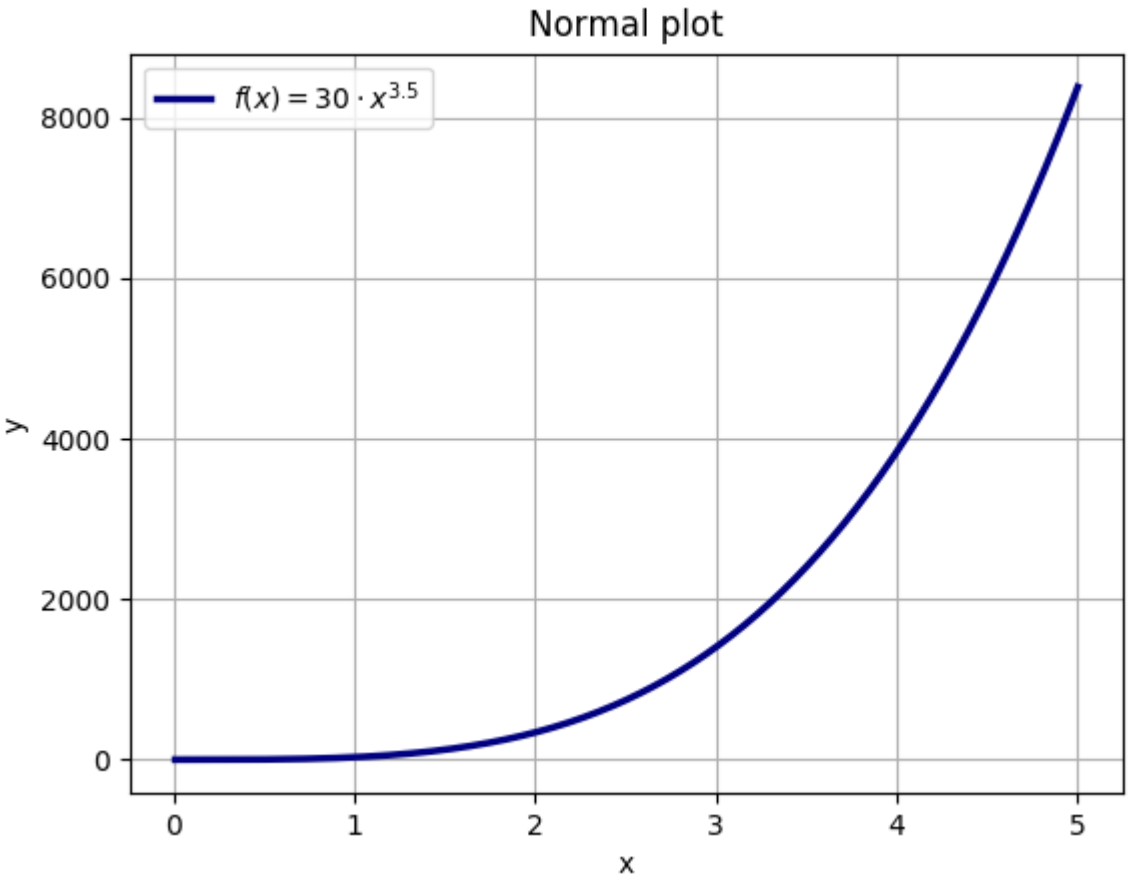
Examples

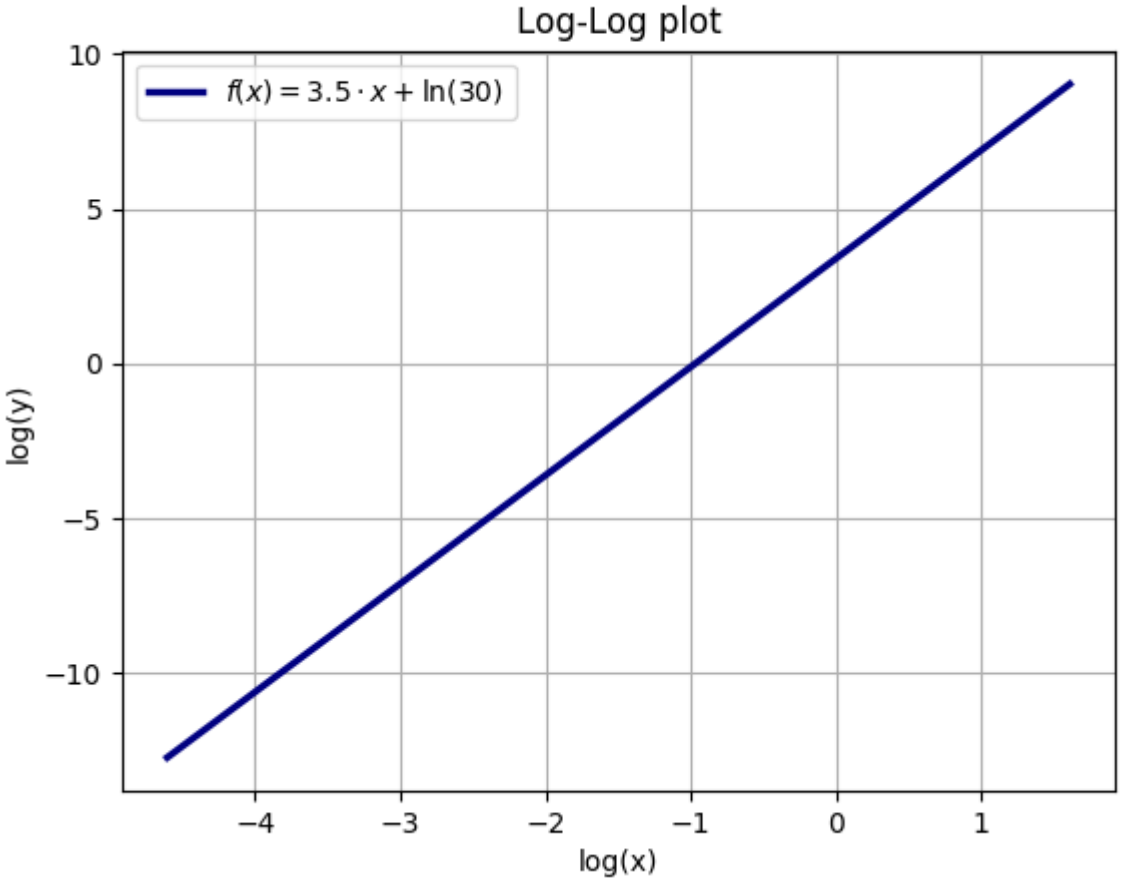
LogLog

yx= A * x ^ aA = 30a = 3.5。lnlny= lnA * x ^ a= lnA+ lnx ^ a= lnA + a * lnx。xy。yxayy0AlnA= ln30 = 3.401。

loglogy = A * x ^ aA = 30a = 3.5

```
import numpy as np
import matplotlib.pyplot as plt
A = 30
a = 3.5
x = np.linspace(0.01, 5, 10000)
y = A * x**a

ax = plt.gca()
plt.plot(x, y, linewidth=2.5, color='navy', label=r'$f(x) = 30 \cdot x^{3.5}$')
plt.legend(loc='upper left')
plt.xlabel(r'x')
plt.ylabel(r'y')
ax.grid(True)
plt.title(r'Normal plot')
plt.show()
plt.clf()

xlog = np.log(x)
ylog = np.log(y)
ax = plt.gca()
plt.plot(xlog, ylog, linewidth=2.5, color='navy', label=r'$f(x) = 3.5\cdot x + \ln(30)$')
plt.legend(loc='best')
plt.xlabel(r'log(x)')
plt.ylabel(r'log(y)')
ax.grid(True)
plt.title(r'Log-Log plot')
plt.show()
plt.clf()
```

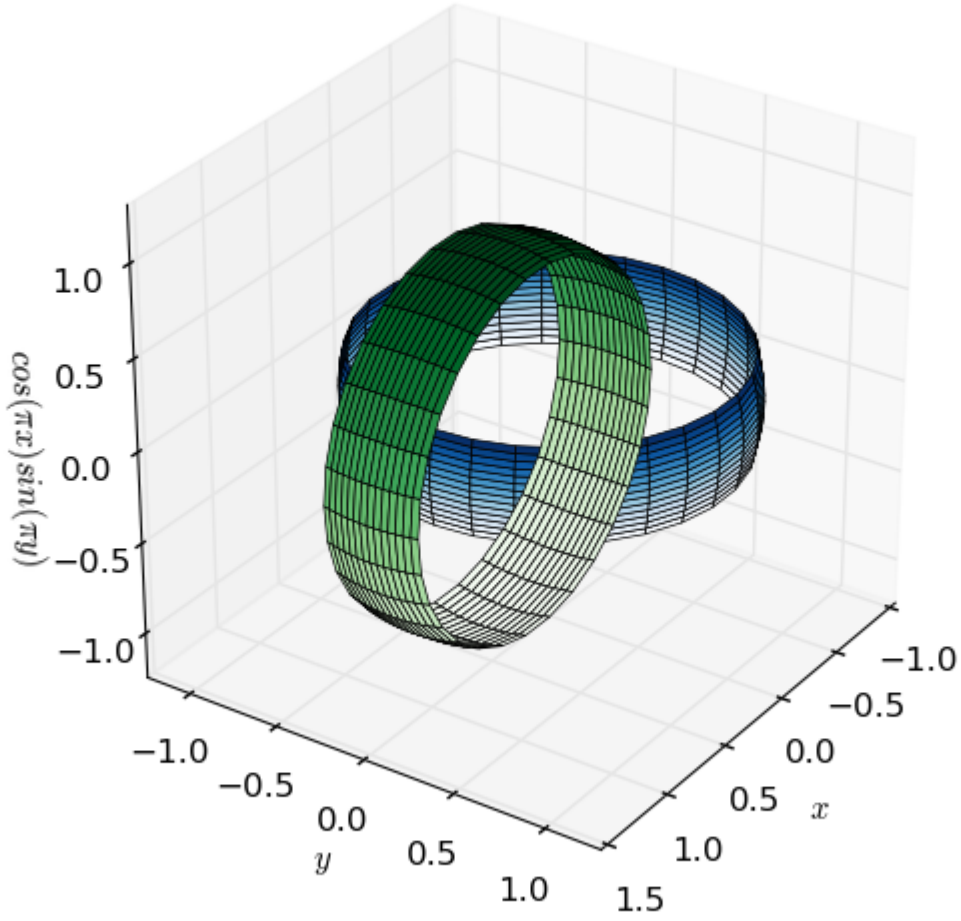

Normal plot
$f(x) = 30 \cdot x^{3.5}$
8000
6000
4000
2000
0
y
0
1
2
3
4
5
x


Log-Log plot
$f(x) = 3.5 \cdot x + \ln(30)$
10
5
0
−5
−10
log(y)
−4
−3
−2
−1
0
1
log(x)

LogLog https://riptutorial.com/zh-TW/matplotlib/topic/10145/loglog

3:

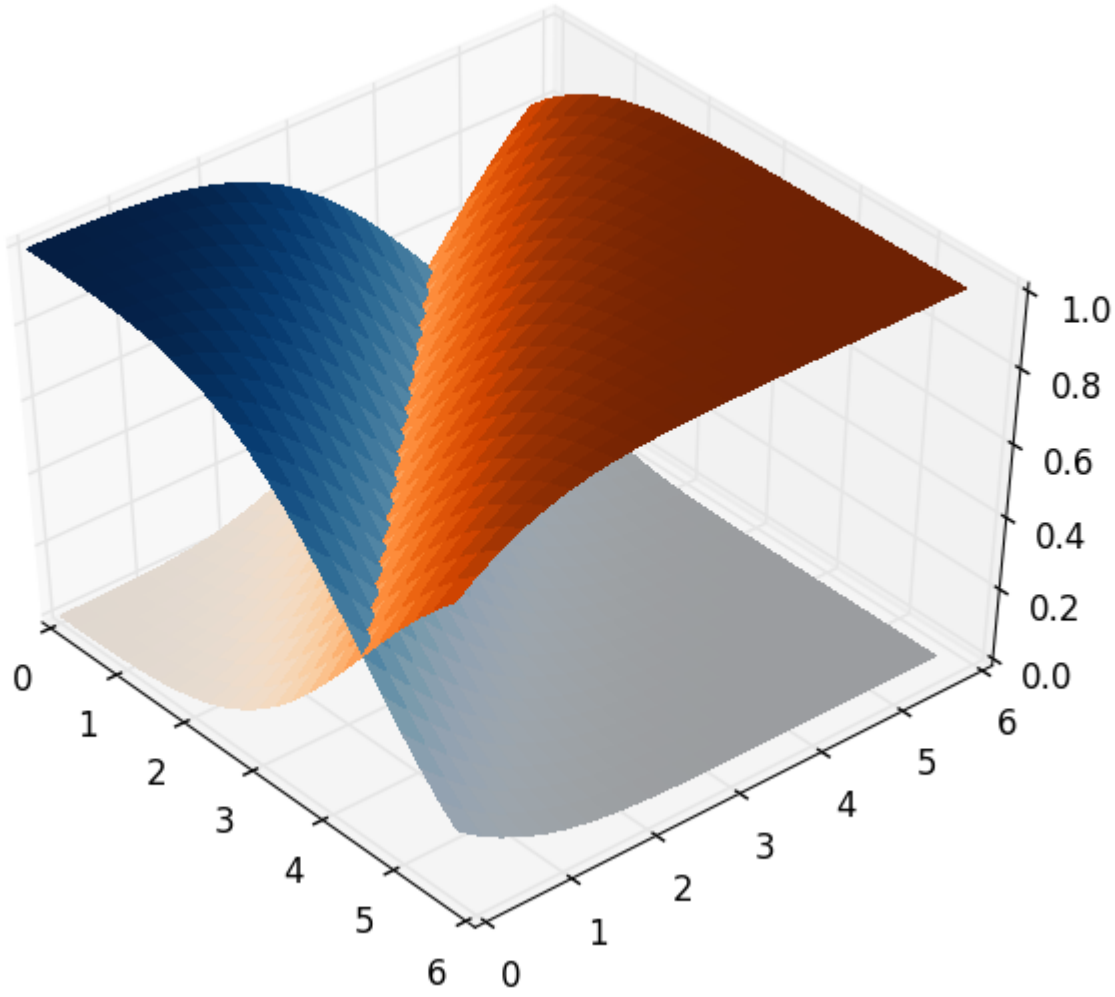
matplotlibkludge2d。2d3d 。gif

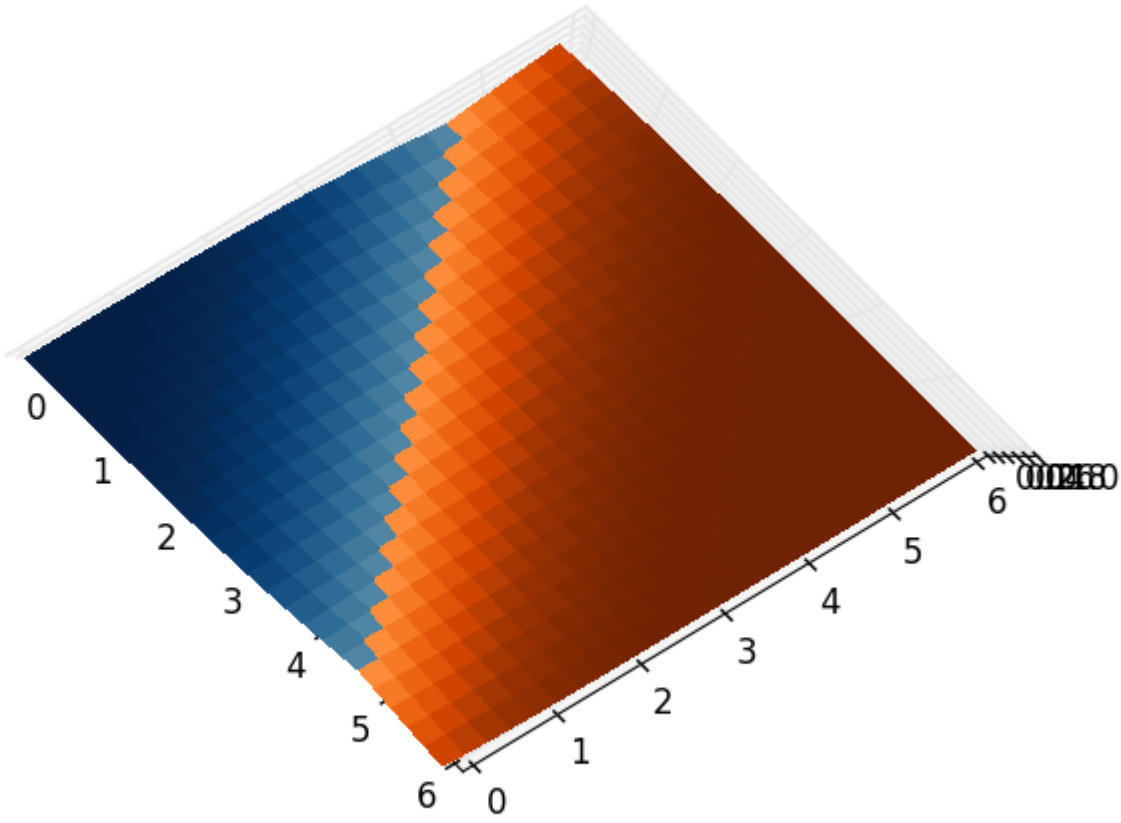


。 - 2D。。

```
from mpl_toolkits.mplot3d import Axes3D
import matplotlib.pyplot as plt
import numpy as np
from scipy.special import erf

fig = plt.figure()
ax = fig.gca(projection='3d')

X = np.arange(0, 6, 0.25)
Y = np.arange(0, 6, 0.25)
X, Y = np.meshgrid(X, Y)

Z1 = np.empty_like(X)
```

```
Z2 = np.empty_like(X)
C1 = np.empty_like(X, dtype=object)
C2 = np.empty_like(X, dtype=object)

for i in range(len(X)):
  for j in range(len(X[0])):
    z1 = 0.5*(erf((X[i,j]+Y[i,j]-4.5)*0.5)+1)
    z2 = 0.5*(erf((-X[i,j]-Y[i,j]+4.5)*0.5)+1)
    Z1[i,j] = z1
    Z2[i,j] = z2

    # If you want to grab a colour from a matplotlib cmap function,
    # you need to give it a number between 0 and 1. z1 and z2 are
    # already in this range, so it just works as is.
    C1[i,j] = plt.get_cmap("Oranges")(z1)
    C2[i,j] = plt.get_cmap("Blues")(z2)


# Create a transparent bridge region
X_bridge = np.vstack([X[-1,:],X[-1,:]])
Y_bridge = np.vstack([Y[-1,:],Y[-1,:]])
Z_bridge = np.vstack([Z1[-1,:],Z2[-1,:]])
color_bridge = np.empty_like(Z_bridge, dtype=object)

color_bridge.fill((1,1,1,0)) # RGBA colour, onlt the last component matters - it represents
the alpha / opacity.

# Join the two surfaces flipping one of them (using also the bridge)
X_full = np.vstack([X, X_bridge, np.flipud(X)])
Y_full = np.vstack([Y, Y_bridge, np.flipud(Y)])
Z_full = np.vstack([Z1, Z_bridge, np.flipud(Z2)])
color_full = np.vstack([C1, color_bridge, np.flipud(C2)])

surf_full = ax.plot_surface(X_full, Y_full, Z_full, rstride=1, cstride=1,
                            facecolors=color_full, linewidth=0,
                            antialiased=False)

plt.show()
```


1.0
0.8
0.6
0.4
0.2
0.0
0
1
2
3
4
5
6
0
1
2
3
4
5
6



Examples

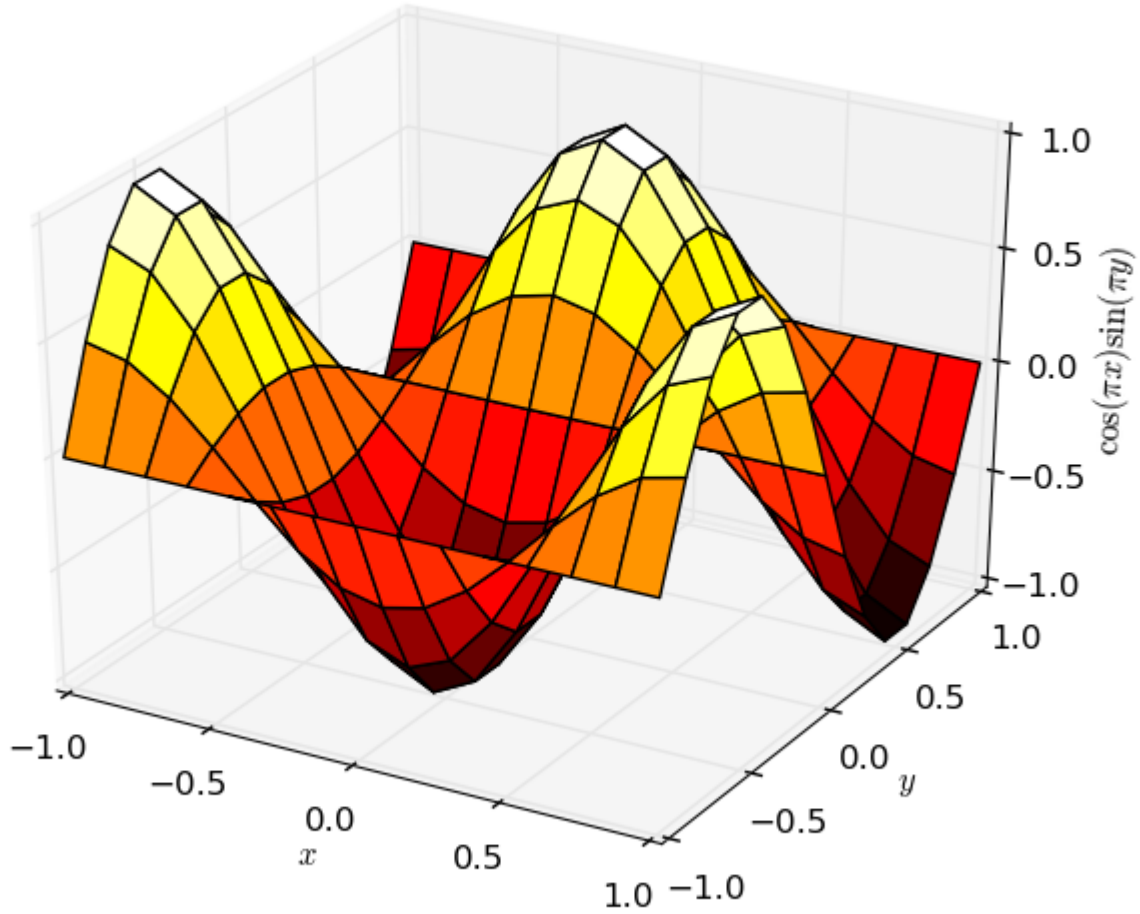
Matplotlib。 mplot3d`Axes3D'3d'`

```
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D

fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
```

`ax.plot_surface`

```
# generate example data
import numpy as np
x,y = np.meshgrid(np.linspace(-1,1,15),np.linspace(-1,1,15))
z = np.cos(x*np.pi)*np.sin(y*np.pi)

# actual plotting example
fig = plt.figure()
```

```
ax = fig.add_subplot(111, projection='3d')
# rstride and cstride are row and column stride (step size)
ax.plot_surface(x,y,z,rstride=1,cstride=1,cmap='hot')
ax.set_xlabel(r'$x$')
ax.set_ylabel(r'$y$')
ax.set_zlabel(r'$\cos(\pi x) \sin(\pi y)$')
plt.show()
```



https://riptutorial.com/zh-TW/matplotlib/topic/1880/

4:

Examples

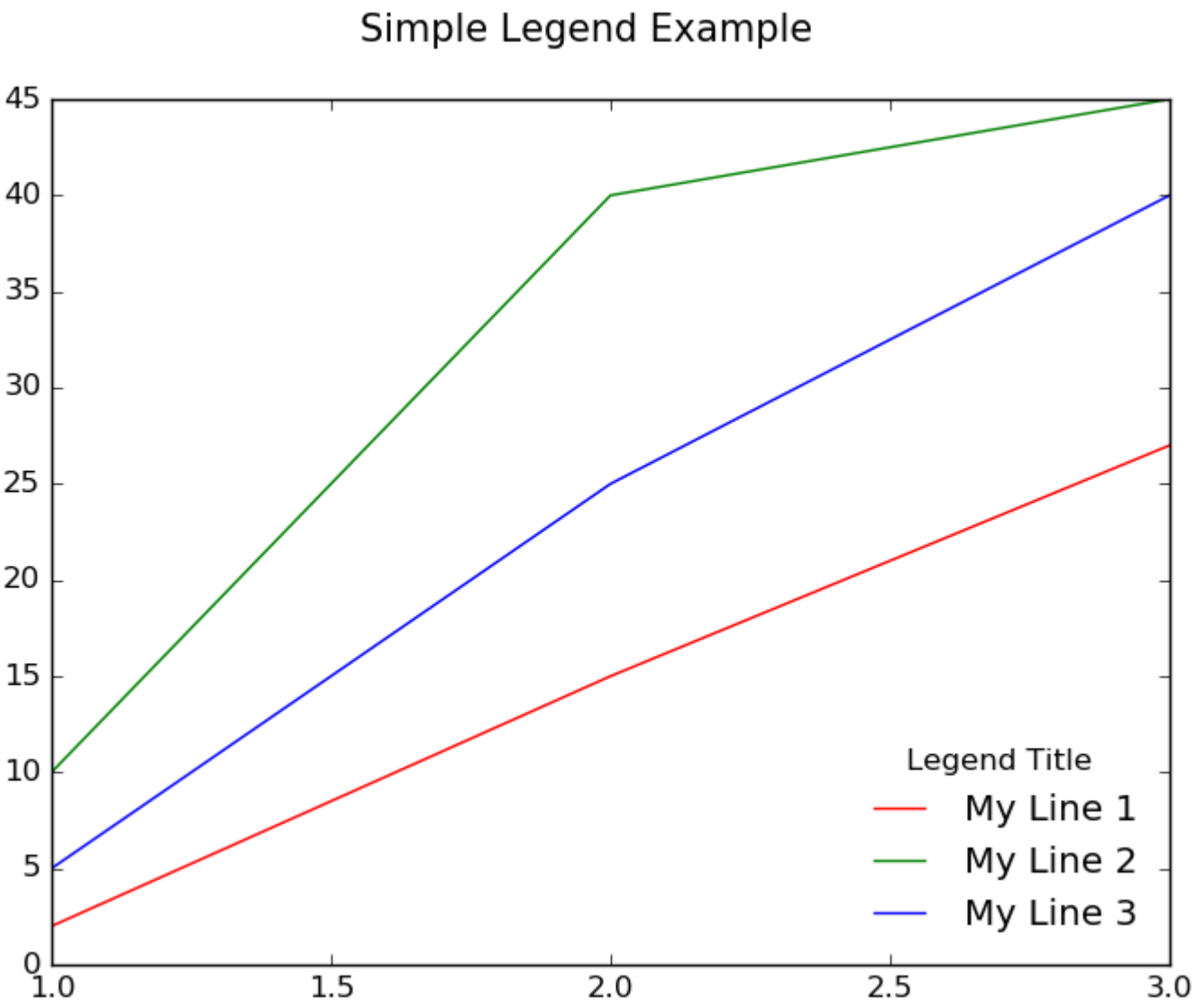
◦ `plot()` *“My Line 1”* ◦

```
ax.plot(x, y1, color="red", label="My Line 1")
```

◦ `ax.legend()`

◦ `legend()`◦

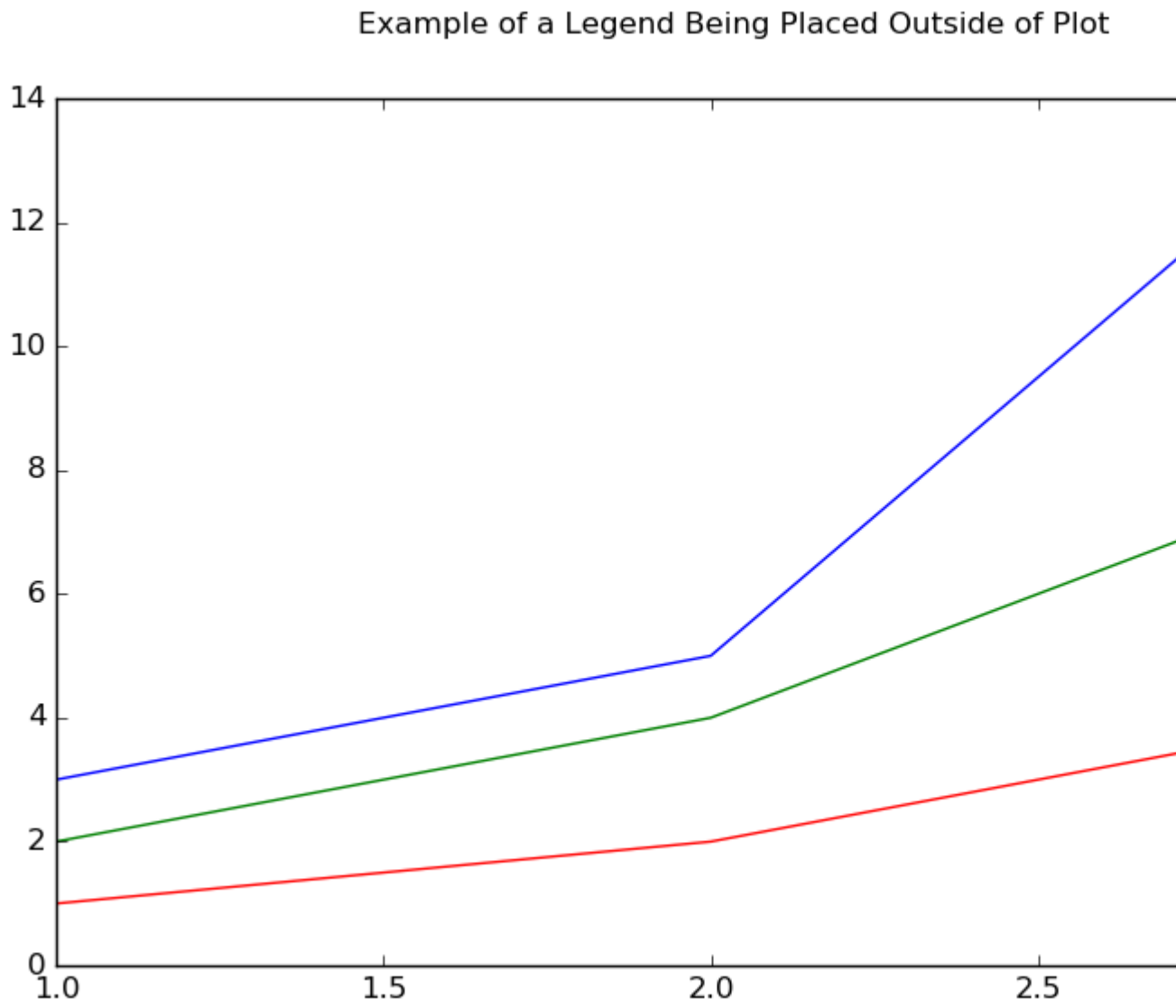
```
ax.legend(loc="lower right", title="Legend Title", frameon=False)
```




```
import matplotlib.pyplot as plt
```

```
# The data
x =  [1, 2, 3]
y1 = [2,  15, 27]
y2 = [10, 40, 45]
y3 = [5,  25, 40]

# Initialize the figure and axes
fig, ax = plt.subplots(1, figsize=(8, 6))

# Set the title for the figure
fig.suptitle('Simple Legend Example ', fontsize=15)

# Draw all the lines in the same plot, assigning a label for each one to be
# shown in the legend
ax.plot(x, y1, color="red", label="My Line 1")
ax.plot(x, y2, color="green", label="My Line 2")
ax.plot(x, y3, color="blue", label="My Line 3")

# Add a legend with title, position it on the lower right (loc) with no box framing (frameon)
ax.legend(loc="lower right", title="Legend Title", frameon=False)

# Show the plot
plt.show()
```

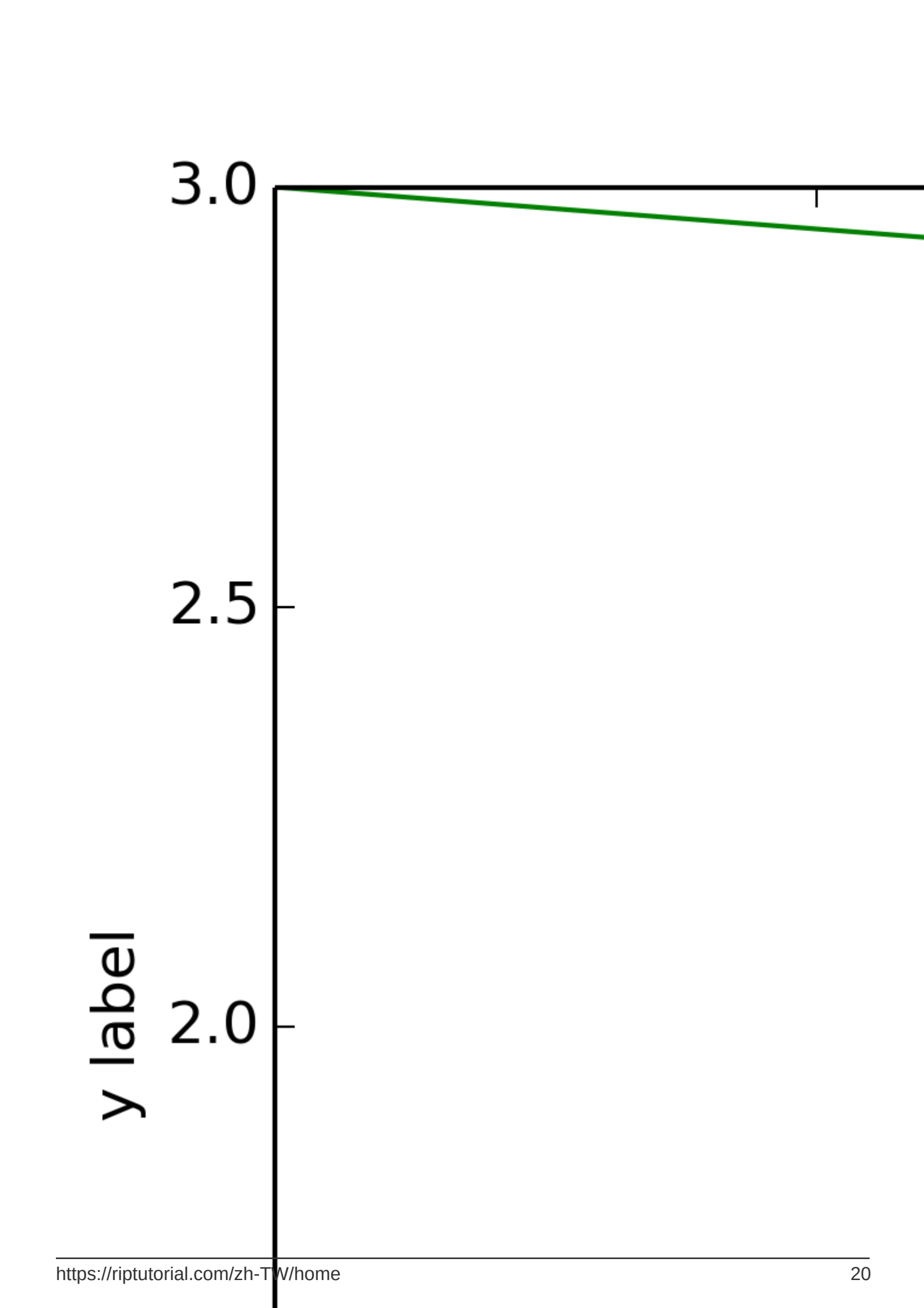
◦ ◦




```
import matplotlib.pylab as plt
fig, ax = plt.subplots(1, 1, figsize=(10,6)) # make the figure with the size 10 x 6 inches
fig.suptitle('Example of a Legend Being Placed Outside of Plot')

# The data
x =  [1, 2, 3]
y1 = [1, 2, 4]
y2 = [2, 4, 8]
y3 = [3, 5, 14]

# Labels to use for each line
line_labels = ["Item A", "Item B", "Item C"]

# Create the lines, assigning different colors for each one.
# Also store the created line objects
l1 = ax.plot(x, y1, color="red")[0]
l2 = ax.plot(x, y2, color="green")[0]
l3 = ax.plot(x, y3, color="blue")[0]

fig.legend([l1, l2, l3],              # List of the line objects
           labels= line_labels,       # The labels for each line
           loc="center right",        # Position of the legend
           borderaxespad=0.1,         # Add little spacing around the legend box
```

```
           title="Legend Title")      # Title for the legend

# Adjust the scaling factor to fit your legend text completely outside the plot
# (smaller value results in more space being made for the legend)
plt.subplots_adjust(right=0.85)

plt.show()
```

`bbox_to_anchor` + `bbox_extra_artists` + `bbox_inches='tight'`


3.0
2.5
2.0
y label

5:

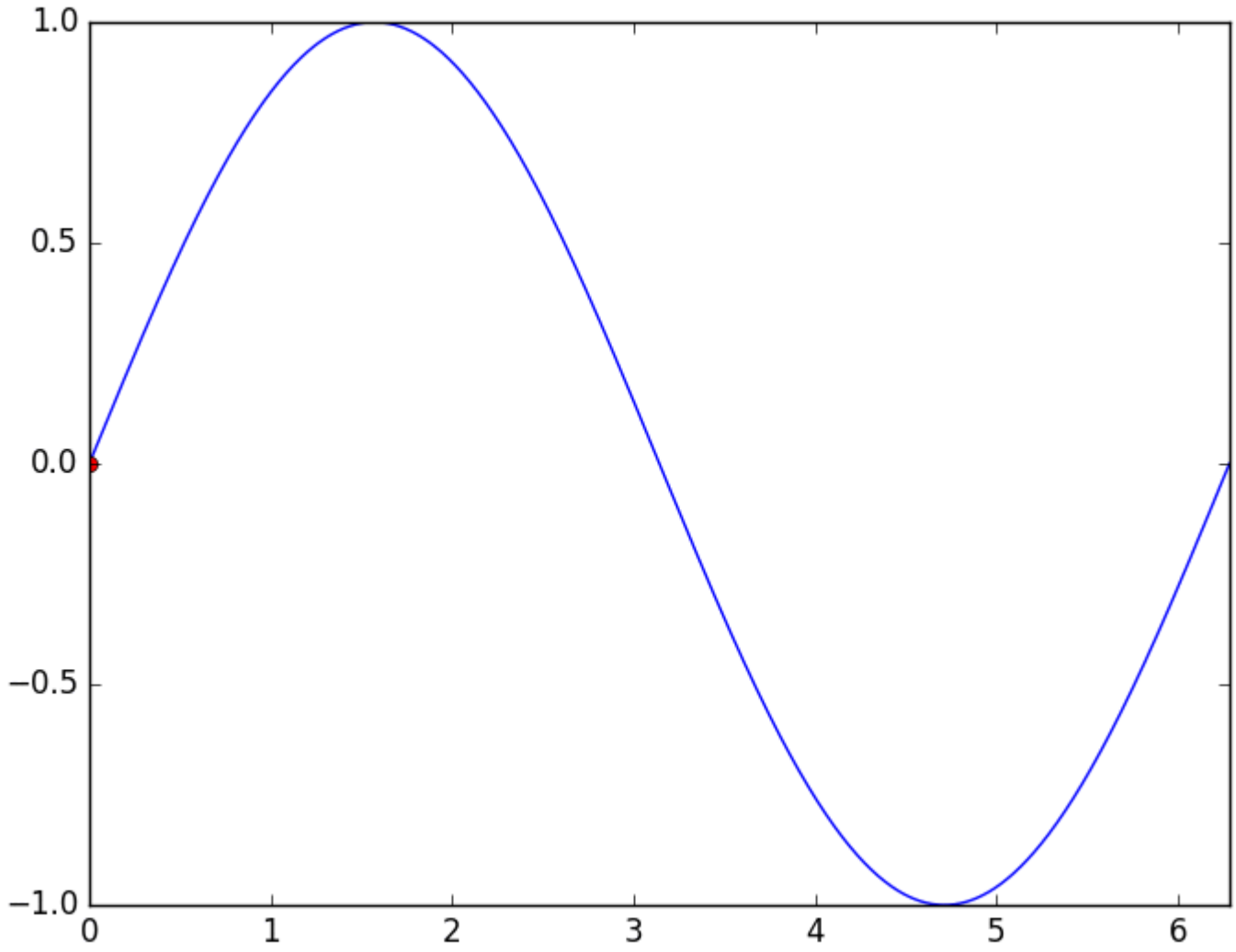
python matplotlib。

Examples

FuncAnimation

matplotlib.animation。 `FuncAnimationFuncAnimation`。 `animate()`。

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

TWOPI = 2*np.pi

fig, ax = plt.subplots()

t = np.arange(0.0, TWOPI, 0.001)
s = np.sin(t)
l = plt.plot(t, s)

ax = plt.axis([0,TWOPI,-1,1])

redDot, = plt.plot([0], [np.sin(0)], 'ro')

def animate(i):
    redDot.set_data(i, np.sin(i))
    return redDot,

# create animation using the animate() function
myAnimation = animation.FuncAnimation(fig, animate, frames=np.arange(0.0, TWOPI, 0.1), \
                                      interval=10, blit=True, repeat=True)

plt.show()
```



gif

save ImageMagick Animation。

```
import numpy as np
import matplotlib.pyplot as plt
import matplotlib.animation as animation
from matplotlib import rcParams

# make sure the full paths for ImageMagick and ffmpeg are configured
rcParams['animation.convert_path'] = r'C:\Program Files\ImageMagick\convert'
rcParams['animation.ffmpeg_path'] = r'C:\Program Files\ffmpeg\bin\ffmpeg.exe'

TWOPI = 2*np.pi

fig, ax = plt.subplots()

t = np.arange(0.0, TWOPI, 0.001)
s = np.sin(t)
l = plt.plot(t, s)
```

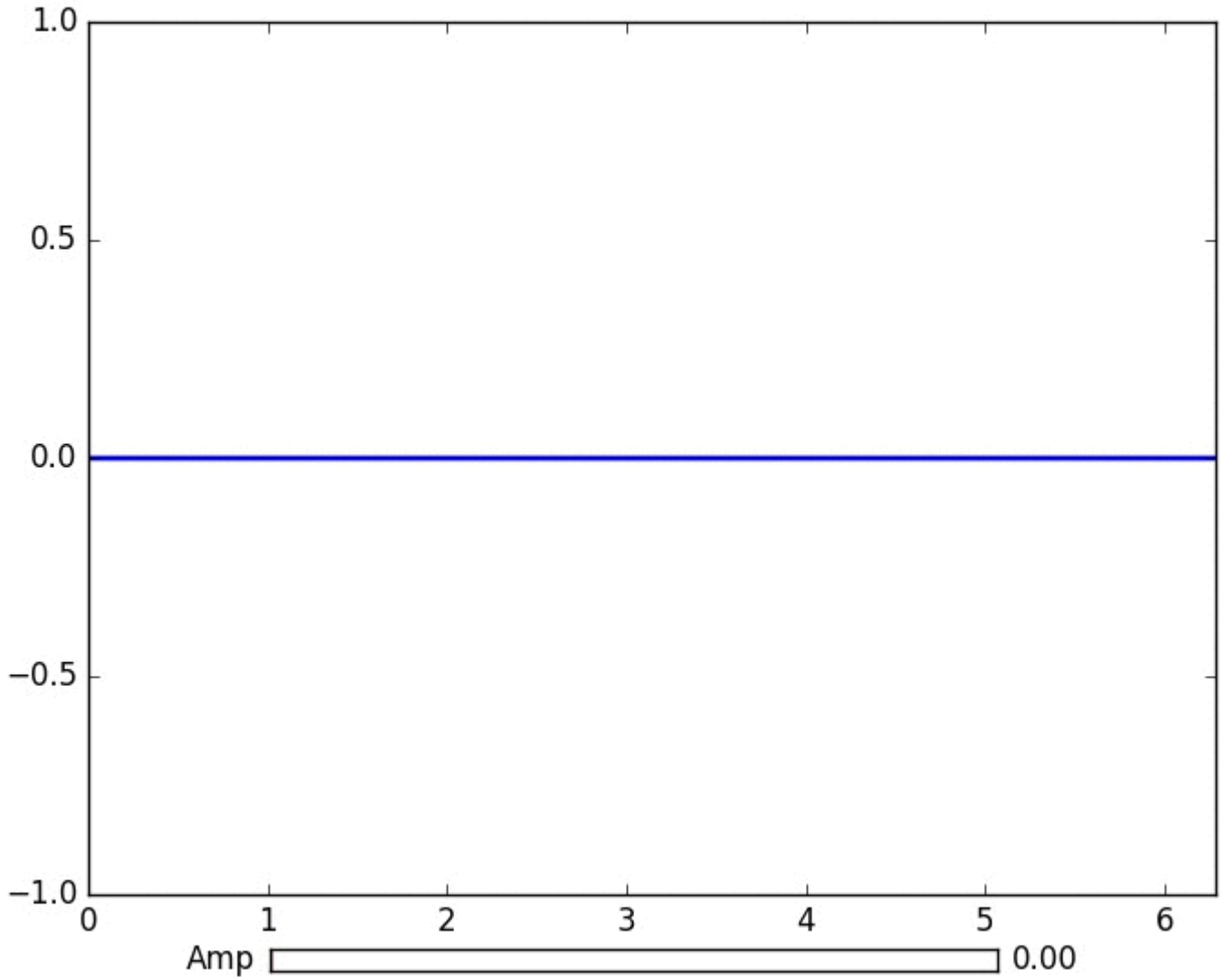
```
ax = plt.axis([0,TWOPI,-1,1])

redDot, = plt.plot([0], [np.sin(0)], 'ro')

def animate(i):
    redDot.set_data(i, np.sin(i))
    return redDot,

# create animation using the animate() function with no repeat
myAnimation = animation.FuncAnimation(fig, animate, frames=np.arange(0.0, TWOPI, 0.1), \
                                      interval=10, blit=True, repeat=False)

# save animation at 30 frames per second
myAnimation.save('myAnimation.gif', writer='imagemagick', fps=30)
```

matplotlib.widgets

MatplotlibGUI ◦ `matplotlib.axes.Axes`◦

◦ `on_changed()`◦

```
import numpy as np
import matplotlib.pyplot as plt
import matplotlib.animation as animation
from matplotlib.widgets import Slider

TWOPI = 2*np.pi

fig, ax = plt.subplots()

t = np.arange(0.0, TWOPI, 0.001)
initial_amp = .5
s = initial_amp*np.sin(t)
l, = plt.plot(t, s, lw=2)

ax = plt.axis([0,TWOPI,-1,1])

axamp = plt.axes([0.25, .03, 0.50, 0.02])
# Slider
samp = Slider(axamp, 'Amp', 0, 1, valinit=initial_amp)

def update(val):
    # amp is the current value of the slider
    amp = samp.val
    # update curve
    l.set_ydata(amp*np.sin(t))
    # redraw canvas while idle
    fig.canvas.draw_idle()

# call update function on slider value change
samp.on_changed(update)

plt.show()
```



- AxesWidget
-
- CheckButtons
-
- EllipseSelector
-
- LassoSelector
- LockDraw
- MultiCursor
-
- RectangleSelector
- SpanSelector
- SubplotTool
- ToolHandles

matplotlib

。 。

fifo。。

```
100
123.5
1589
```

deque。 deque。dequedeque。x。

。。qt4agg。 matplotlib

matplotlib 。

'。

```
import matplotlib
import collections
#selecting the right backend, change qt4agg to your desired backend
matplotlib.use('qt4agg')
import matplotlib.pyplot as plt
import matplotlib.animation as animation

#command to open the pipe
datapipe = open('path to your pipe','r')

#amount of data to be displayed at once, this is the size of the x axis
#increasing this amount also makes plotting slightly slower
data_amount = 1000

#set the size of the deque object
datalist = collections.deque([0]*data_amount,data_amount)

#configure the graph itself
fig, ax = plt.subplots()
line, = ax.plot([0,]*data_amount)

#size of the y axis is set here
ax.set_ylim(0,256)

def update(data):
        line.set_ydata(data)
        return line,

def data_gen():
    while True:
        """
        We read two data points in at once, to improve speed
        You can read more at once to increase speed
        Or you can read just one at a time for improved animation smoothness
        data from the pipe comes in as a string,
        and is seperated with a newline character,
        which is why we use respectively eval and rstrip.
        """
        datalist.append(eval((datapipe.readline()).rstrip('\n')))
        datalist.append(eval((datapipe.readline()).rstrip('\n')))
        yield datalist

ani = animation.FuncAnimation(fig,update,data_gen,interval=0, blit=True)
plt.show()
```

datalist.append。。

1.7ghz i3 4005u150hz。

https://riptutorial.com/zh-TW/matplotlib/topic/6983/

6:

Examples

Matplotlib`image`

```
import matplotlib.image as mpimg
import matplotlib.pyplot as plt
```

`imread.png`

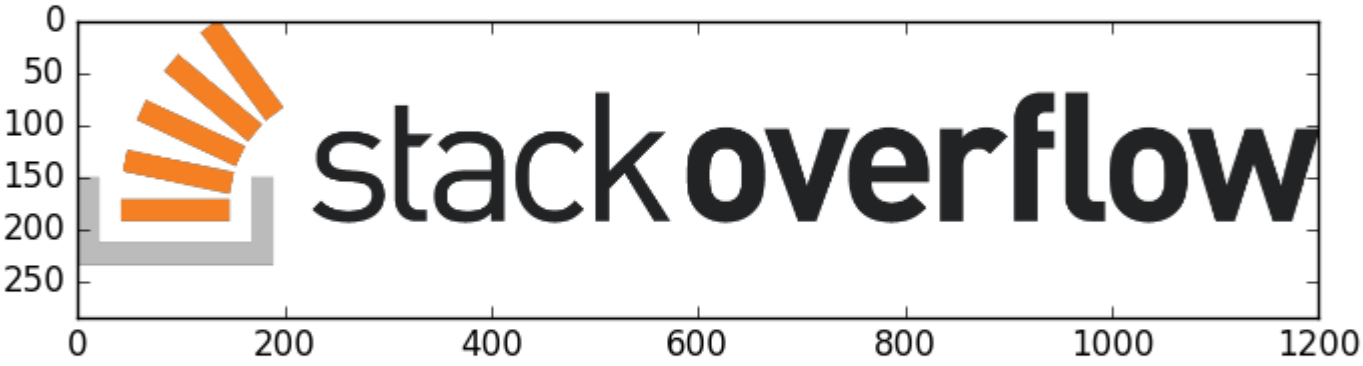
```
img = mpimg.imread('my_image.png')
```

`imshow`

```
plt.imshow(img)
```

Stack Overflow

```
import matplotlib.image as mpimg
import matplotlib.pyplot as plt
img = mpimg.imread('so-logo.png')
plt.imshow(img)
plt.show()
```



https://riptutorial.com/zh-TW/matplotlib/topic/4575/

7:

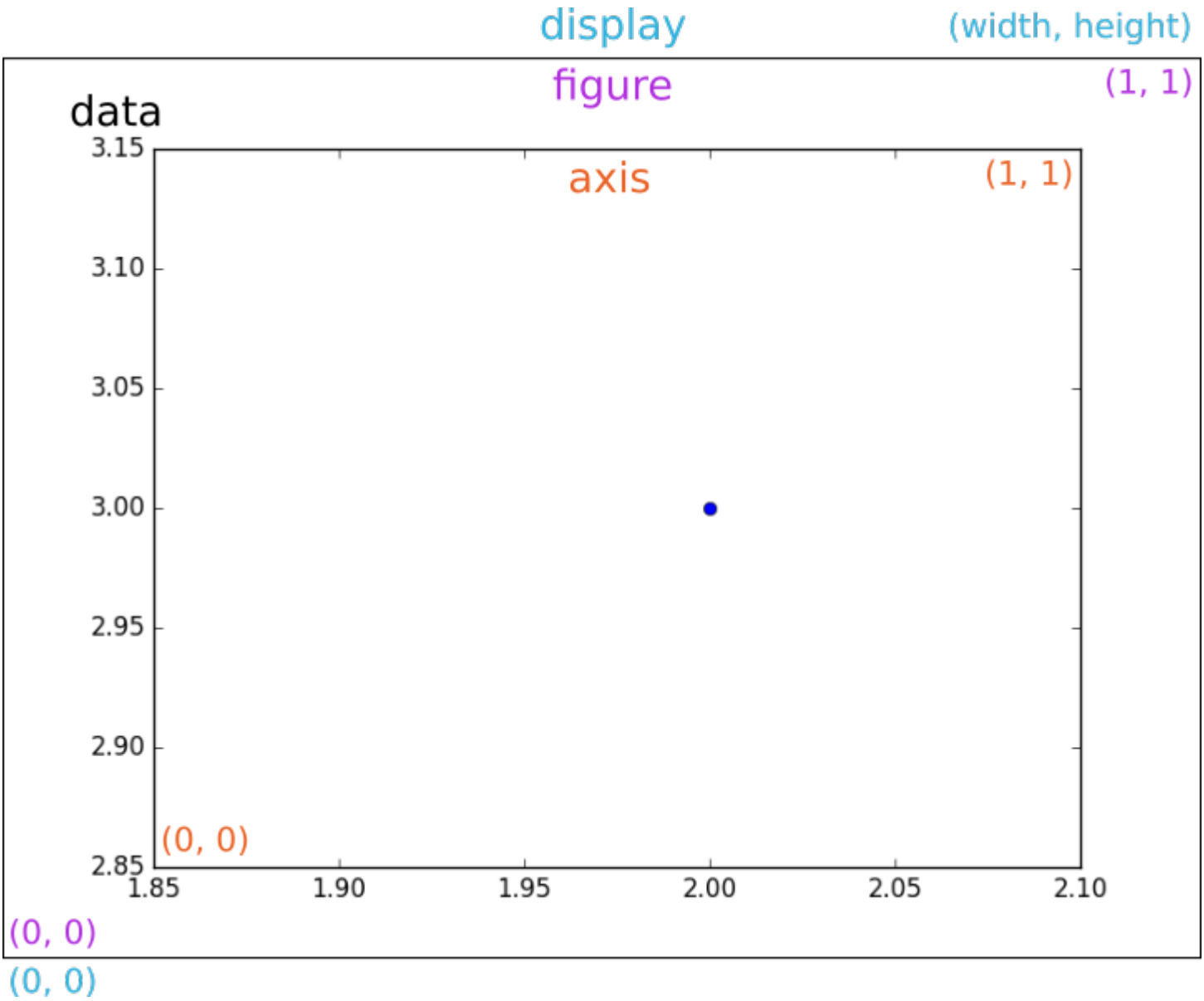
Matplotlib◦ ◦

◦ ◦ Axesxlimylim◦ ax.transData ◦

AxesAxes◦ 0,01,1◦ ◦ ax.transAxes ◦

Figure ◦ 0,01,1◦ ◦ fig.transFigure ◦

◦ 0,0◦ ◦ ◦ Nonematplotlib.transforms.IdentityTransform() ◦



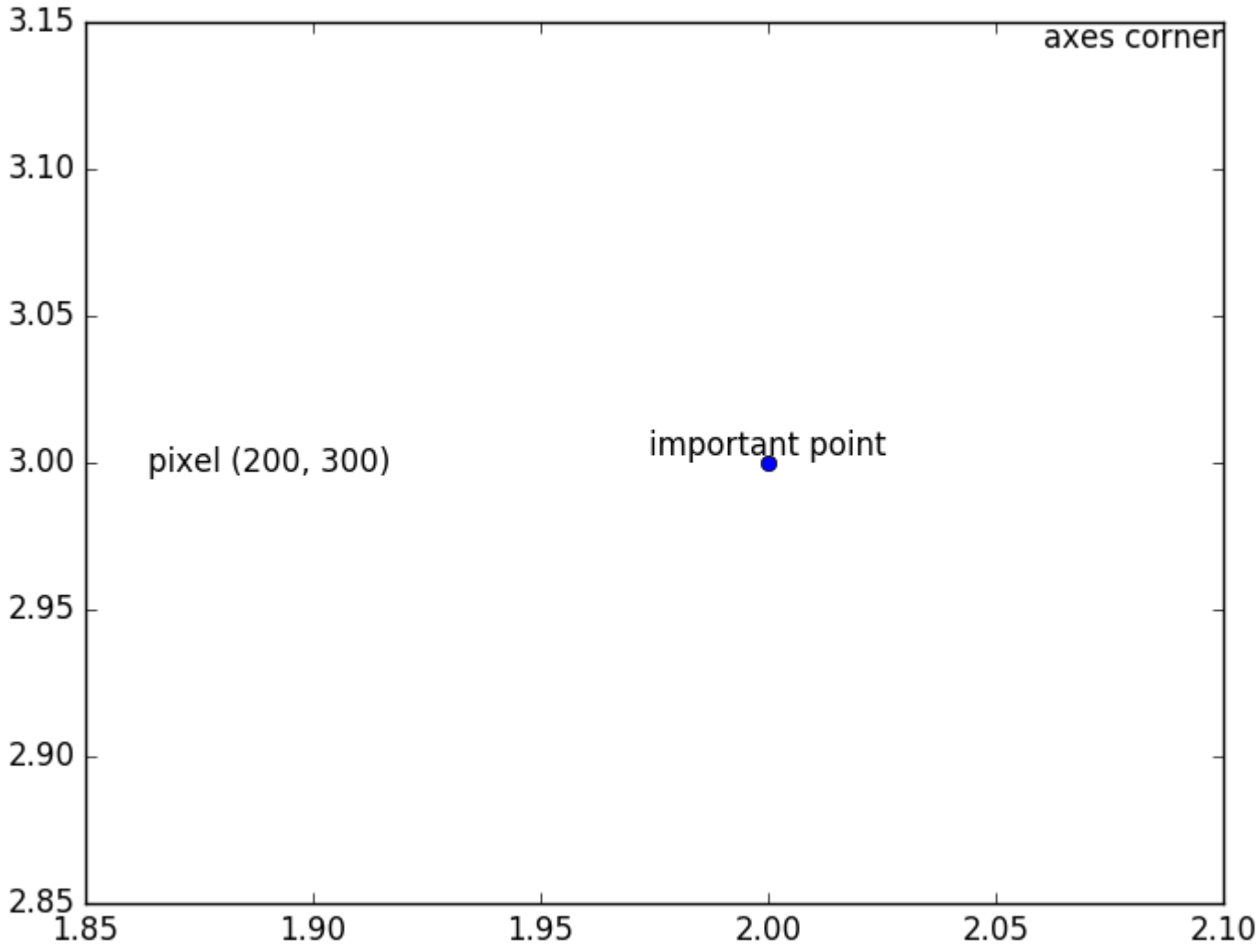
◦

Examples

Matplotlib◦ ◦ ◦ text()transformtransform◦

```
import matplotlib.pyplot as plt

fig, ax = plt.subplots()

ax.plot([2.], [3.], 'bo')

plt.text(  # position text relative to data
    2., 3., 'important point',  # x, y, text,
    ha='center', va='bottom',   # text alignment,
    transform=ax.transData      # coordinate system transformation
)
plt.text(  # position text relative to Axes
    1.0, 1.0, 'axes corner',
    ha='right', va='top',
    transform=ax.transAxes
)
plt.text(  # position text relative to Figure
    0.0, 1.0, 'figure corner',
    ha='left', va='top',
    transform=fig.transFigure
)
plt.text(  # position text absolutely at specific pixel on image
    200, 300, 'pixel (200, 300)',
    ha='center', va='center',
    transform=None
)

plt.show()
```

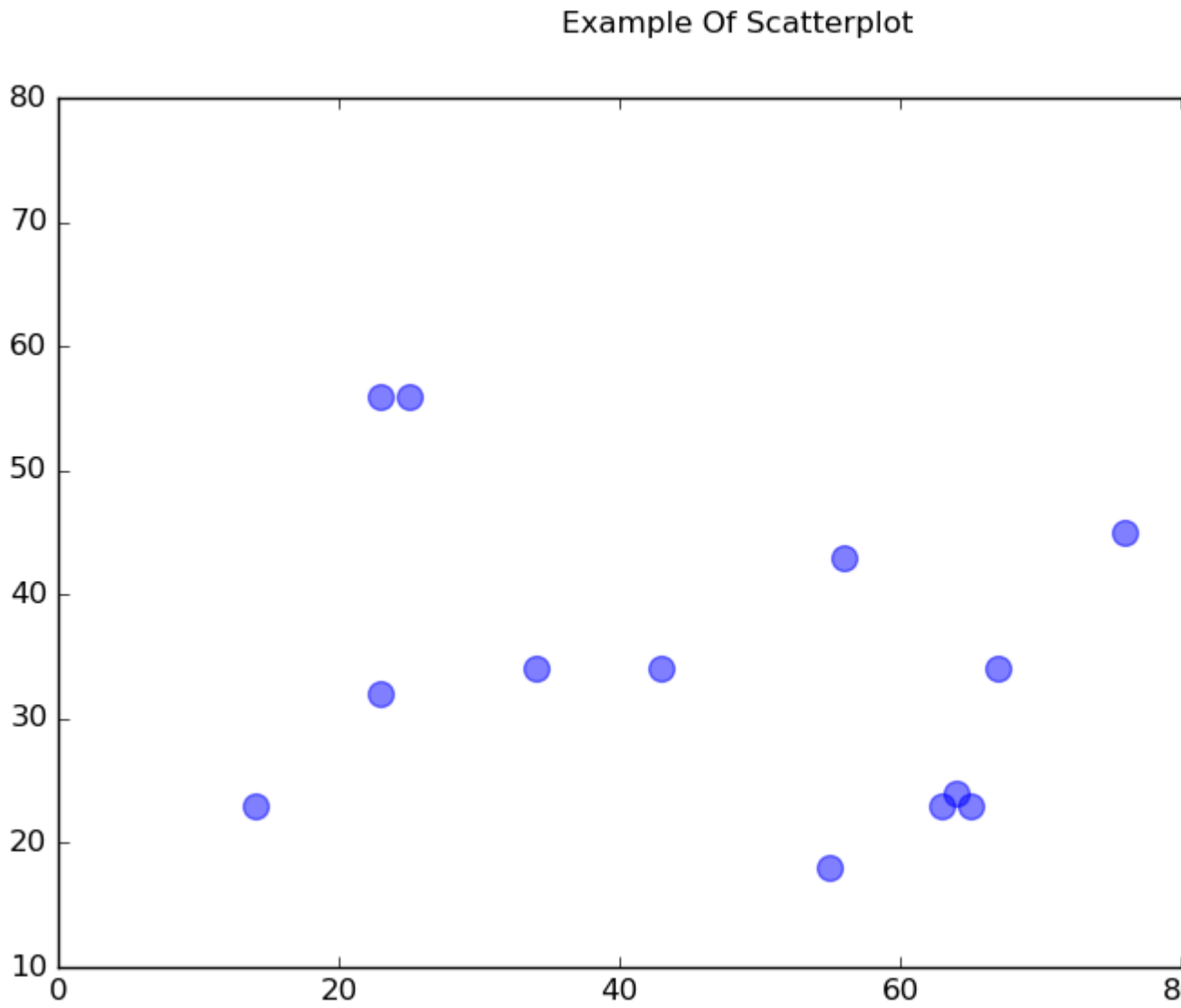
figure corner



https://riptutorial.com/zh-TW/matplotlib/topic/4566/

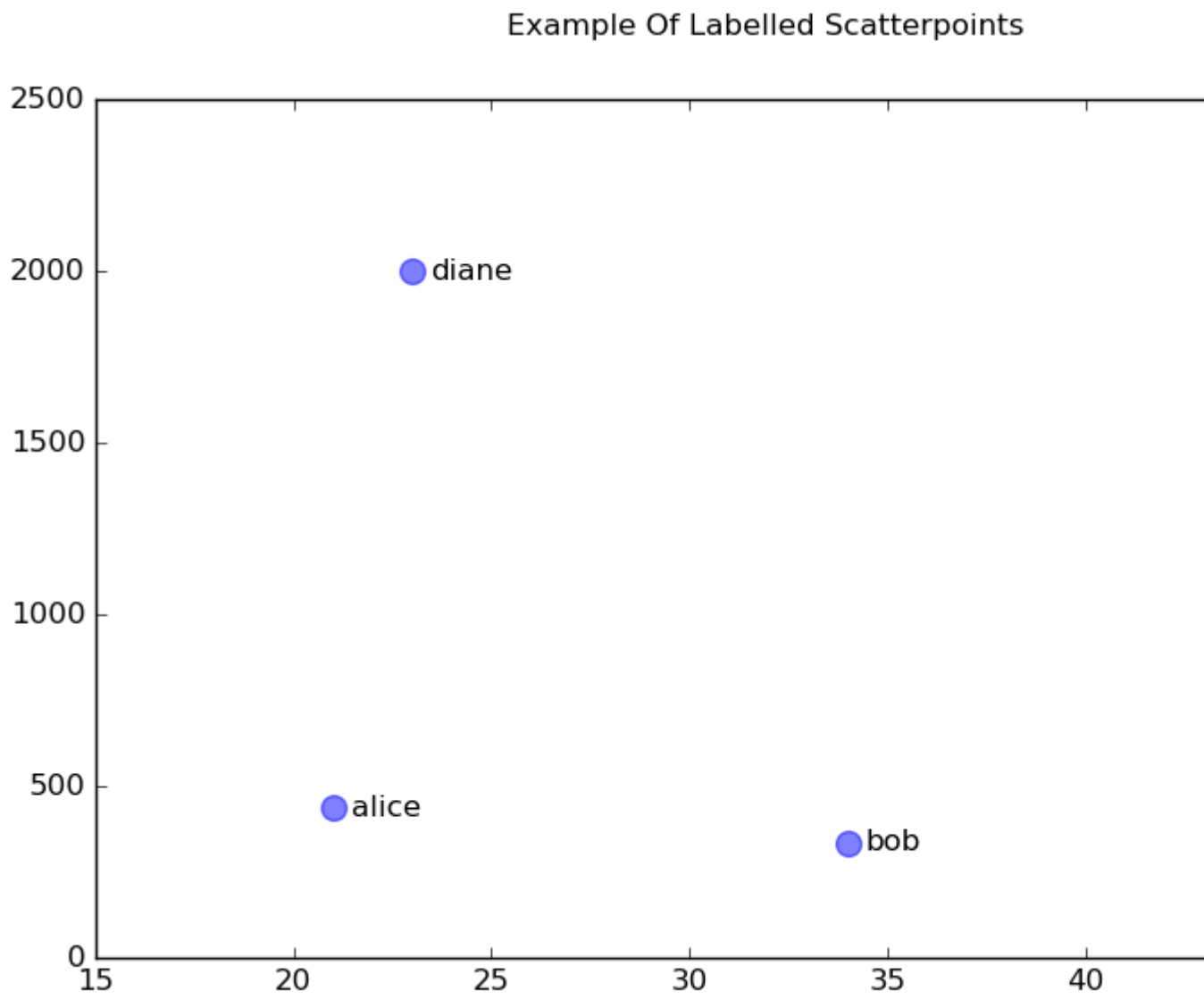
8:

Examples



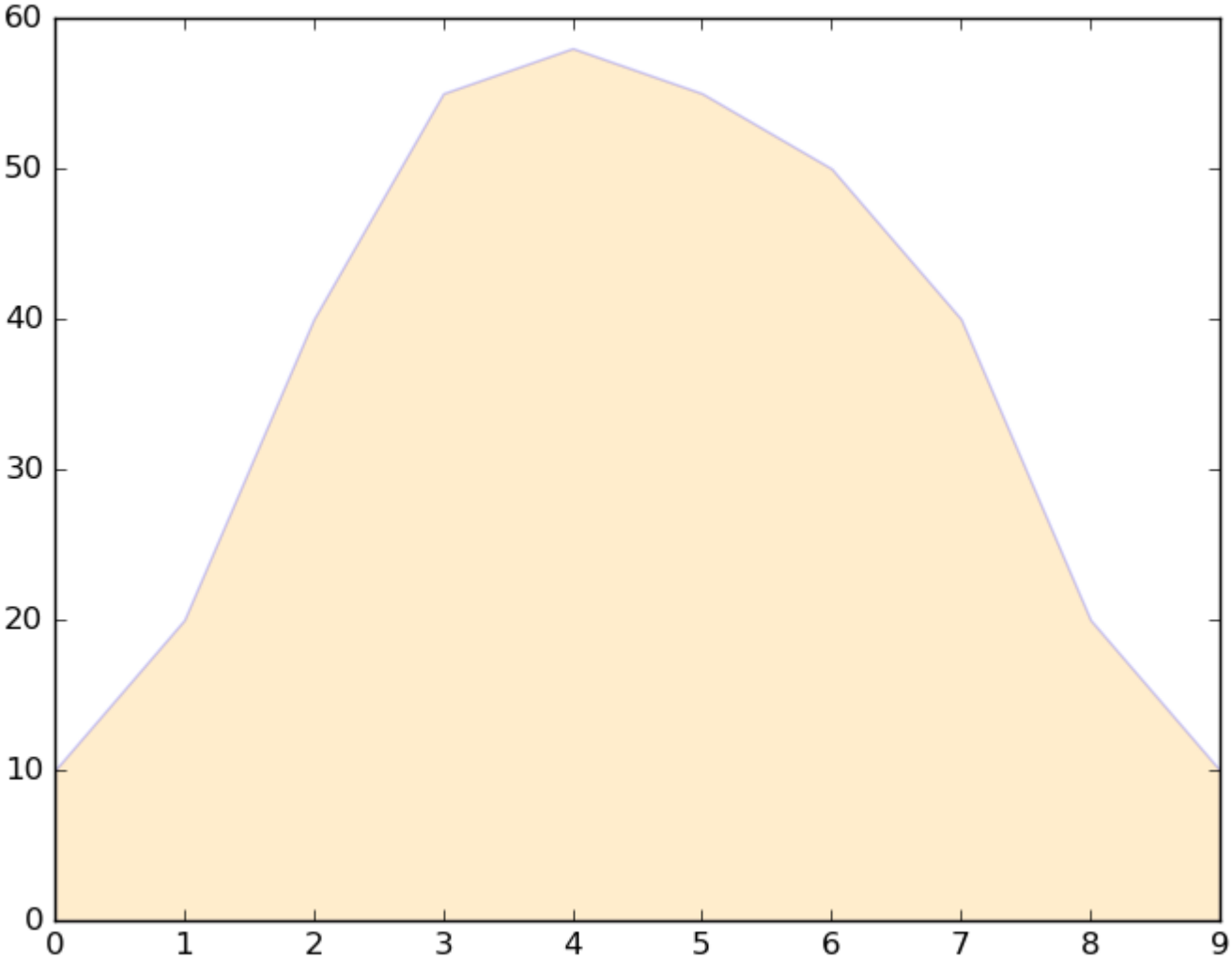

```
import matplotlib.pyplot as plt

# Data
x = [43,76,34,63,56,82,87,55,64,87,95,23,14,65,67,25,23,85]
y = [34,45,34,23,43,76,26,18,24,74,23,56,23,23,34,56,32,23]

fig, ax = plt.subplots(1, figsize=(10, 6))
fig.suptitle('Example Of Scatterplot')

# Create the Scatter Plot
ax.scatter(x, y,
            color="blue",    # Color of the dots
            s=100,           # Size of the dots
            alpha=0.5,       # Alpha/transparency of the dots (1 is opaque, 0 is transparent)
            linewidths=1)    # Size of edge around the dots
```

```
# Show the plot
plt.show()
```



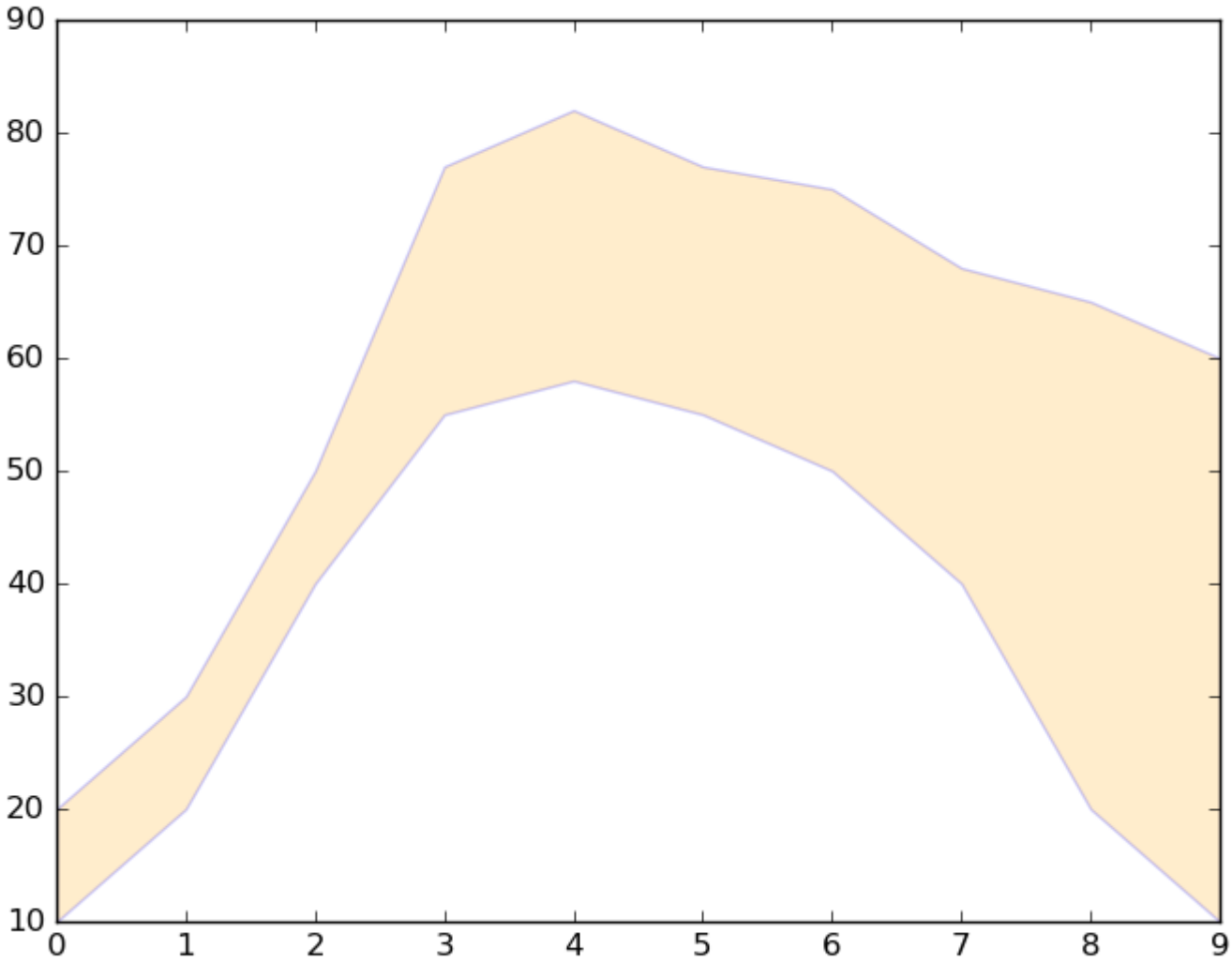

```
import matplotlib.pyplot as plt

# Data
x = [21, 34, 44, 23]
y = [435, 334, 656, 1999]
labels = ["alice", "bob", "charlie", "diane"]

# Create the figure and axes objects
fig, ax = plt.subplots(1, figsize=(10, 6))
fig.suptitle('Example Of Labelled Scatterpoints')

# Plot the scatter points
ax.scatter(x, y,
           color="blue",  # Color of the dots
           s=100,         # Size of the dots
           alpha=0.5,     # Alpha of the dots
           linewidths=1)  # Size of edge around the dots
```

```
# Add the participant names as text labels for each point
for x_pos, y_pos, label in zip(x, y, labels):
    ax.annotate(label,              # The label for this point
                xy=(x_pos, y_pos), # Position of the corresponding point
                xytext=(7, 0),     # Offset text by 7 points to the right
                textcoords='offset points', # tell it to use offset points
                ha='left',         # Horizontally aligned to the left
                va='center')       # Vertical alignment is centered

# Show the plot
plt.show()
```

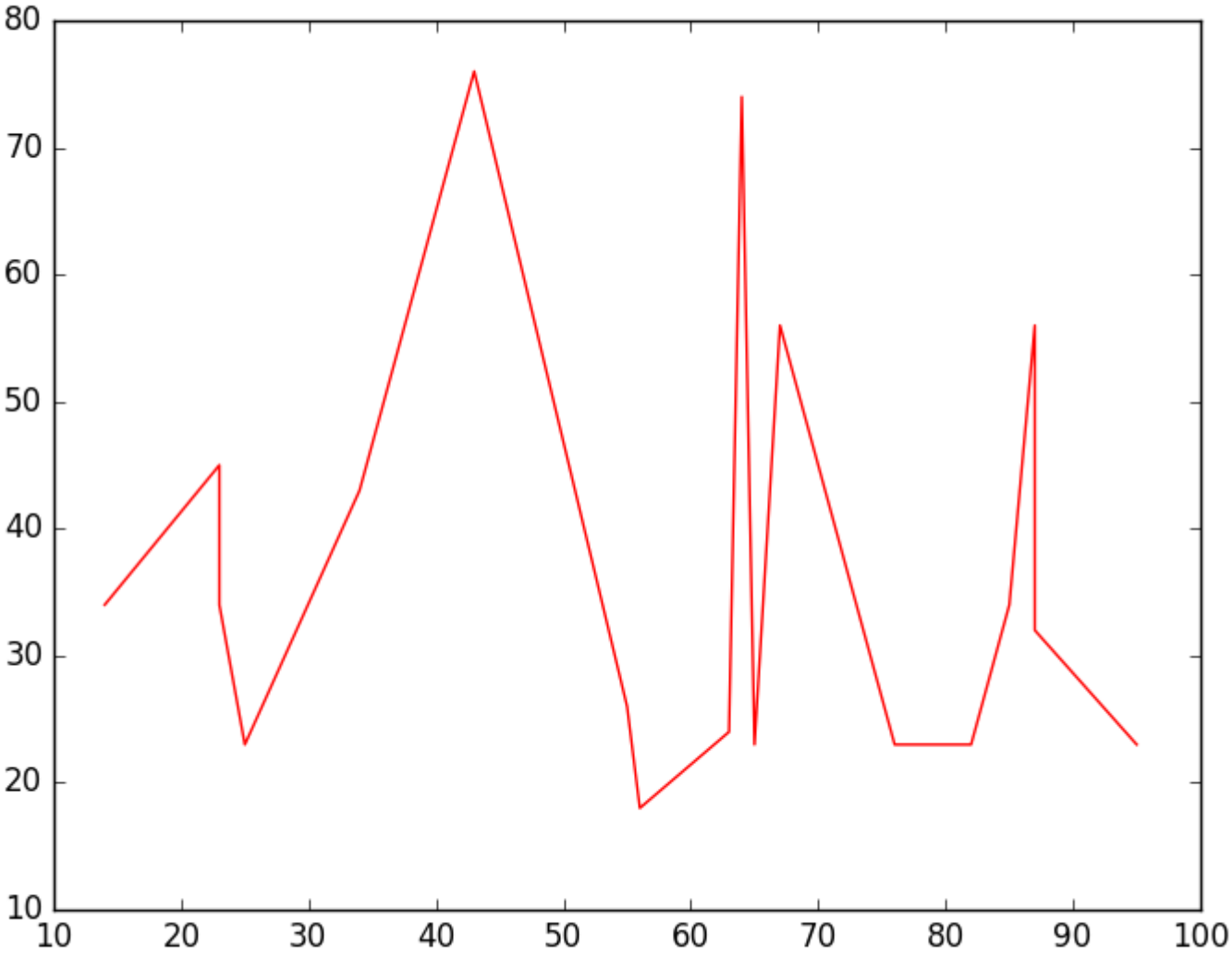



```
import matplotlib.pyplot as plt

# Data
x =  [0,1,2,3,4,5,6,7,8,9]
y1 = [10,20,40,55,58,55,50,40,20,10]

# Shade the area between y1 and line y=0
plt.fill_between(x, y1, 0,
```

```
                facecolor="orange", # The fill color
                color='blue',       # The outline color
                alpha=0.2)          # Transparency of the fill

# Show the plot
plt.show()
```



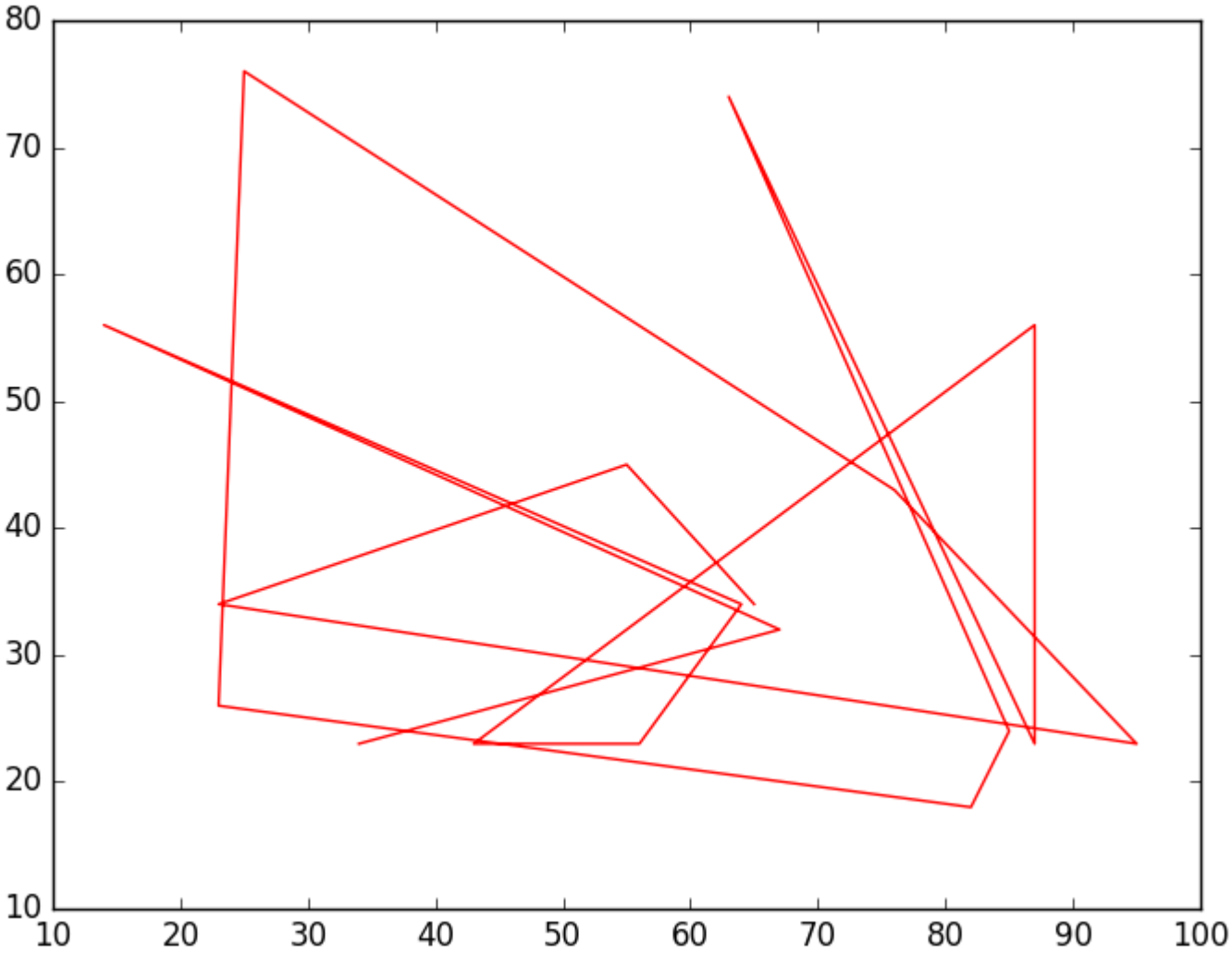

```
import matplotlib.pyplot as plt

# Data
x =  [0,1,2,3,4,5,6,7,8,9]
y1 = [10,20,40,55,58,55,50,40,20,10]
y2 = [20,30,50,77,82,77,75,68,65,60]

# Shade the area between y1 and y2
plt.fill_between(x, y1, y2,
                facecolor="orange", # The fill color
                color='blue',       # The outline color
                alpha=0.2)          # Transparency of the fill

# Show the plot
plt.show()
```




```
import matplotlib.pyplot as plt

# Data
x = [14,23,23,25,34,43,55,56,63,64,65,67,76,82,85,87,87,95]
y = [34,45,34,23,43,76,26,18,24,74,23,56,23,23,34,56,32,23]

# Create the plot
plt.plot(x, y, 'r-')
# r- is a style code meaning red solid line

# Show the plot
plt.show()
```

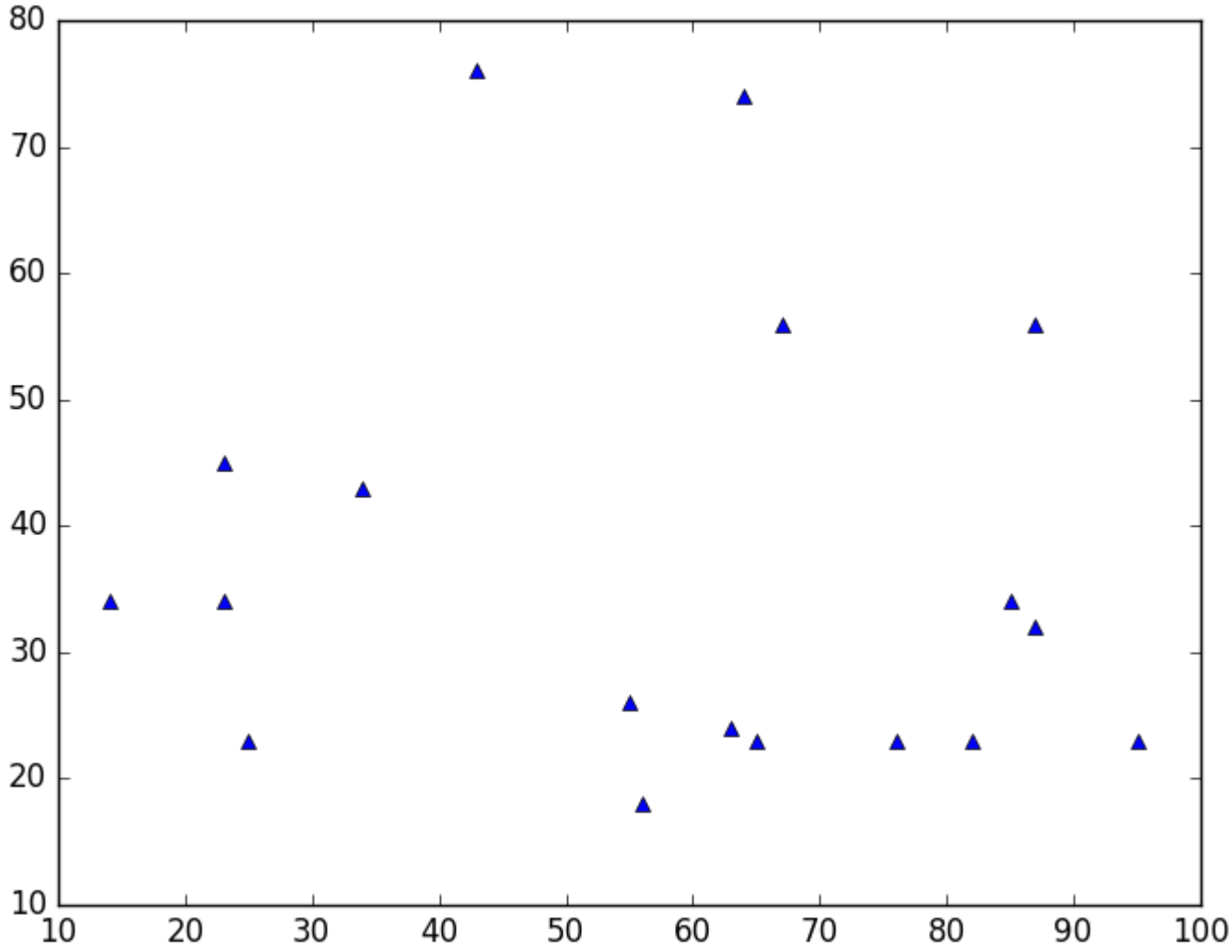
yxx◦ X

```
# shuffle the elements in x
np.random.shuffle(x)
plt.plot(x, y, 'r-')
plt.show()
```



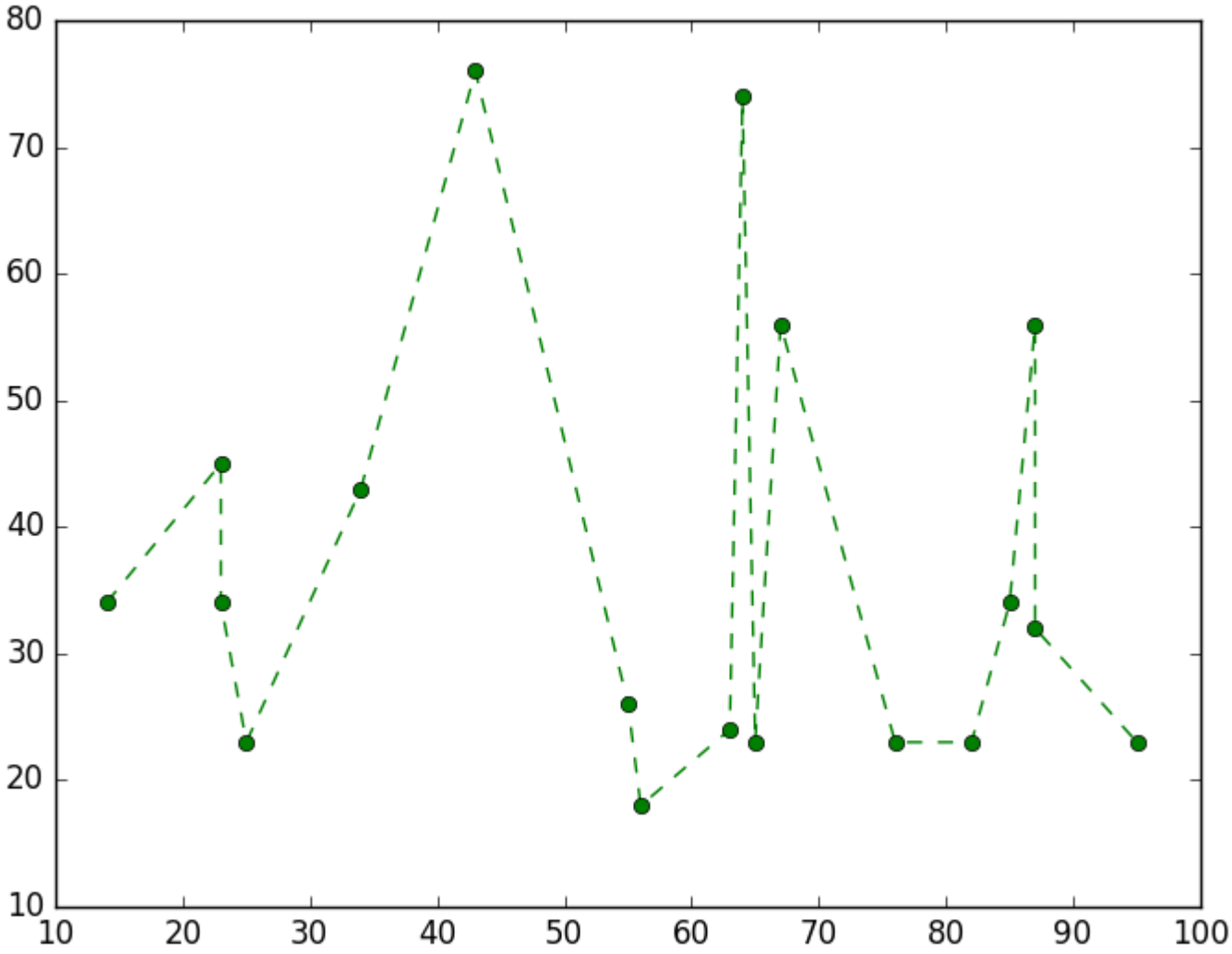
`plot()`。 style。

```
plt.plot(x, y, 'b^')
# Create blue up-facing triangles
```



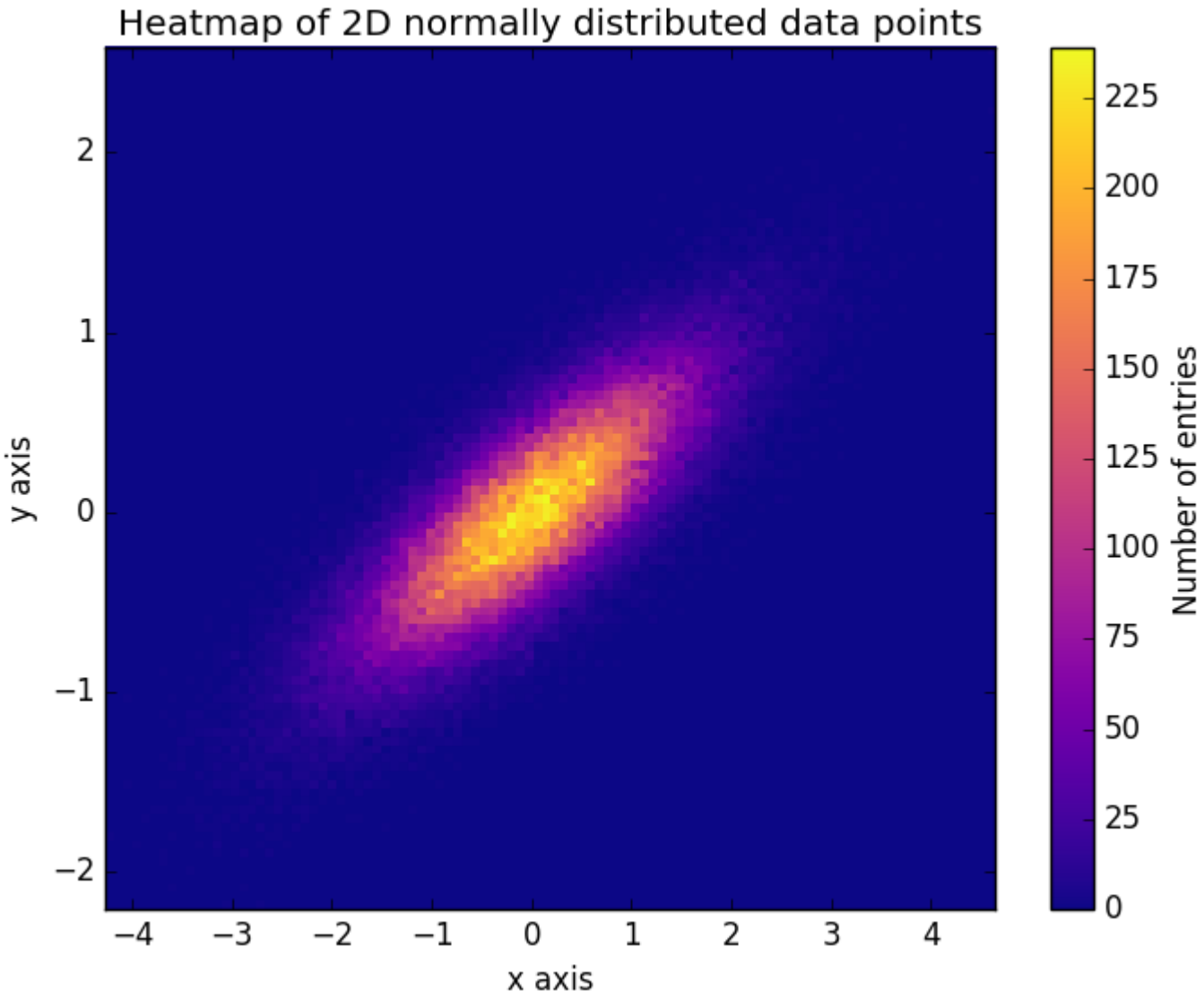
style

```
plt.plot(x, y, 'go--')
# green circles and dashed line
```



。“”。

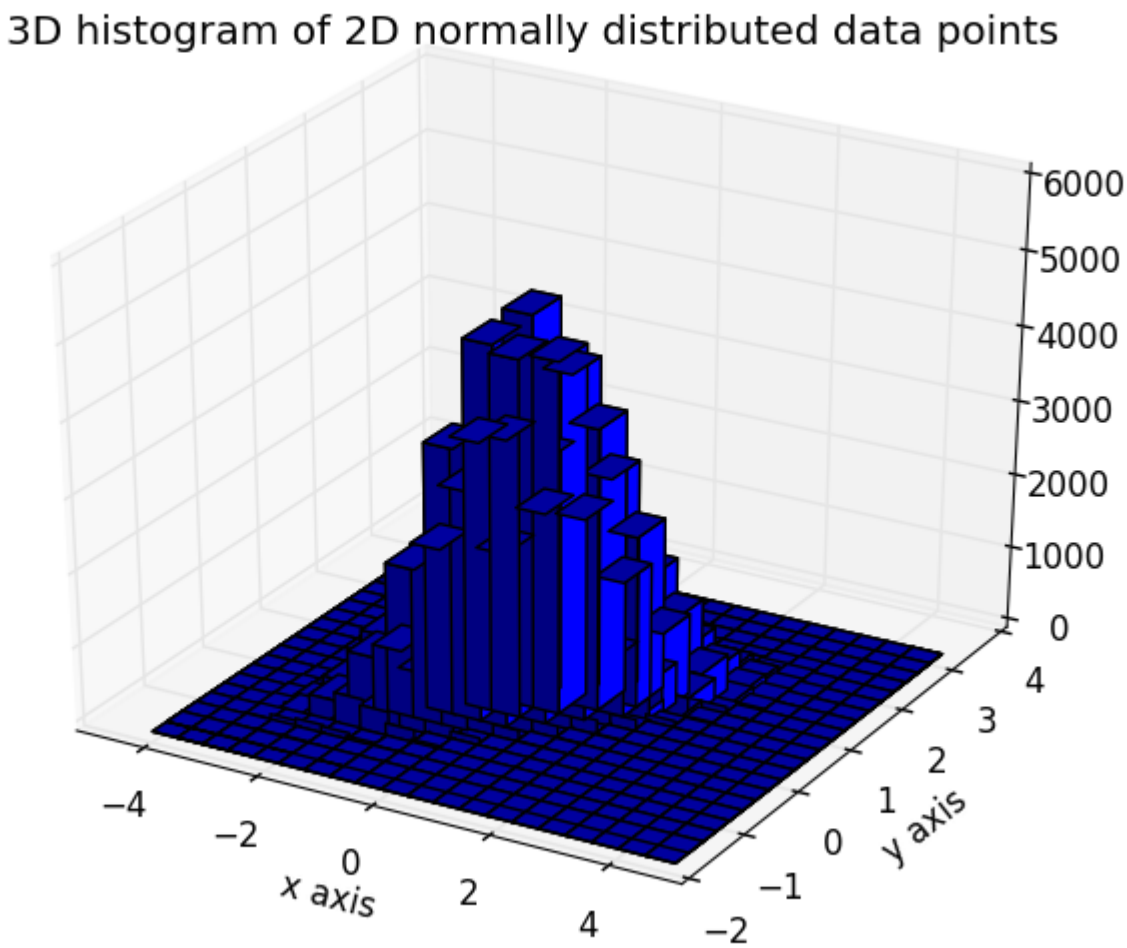
0`[0.0, 0.0]` a。 numpynumpy.random.multivariate_normal;pyplot matplotlib.pyplot.hist2d`hist2d`。




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

# Define numbers of generated data points and bins per axis.
N_numbers = 100000
N_bins = 100

# set random seed
np.random.seed(0)

# Generate 2D normally distributed numbers.
x, y = np.random.multivariate_normal(
        mean=[0.0, 0.0],      # mean
        cov=[[1.0, 0.4],
             [0.4, 0.25]],    # covariance matrix
        size=N_numbers
        ).T                   # transpose to get columns


# Construct 2D histogram from data using the 'plasma' colormap
plt.hist2d(x, y, bins=N_bins, normed=False, cmap='plasma')
```

```
# Plot a colorbar with label.
cb = plt.colorbar()
cb.set_label('Number of entries')

# Add title and labels to plot.
plt.title('Heatmap of 2D normally distributed data points')
plt.xlabel('x axis')
plt.ylabel('y axis')

# Show the plot.
plt.show()
```

3D20。matplotlib 。




```
from mpl_toolkits.mplot3d import Axes3D
import numpy as np
import matplotlib
import matplotlib.pyplot as plt

# Define numbers of generated data points and bins per axis.
N_numbers = 100000
```

```
N_bins = 20

# set random seed
np.random.seed(0)

# Generate 2D normally distributed numbers.
x, y = np.random.multivariate_normal(
        mean=[0.0, 0.0],      # mean
        cov=[[1.0, 0.4],
             [0.4, 0.25]],    # covariance matrix
        size=N_numbers
        ).T                   # transpose to get columns

fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
hist, xedges, yedges = np.histogram2d(x, y, bins=N_bins)

# Add title and labels to plot.
plt.title('3D histogram of 2D normally distributed data points')
plt.xlabel('x axis')
plt.ylabel('y axis')

# Construct arrays for the anchor positions of the bars.
# Note: np.meshgrid gives arrays in (ny, nx) so we use 'F' to flatten xpos,
# ypos in column-major order. For numpy >= 1.7, we could instead call meshgrid
# with indexing='ij'.
xpos, ypos = np.meshgrid(xedges[:-1] + 0.25, yedges[:-1] + 0.25)
xpos = xpos.flatten('F')
ypos = ypos.flatten('F')
zpos = np.zeros_like(xpos)

# Construct arrays with the dimensions for the 16 bars.
dx = 0.5 * np.ones_like(zpos)
dy = dx.copy()
dz = hist.flatten()

ax.bar3d(xpos, ypos, zpos, dx, dy, dz, color='b', zsort='average')

# Show the plot.
plt.show()
```

https://riptutorial.com/zh-TW/matplotlib/topic/3266/

9:

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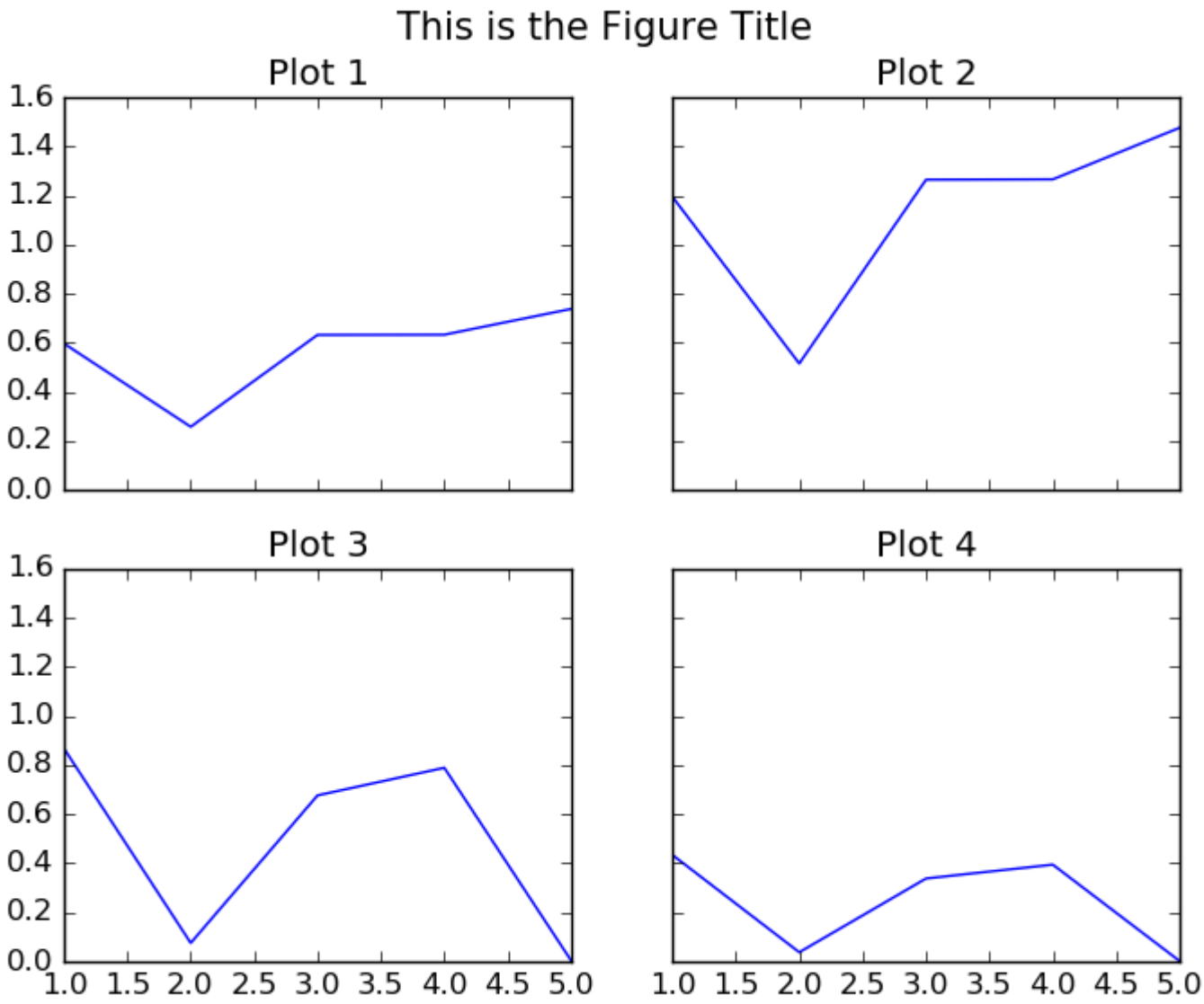
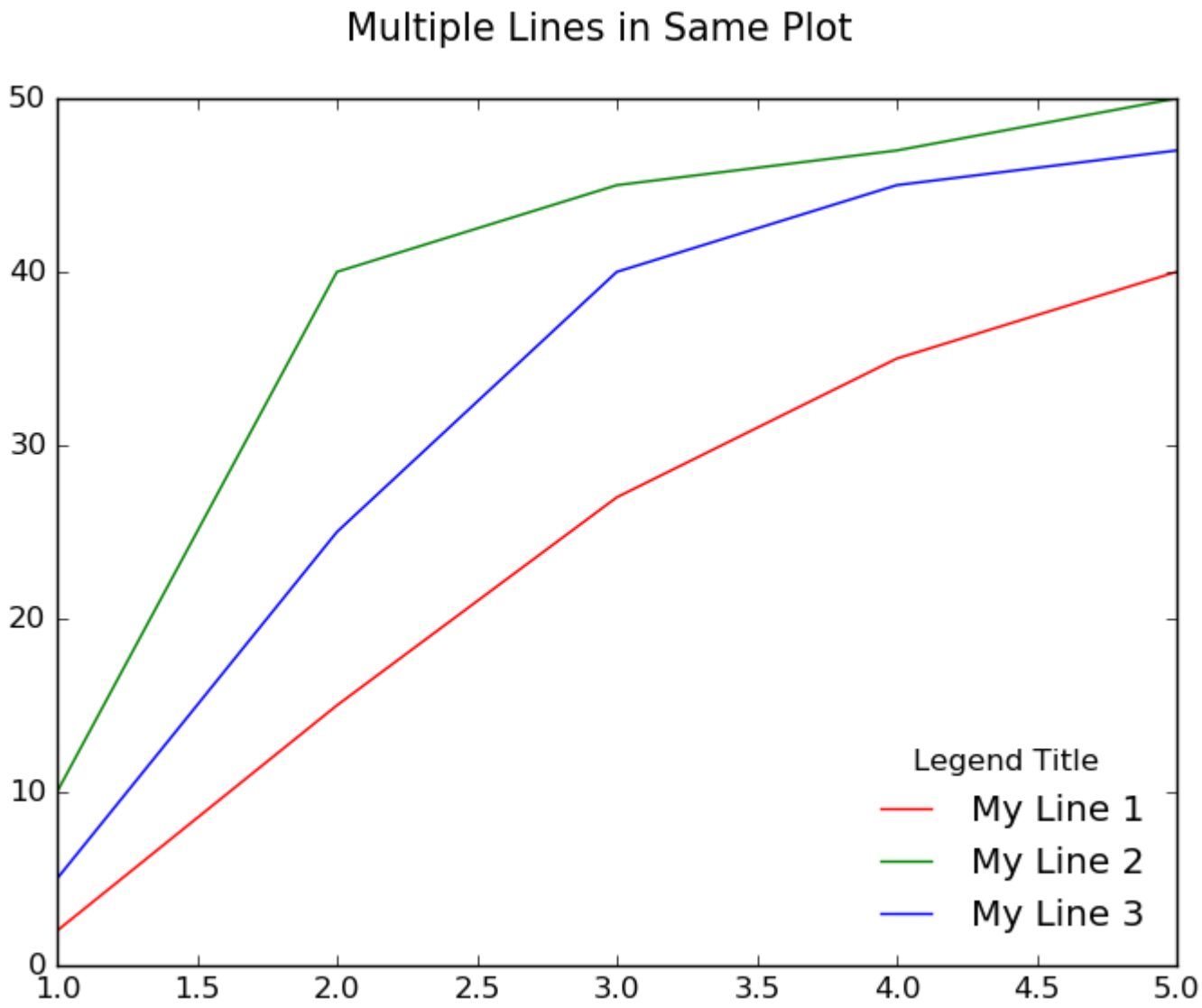
Examples




```
"""
================================================================================
CREATE A 2 BY 2 GRID OF SUB-PLOTS WITHIN THE SAME FIGURE.
================================================================================
"""
import matplotlib.pyplot as plt

# The data
x = [1,2,3,4,5]
y1 = [0.59705847, 0.25786401, 0.63213726, 0.63287317, 0.73791151]
y2 = [1.19411694, 0.51572803, 1.26427451, 1.26574635, 1.47582302]
y3 = [0.86793828, 0.07563408, 0.67670068, 0.78932712, 0.0043694]
# 5 more random values
```

```
y4 = [0.43396914, 0.03781704, 0.33835034, 0.39466356, 0.0021847]

# Initialise the figure and a subplot axes. Each subplot sharing (showing) the
# same range of values for the x and y axis in the plots.
fig, axes = plt.subplots(2, 2, figsize=(8, 6), sharex=True, sharey=True)

# Set the title for the figure
fig.suptitle('This is the Figure Title', fontsize=15)

# Top Left Subplot
axes[0,0].plot(x, y1)
axes[0,0].set_title("Plot 1")

# Top Right Subplot
axes[0,1].plot(x, y2)
axes[0,1].set_title("Plot 2")

# Bottom Left Subplot
axes[1,0].plot(x, y3)
axes[1,0].set_title("Plot 3")

# Bottom Right Subplot
axes[1,1].plot(x, y4)
axes[1,1].set_title("Plot 4")

plt.show()
```

I




```
"""
================================================================================
                    DRAW MULTIPLE LINES IN THE SAME PLOT
================================================================================
"""
import matplotlib.pyplot as plt

# The data
x =  [1, 2, 3, 4, 5]
y1 = [2,  15, 27, 35, 40]
y2 = [10, 40, 45, 47, 50]
y3 = [5,  25, 40, 45, 47]

# Initialise the figure and axes.
fig, ax = plt.subplots(1, figsize=(8, 6))

# Set the title for the figure
fig.suptitle('Multiple Lines in Same Plot', fontsize=15)

# Draw all the lines in the same plot, assigning a label for each one to be
# shown in the legend.
ax.plot(x, y1, color="red", label="My Line 1")
ax.plot(x, y2, color="green", label="My Line 2")
```

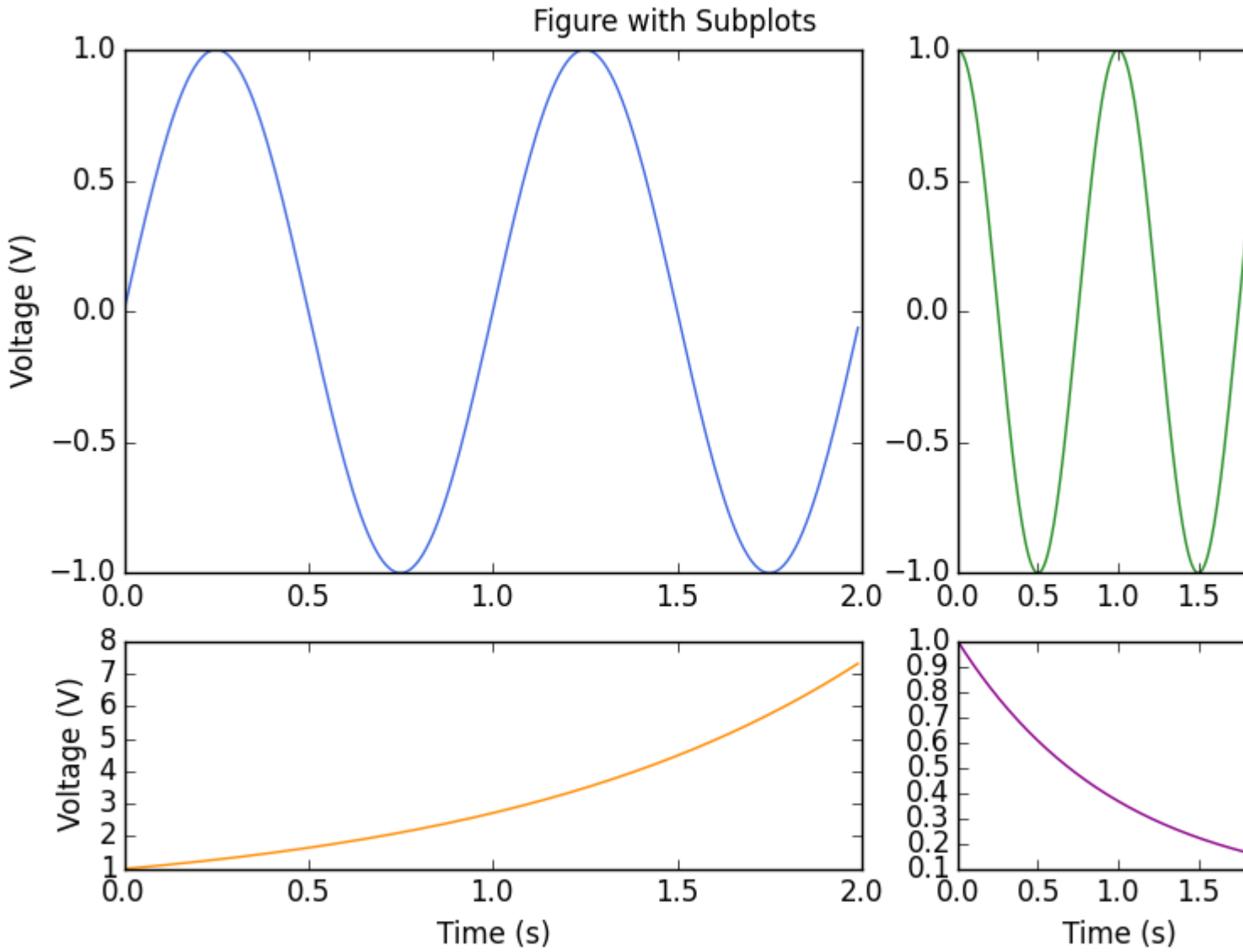
```
ax.plot(x, y3, color="blue", label="My Line 3")

# Add a legend, and position it on the lower right (with no box)
plt.legend(loc="lower right", title="Legend Title", frameon=False)

plt.show()
```

gridspec

gridspec◦ ◦ ◦

```
import numpy as np
import matplotlib.pyplot as plt
from matplotlib.gridspec import  GridSpec

# Make some data
t = np.arange(0, 2, 0.01)
y1 = np.sin(2*np.pi * t)
y2 = np.cos(2*np.pi * t)
y3 = np.exp(t)
y4 = np.exp(-t)

# Initialize the grid with 3 rows and 3 columns
ncols = 3
nrows = 3
grid = GridSpec(nrows, ncols,
                left=0.1, bottom=0.15, right=0.94, top=0.94, wspace=0.3, hspace=0.3)

fig = plt.figure(0)
fig.clf()

# Add axes which can span multiple grid boxes
ax1 = fig.add_subplot(grid[0:2, 0:2])
ax2 = fig.add_subplot(grid[0:2, 2])
ax3 = fig.add_subplot(grid[2, 0:2])
ax4 = fig.add_subplot(grid[2, 2])

ax1.plot(t, y1, color='royalblue')
ax2.plot(t, y2, color='forestgreen')
ax3.plot(t, y3, color='darkorange')
ax4.plot(t, y4, color='darkmagenta')

# Add labels and titles
fig.suptitle('Figure with Subplots')
ax1.set_ylabel('Voltage (V)')
ax3.set_ylabel('Voltage (V)')
ax3.set_xlabel('Time (s)')
ax4.set_xlabel('Time (s)')
```

◦

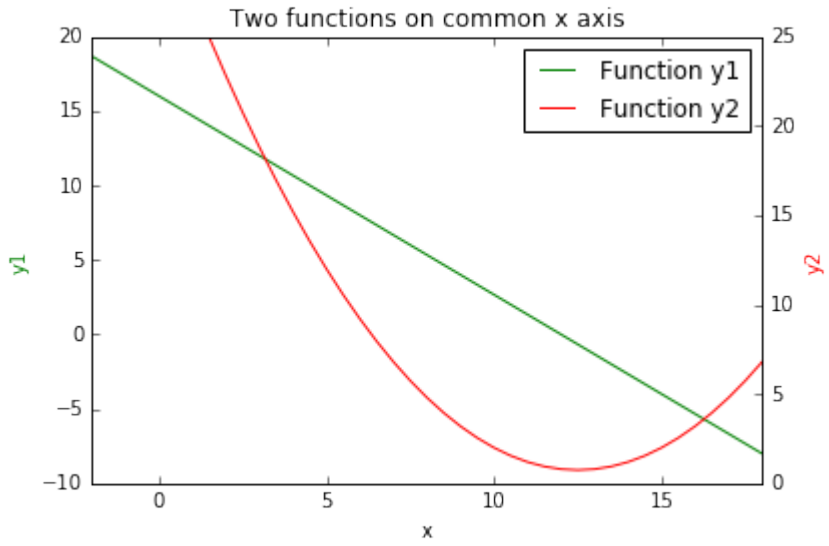


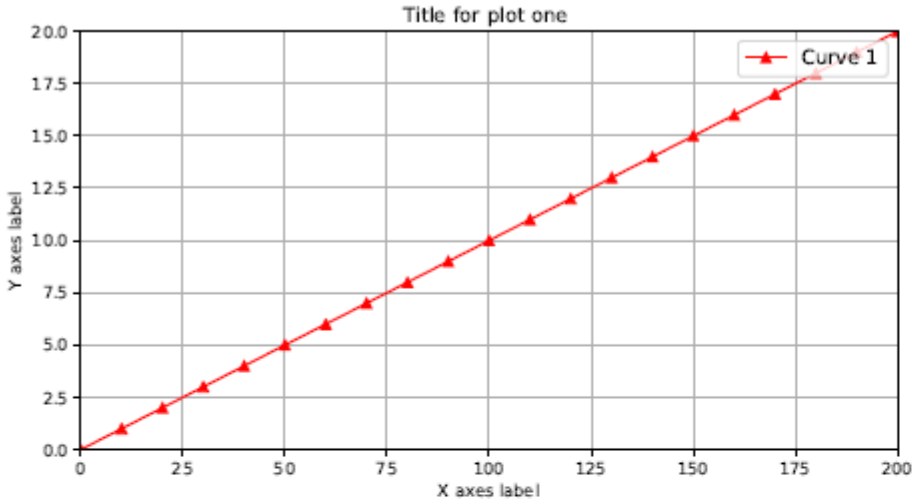
x2。

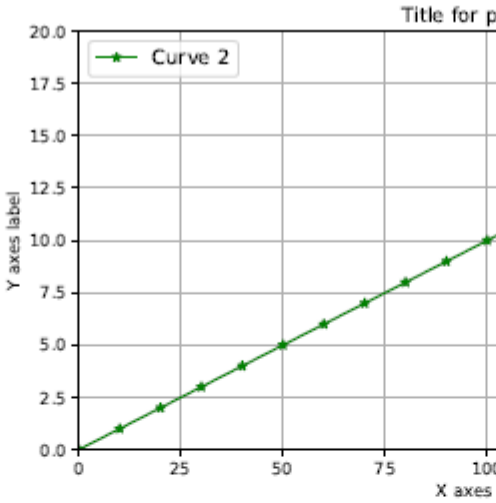
```
import numpy as np
import matplotlib.pyplot as plt

# create some data
x = np.arange(-2, 20, 0.5)                  # values of x
y1 = map(lambda x: -4.0/3.0*x + 16, x)      # values of y1(x)
y2 = map(lambda x: 0.2*x**2 -5*x + 32, x)   # svalues of y2(x)

fig = plt.figure()
ax1 = fig.add_subplot(111)

# create line plot of y1(x)
line1, = ax1.plot(x, y1, 'g', label="Function y1")
ax1.set_xlabel('x')
ax1.set_ylabel('y1', color='g')

# create shared axis for y2(x)
ax2 = ax1.twinx()
```

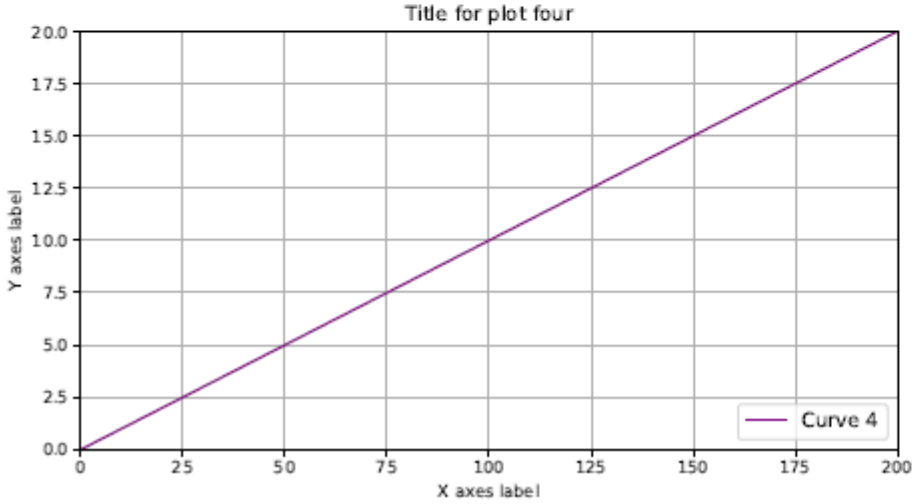
```
# create line plot of y2(x)
line2, = ax2.plot(x, y2, 'r', label="Function y2")
ax2.set_ylabel('y2', color='r')

# set title, plot limits, etc
plt.title('Two functions on common x axis')
plt.xlim(-2, 18)
plt.ylim(0, 25)

# add a legend, and position it on the upper right
plt.legend((line1, line2), ('Function y1', 'Function y2'))

plt.show()
```

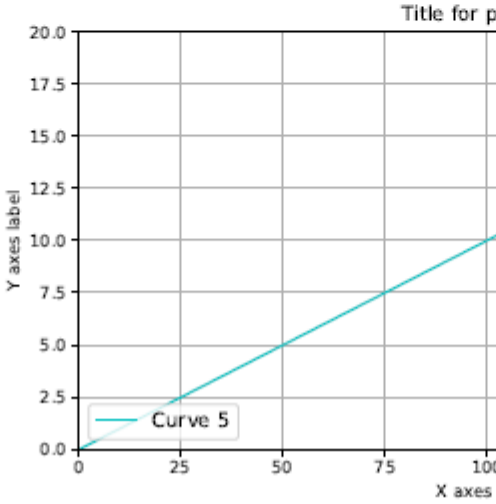
。

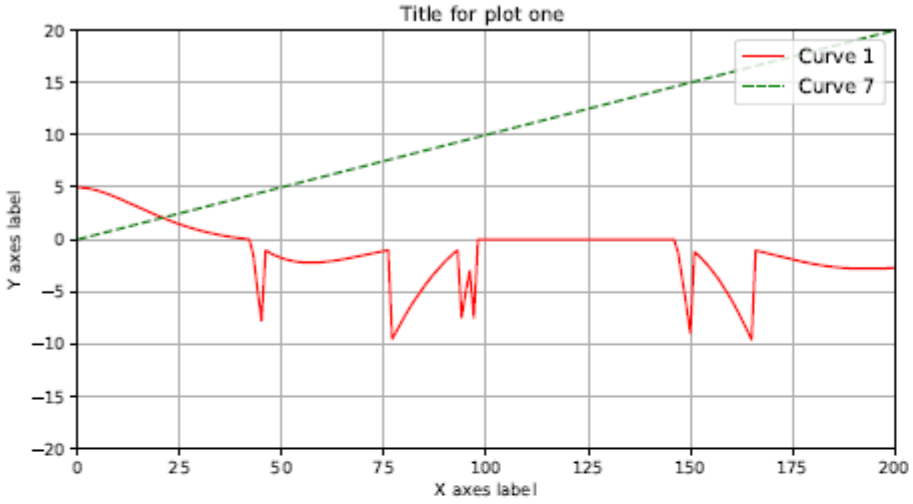


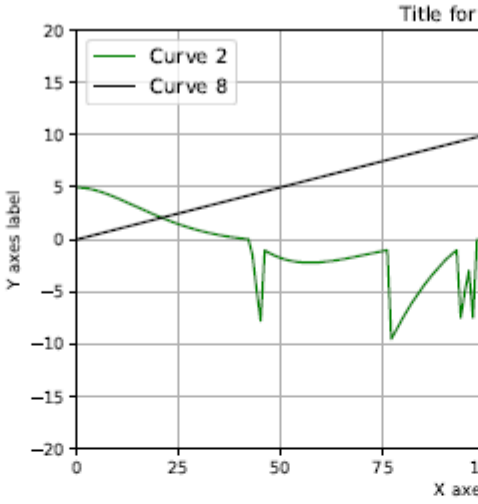

Title for plot one
Curve 1
Y axes label
X axes label
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
0
25
50
75
100
125
150
175
200

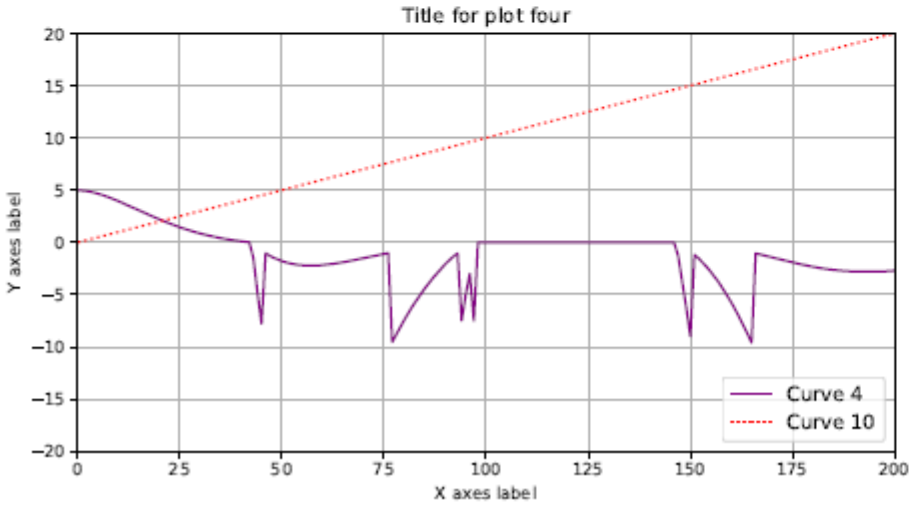

Curve 2
Y axes label
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
0
25
50
75

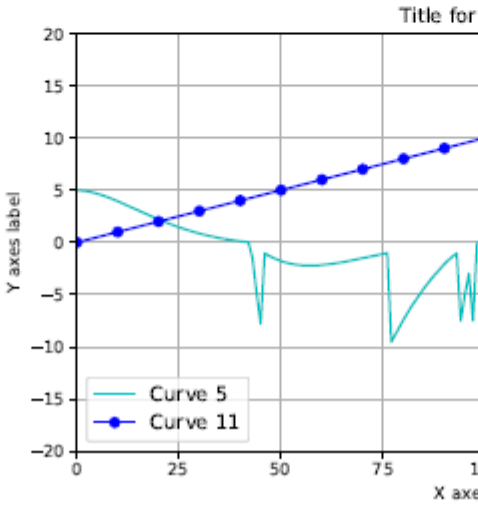

Title for plot four
Curve 4
Y axes label
X axes label
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
0
25
50
75
100
125
150
175
200


Curve 5
Y axes label
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
0
25
50
75









CAE.csv

```
TIME,Acceleration
0,4.992235
0.09952711,4.956489
0.1999273,4.915645
0.2994544,4.850395
0.3998545,4.763977
0.4993816,4.65888
0.5997818,4.537595
0.6993089,4.402862
0.799709,4.256423
0.8992361,4.100522
0.9996362,3.937148
1.099163,3.768047
1.199564,3.579082
```

```
import matplotlib
matplotlib.use("TKAgg")

# module to save pdf files
from matplotlib.backends.backend_pdf import PdfPages

import matplotlib.pyplot as plt  # module to plot

import pandas as pd  # module to read csv file
```

```
# module to allow user to select csv file
from tkinter.filedialog import askopenfilename

# module to allow user to select save directory
from tkinter.filedialog import askdirectory


#=============================================================================
#  User chosen Data for plots
#=============================================================================

# User choose csv file then read csv file
filename = askopenfilename() # user selected file
data = pd.read_csv(filename, delimiter=',')

# check to see if data is reading correctly
#print(data)

#=============================================================================
#  Plots on two different Figures and sets the size of the figures
#=============================================================================

# figure size = (width,height)
f1 = plt.figure(figsize=(30,10))
f2 = plt.figure(figsize=(30,10))

#-----------------------------------------------------------------------------
#  Figure 1 with 6 plots
#-----------------------------------------------------------------------------

# plot one
# Plot column labeled TIME from csv file and color it red
# subplot(2 Rows, 3 Columns, First subplot,)
ax1 = f1.add_subplot(2,3,1)
ax1.plot(data[["TIME"]], label = 'Curve 1', color = "r", marker = '^', markevery = 10)
# added line marker triangle


# plot two
# plot column labeled TIME from csv file and color it green
# subplot(2 Rows, 3 Columns, Second subplot)
ax2 = f1.add_subplot(2,3,2)
ax2.plot(data[["TIME"]], label = 'Curve 2', color = "g", marker = '*', markevery = 10)
# added line marker star


# plot three
# plot column labeled TIME from csv file and color it blue
# subplot(2 Rows, 3 Columns, Third subplot)
ax3 = f1.add_subplot(2,3,3)
ax3.plot(data[["TIME"]], label = 'Curve 3', color = "b", marker = 'D', markevery = 10)
# added line marker diamond


# plot four
# plot column labeled TIME from csv file and color it purple
# subplot(2 Rows, 3 Columns, Fourth subplot)
ax4 = f1.add_subplot(2,3,4)
ax4.plot(data[["TIME"]], label = 'Curve 4', color = "#800080")
```

```
# plot five
# plot column labeled TIME from csv file and color it cyan
# subplot(2 Rows, 3 Columns, Fifth subplot)
ax5 = f1.add_subplot(2,3,5)
ax5.plot(data[["TIME"]], label = 'Curve 5', color = "c")


# plot six
# plot column labeled TIME from csv file and color it black
# subplot(2 Rows, 3 Columns, Sixth subplot)
ax6 = f1.add_subplot(2,3,6)
ax6.plot(data[["TIME"]], label = 'Curve 6', color = "k")

#-------------------------------------------------------------------------------
# Figure 2 with 6 plots
#-------------------------------------------------------------------------------

# plot one
# Curve 1: plot column labeled Acceleration from csv file and color it red
# Curve 2: plot column labeled     TIME     from csv file and color it green
# subplot(2 Rows, 3 Columns, First subplot)
ax10 = f2.add_subplot(2,3,1)
ax10.plot(data[["Acceleration"]], label = 'Curve 1', color = "r")
ax10.plot(data[["TIME"]], label = 'Curve 7', color="g", linestyle ='--')
# dashed line


# plot two
# Curve 1: plot column labeled Acceleration from csv file and color it green
# Curve 2: plot column labeled     TIME     from csv file and color it black
# subplot(2 Rows, 3 Columns, Second subplot)
ax20 = f2.add_subplot(2,3,2)
ax20.plot(data[["Acceleration"]], label = 'Curve 2', color = "g")
ax20.plot(data[["TIME"]], label = 'Curve 8', color = "k", linestyle ='-')
# solid line (default)


# plot three
# Curve 1: plot column labeled Acceleration from csv file and color it blue
# Curve 2: plot column labeled     TIME     from csv file and color it purple
# subplot(2 Rows, 3 Columns, Third subplot)
ax30 = f2.add_subplot(2,3,3)
ax30.plot(data[["Acceleration"]], label = 'Curve 3', color = "b")
ax30.plot(data[["TIME"]], label = 'Curve 9', color = "#800080", linestyle ='-.')
# dash_dot line


# plot four
# Curve 1: plot column labeled Acceleration from csv file and color it purple
# Curve 2: plot column labeled     TIME     from csv file and color it red
# subplot(2 Rows, 3 Columns, Fourth subplot)
ax40 = f2.add_subplot(2,3,4)
ax40.plot(data[["Acceleration"]], label = 'Curve 4', color = "#800080")
ax40.plot(data[["TIME"]], label = 'Curve 10', color = "r", linestyle =':')
# dotted line


# plot five
# Curve 1: plot column labeled Acceleration from csv file and color it cyan
# Curve 2: plot column labeled     TIME     from csv file and color it blue
# subplot(2 Rows, 3 Columns, Fifth subplot)
```

```
ax50 = f2.add_subplot(2,3,5)
ax50.plot(data[["Acceleration"]], label = 'Curve 5', color = "c")
ax50.plot(data[["TIME"]], label = 'Curve 11', color = "b", marker = 'o', markevery = 10)
# added line marker circle


# plot six
# Curve 1: plot column labeled Acceleration from csv file and color it black
# Curve 2: plot column labeled     TIME     from csv file and color it cyan
# subplot(2 Rows, 3 Columns, Sixth subplot)
ax60 = f2.add_subplot(2,3,6)
ax60.plot(data[["Acceleration"]], label = 'Curve 6', color = "k")
ax60.plot(data[["TIME"]], label = 'Curve 12', color = "c", marker = 's', markevery = 10)
# added line marker square


#============================================================================
#  Figure Plot options
#============================================================================

#----------------------------------------------------------------------------
#  Figure 1 options
#----------------------------------------------------------------------------

#switch to figure one for editing
plt.figure(1)

# Plot one options
ax1.legend(loc='upper right', fontsize='large')
ax1.set_title('Title for plot one ')
ax1.set_xlabel('X axes label')
ax1.set_ylabel('Y axes label')
ax1.grid(True)
ax1.set_xlim([0,200])
ax1.set_ylim([0,20])

# Plot two options
ax2.legend(loc='upper left', fontsize='large')
ax2.set_title('Title for plot two ')
ax2.set_xlabel('X axes label')
ax2.set_ylabel('Y axes label')
ax2.grid(True)
ax2.set_xlim([0,200])
ax2.set_ylim([0,20])

# Plot three options
ax3.legend(loc='upper center', fontsize='large')
ax3.set_title('Title for plot three ')
ax3.set_xlabel('X axes label')
ax3.set_ylabel('Y axes label')
ax3.grid(True)
ax3.set_xlim([0,200])
ax3.set_ylim([0,20])

# Plot four options
ax4.legend(loc='lower right', fontsize='large')
ax4.set_title('Title for plot four')
ax4.set_xlabel('X axes label')
ax4.set_ylabel('Y axes label')
ax4.grid(True)
ax4.set_xlim([0,200])
```

```
ax4.set_ylim([0,20])

# Plot five options
ax5.legend(loc='lower left', fontsize='large')
ax5.set_title('Title for plot five ')
ax5.set_xlabel('X axes label')
ax5.set_ylabel('Y axes label')
ax5.grid(True)
ax5.set_xlim([0,200])
ax5.set_ylim([0,20])

# Plot six options
ax6.legend(loc='lower center', fontsize='large')
ax6.set_title('Title for plot six')
ax6.set_xlabel('X axes label')
ax6.set_ylabel('Y axes label')
ax6.grid(True)
ax6.set_xlim([0,200])
ax6.set_ylim([0,20])

#-------------------------------------------------------------------------------
#  Figure 2 options
#-------------------------------------------------------------------------------

#switch to figure two for editing
plt.figure(2)

# Plot one options
ax10.legend(loc='upper right', fontsize='large')
ax10.set_title('Title for plot one ')
ax10.set_xlabel('X axes label')
ax10.set_ylabel('Y axes label')
ax10.grid(True)
ax10.set_xlim([0,200])
ax10.set_ylim([-20,20])

# Plot two options
ax20.legend(loc='upper left', fontsize='large')
ax20.set_title('Title for plot two ')
ax20.set_xlabel('X axes label')
ax20.set_ylabel('Y axes label')
ax20.grid(True)
ax20.set_xlim([0,200])
ax20.set_ylim([-20,20])

# Plot three options
ax30.legend(loc='upper center', fontsize='large')
ax30.set_title('Title for plot three ')
ax30.set_xlabel('X axes label')
ax30.set_ylabel('Y axes label')
ax30.grid(True)
ax30.set_xlim([0,200])
ax30.set_ylim([-20,20])

# Plot four options
ax40.legend(loc='lower right', fontsize='large')
ax40.set_title('Title for plot four')
ax40.set_xlabel('X axes label')
ax40.set_ylabel('Y axes label')
ax40.grid(True)
ax40.set_xlim([0,200])
```

```
ax40.set_ylim([-20,20])

# Plot five options
ax50.legend(loc='lower left', fontsize='large')
ax50.set_title('Title for plot five ')
ax50.set_xlabel('X axes label')
ax50.set_ylabel('Y axes label')
ax50.grid(True)
ax50.set_xlim([0,200])
ax50.set_ylim([-20,20])

# Plot six options
ax60.legend(loc='lower center', fontsize='large')
ax60.set_title('Title for plot six')
ax60.set_xlabel('X axes label')
ax60.set_ylabel('Y axes label')
ax60.grid(True)
ax60.set_xlim([0,200])
ax60.set_ylim([-20,20])


#============================================================================
#  User chosen file location Save PDF
#============================================================================

savefilename = askdirectory()# user selected file path
pdf = PdfPages(f'{savefilename}/longplot.pdf')
# using formatted string literals ("f-strings")to place the variable into the string

# save both figures into one pdf file
pdf.savefig(1)
pdf.savefig(2)

pdf.close()


#============================================================================
#  Show plot
#============================================================================

# manually set the subplot spacing when there are multiple plots
#plt.subplots_adjust(left=None, bottom=None, right=None, top=None, wspace =None, hspace=None )

# Automaticlly adds space between plots
plt.tight_layout()

plt.show()
```

https://riptutorial.com/zh-TW/matplotlib/topic/3279/

10:

Examples

◦ matplotlibpyplot ◦

```
import matplotlib.pyplot as plt
fig = plt.figure()
```

◦ ID;10◦

```
import matplotlib.pyplot as plt
fig = plt.figure()
fig == plt.figure(1)  # True
```

◦ ◦

```
import matplotlib.pyplot as plt
fig = plt.figure('image')
```

```
plt.figure(fig.number) # or
plt.figure(1)
```

matplotlibpyplotAPI◦

pyplot

```
import matplotlib.pyplot as plt

ax = plt.subplot(3, 2, 1)  # 3 rows, 2 columns, the first subplot
```

API

```
import matplotlib.pyplot as plt

fig = plt.figure()
ax = fig.add_subplot(3, 2, 1)
```

```
plt.subplots()
```

```
import matplotlib.pyplot as plt

fig, (ax1, ax2) = plt.subplots(ncols=2, nrows=1)  # 1 row, 2 columns
```

https://riptutorial.com/zh-TW/matplotlib/topic/2307/

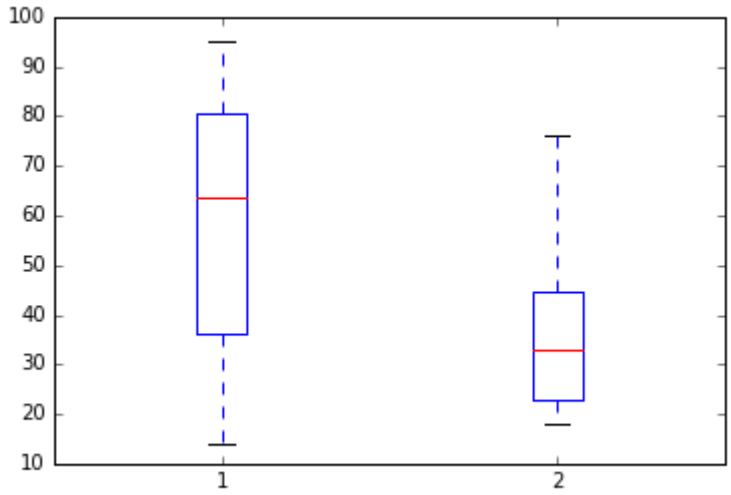
11:

Examples

◦ ◦

matplotlibboxplot

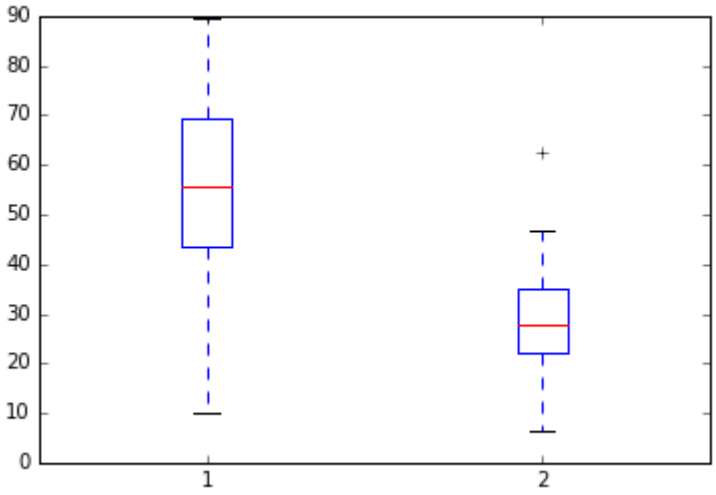
```
import matplotlib as plt

dataline1 = [43,76,34,63,56,82,87,55,64,87,95,23,14,65,67,25,23,85]
dataline2 = [34,45,34,23,43,76,26,18,24,74,23,56,23,23,34,56,32,23]
data = [ dataline1, dataline2 ]

plt.boxplot( data )
```



---

numpy◦

```
import numpy as np
import matplotlib as plt

np.random.seed(123)
dataline1 = np.random.normal( loc=50, scale=20, size=18 )
dataline2 = np.random.normal( loc=30, scale=10, size=18 )
data = np.stack( [ dataline1, dataline2 ], axis=1 )

plt.boxplot( data )
```



https://riptutorial.com/zh-TW/matplotlib/topic/6086/

12:

Examples

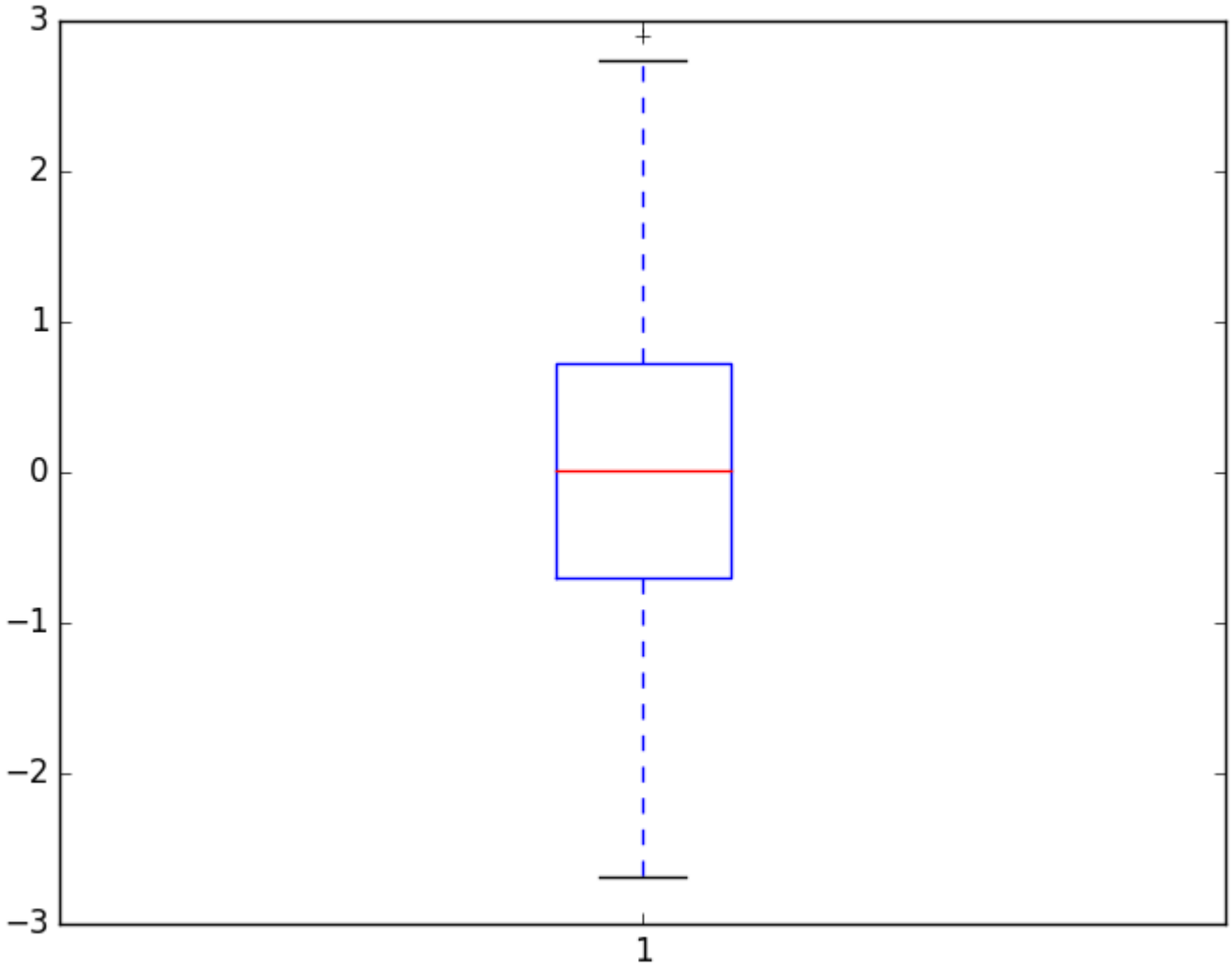
Boxplot

Matplotlib 。50。Q1Q32575Q1 - 1.5 *IQR; Q3* + *1.5* IQR; IQR。。

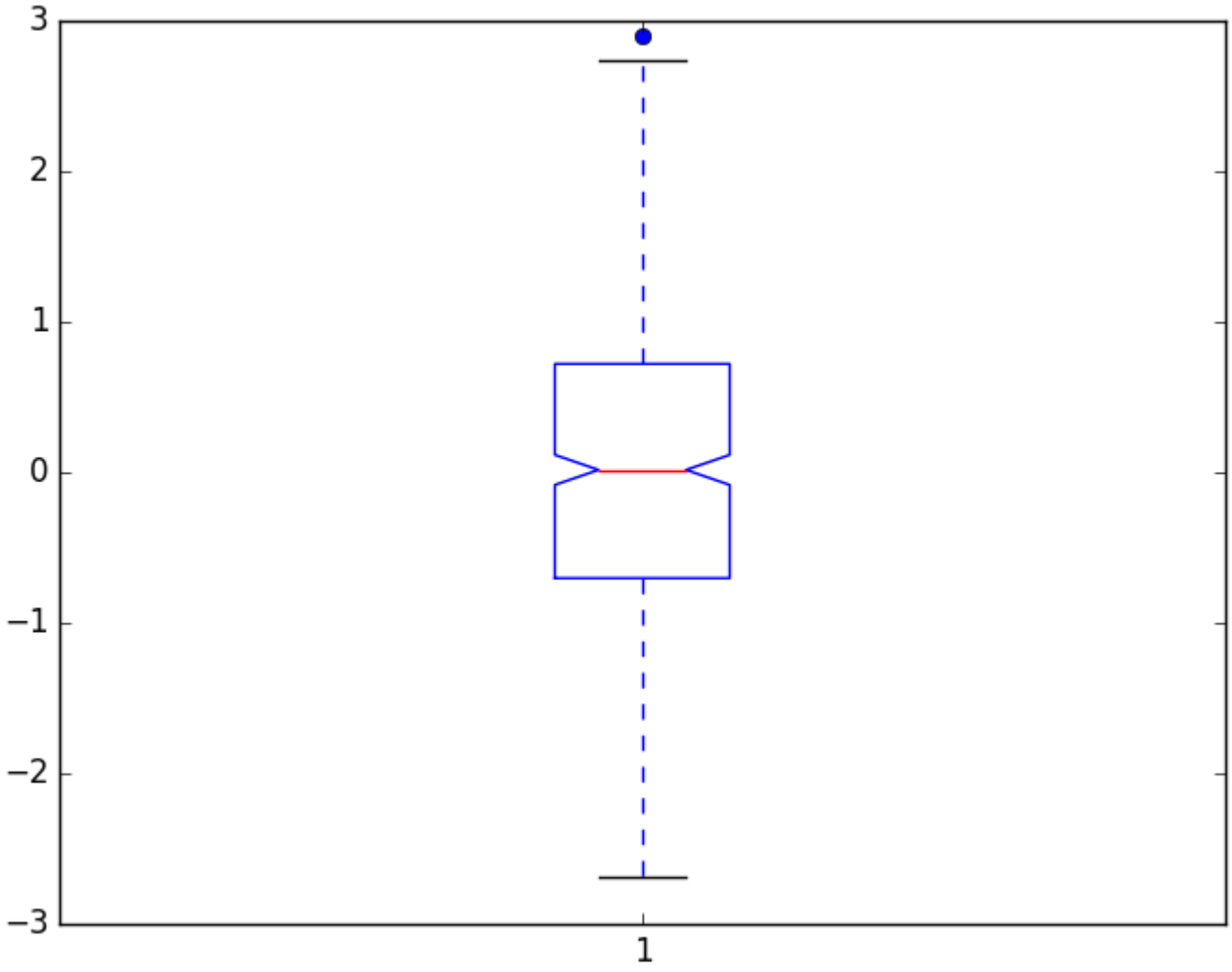
boxplot。 。 。

boxplotmatplotlib

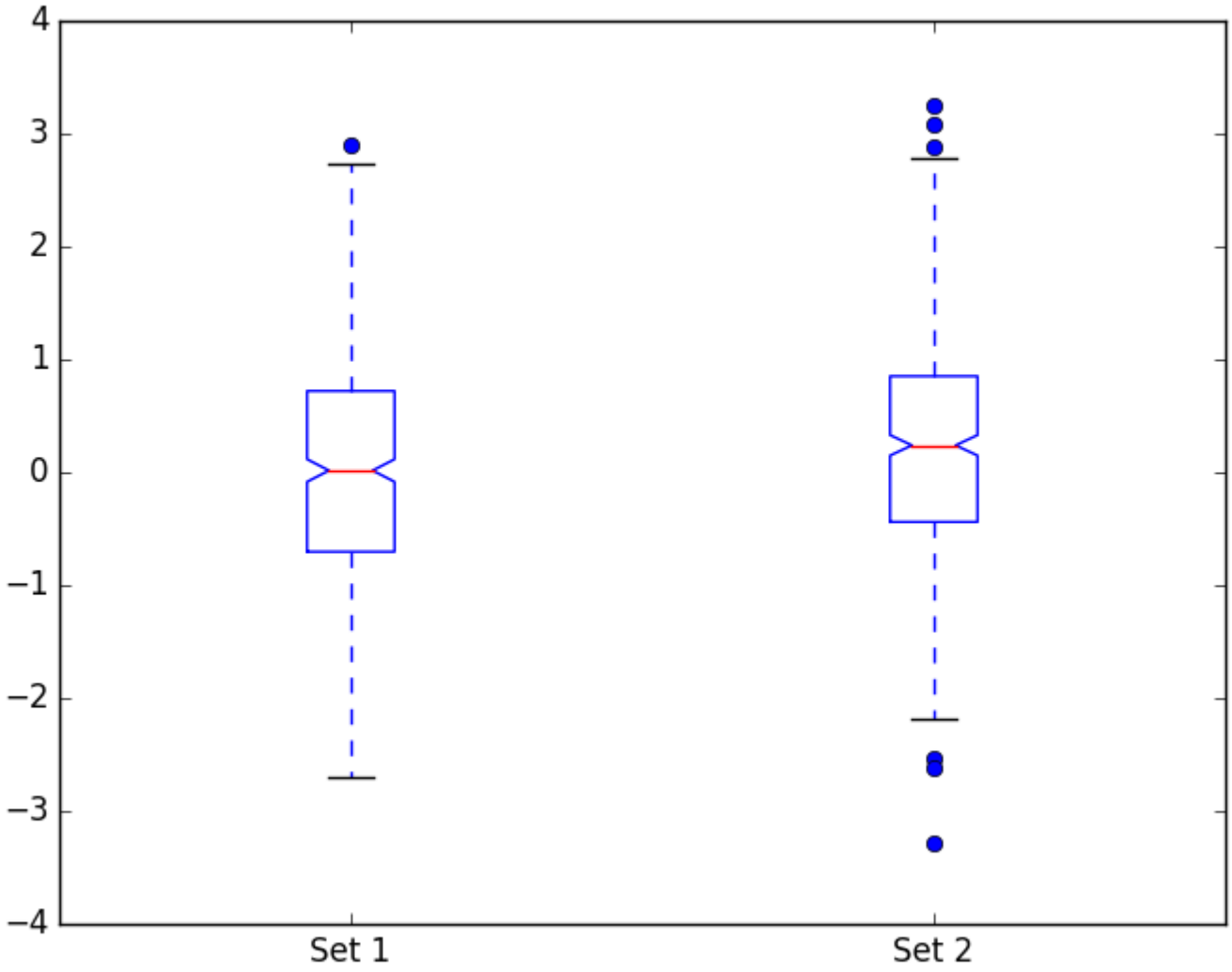
```
import matplotlib.pyplot as plt
import numpy as np

X1 = np.random.normal(0, 1, 500)
X2 = np.random.normal(0.3, 1, 500)

# The most simple boxplot
plt.boxplot(X1)
plt.show()

# Changing some of its features
plt.boxplot(X1, notch=True, sym="o") # Use sym="" to shown no fliers; also showfliers=False
plt.show()

# Showing multiple boxplots on the same window
plt.boxplot((X1, X2), notch=True, sym="o", labels=["Set 1", "Set 2"])
plt.show()

# Hidding features of the boxplot
plt.boxplot(X2, notch=False, showfliers=False, showbox=False, showcaps=False, positions=[4],
labels=["Set 2"])
plt.show()

# Advanced customization of the boxplot
line_props = dict(color="r", alpha=0.3)
bbox_props = dict(color="g", alpha=0.9, linestyle="dashdot")
flier_props = dict(marker="o", markersize=17)
plt.boxplot(X1, notch=True, whiskerprops=line_props, boxprops=bbox_props,
flierprops=flier_props)
plt.show()
```



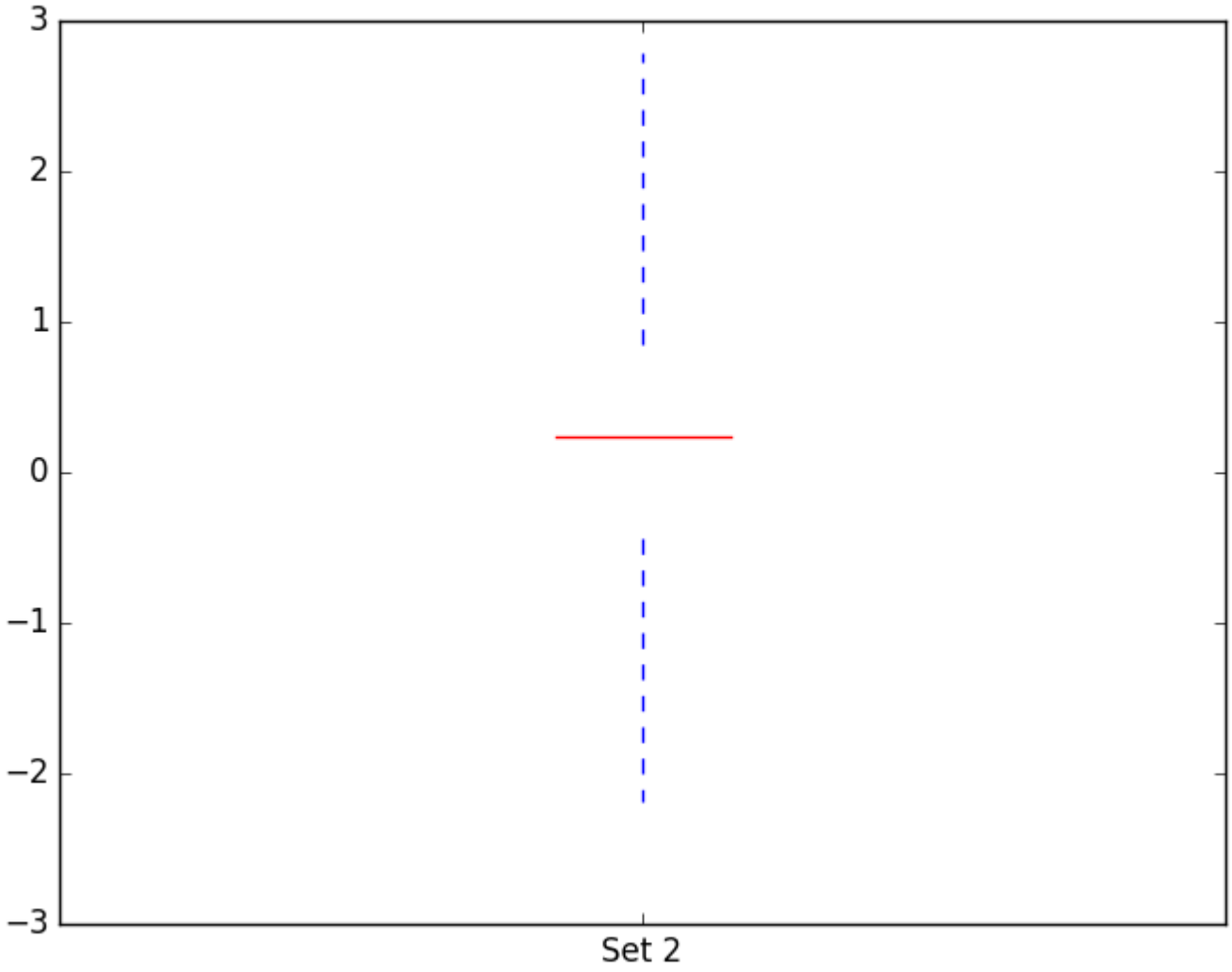
1. *matplotlib boxplot*



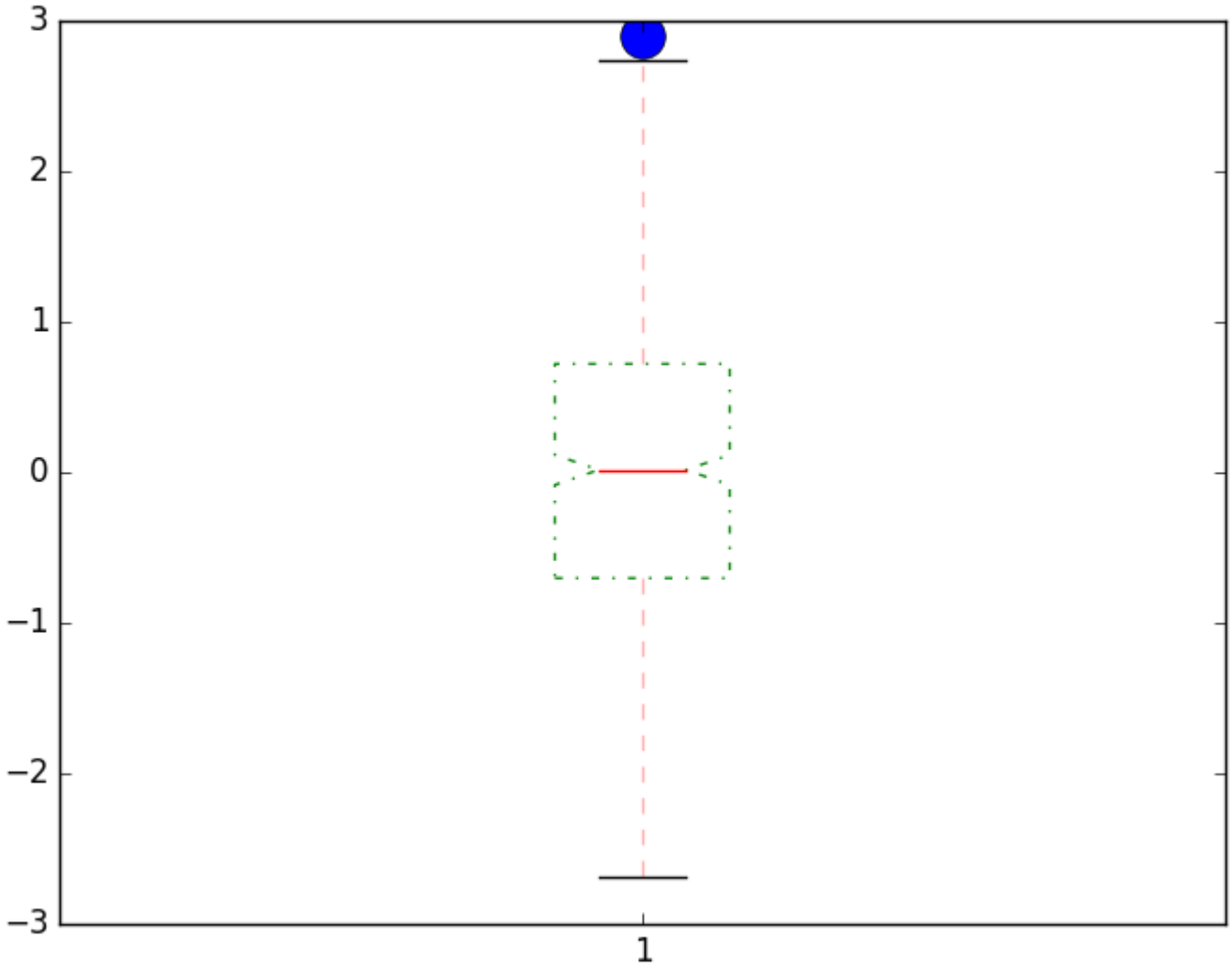
2. *boxplot*



3.



4.



5.

boxplot

```
line_props = dict(color="r", alpha=0.3)
bbox_props = dict(color="g", alpha=0.9, linestyle="dashdot")
flier_props = dict(marker="o", markersize=17)
plt.boxplot(X1, notch=True, whiskerprops=line_props, boxprops=bbox_props,
flierprops=flier_props)
plt.show()
```

...Line2D。。whiskerprops boxprops flierpropscapprops。。

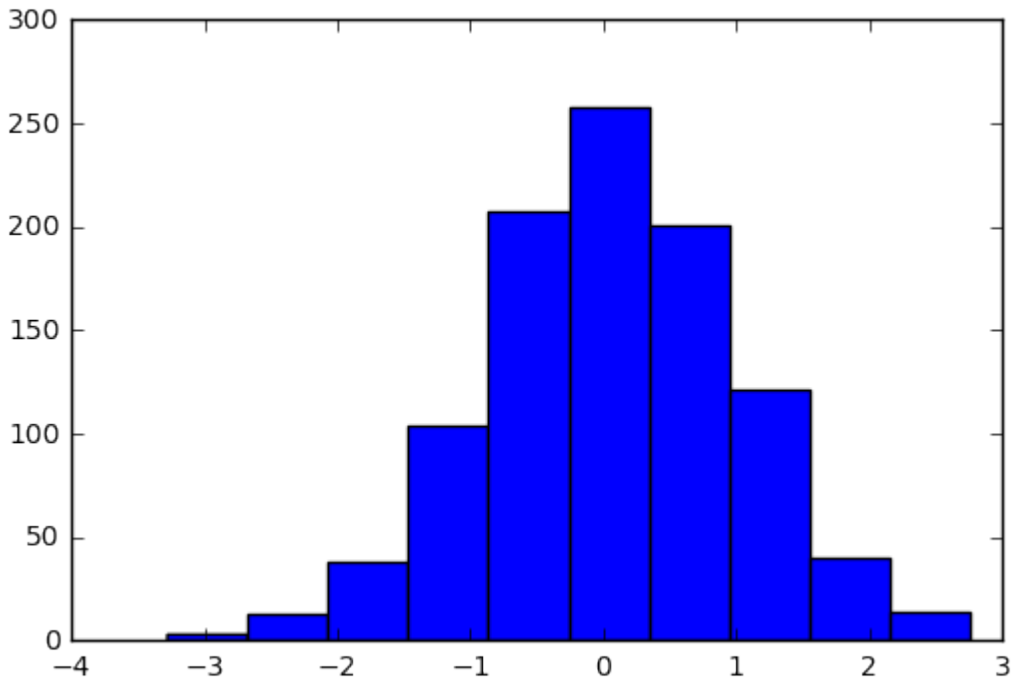
boxplot。matplotlib。

https://riptutorial.com/zh-TW/matplotlib/topic/6368/

13:

Examples

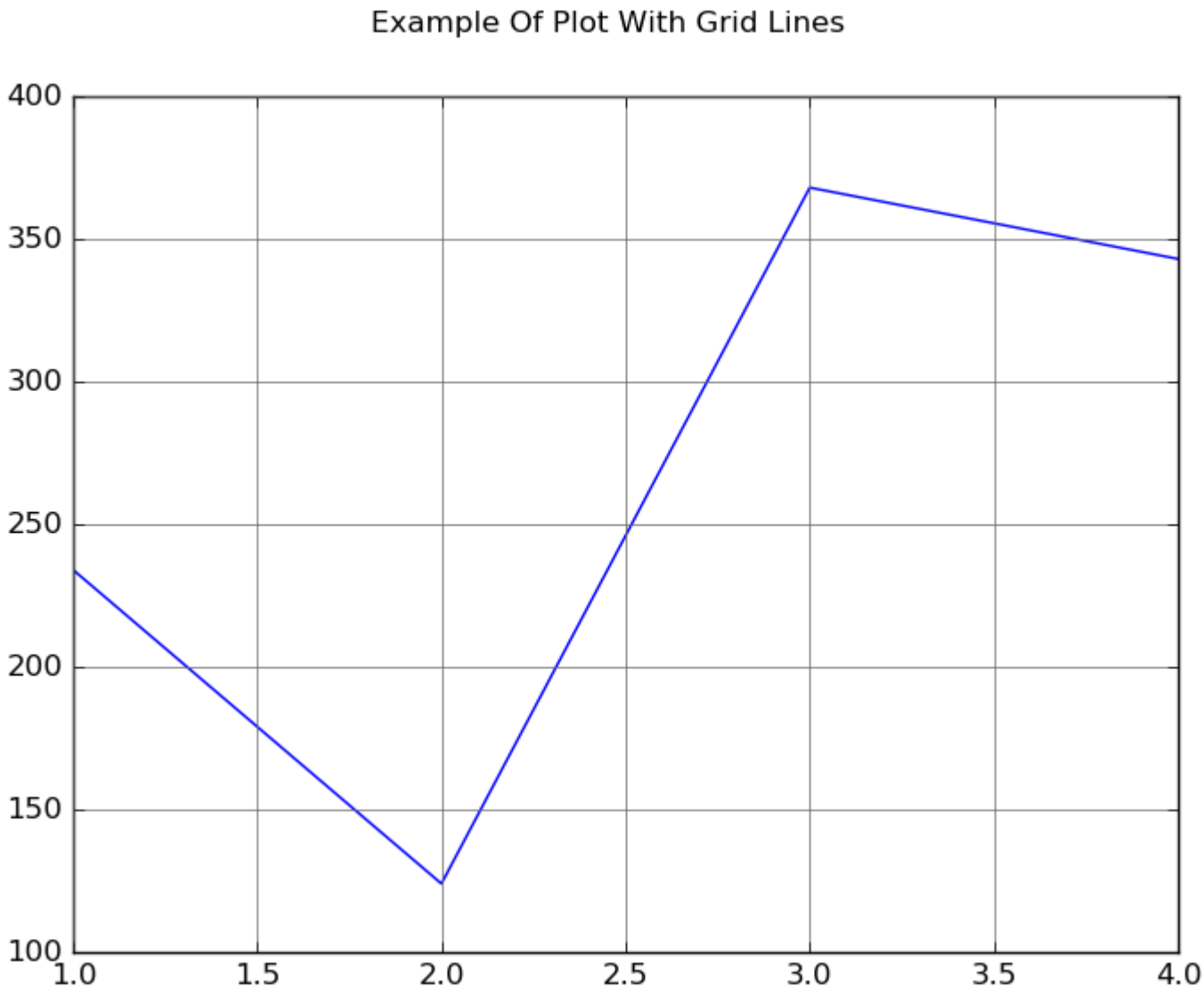
```
import matplotlib.pyplot as plt
import numpy as np

# generate 1000 data points with normal distribution
data = np.random.randn(1000)

plt.hist(data)

plt.show()
```



https://riptutorial.com/zh-TW/matplotlib/topic/7329/

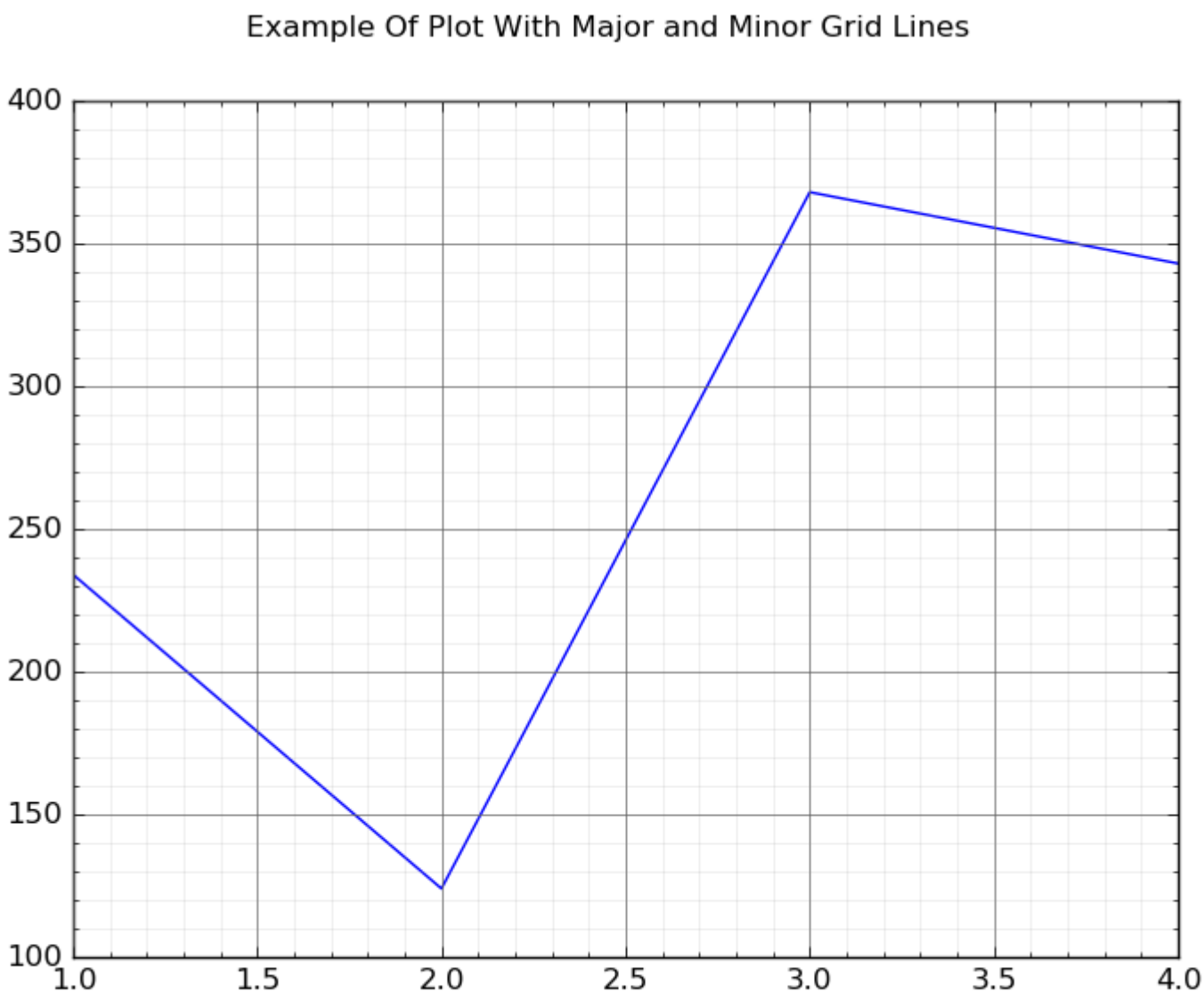
14:

Examples




```
import matplotlib.pyplot as plt

# The Data
x = [1, 2, 3, 4]
y = [234, 124,368, 343]

# Create the figure and axes objects
fig, ax = plt.subplots(1, figsize=(8, 6))
fig.suptitle('Example Of Plot With Grid Lines')

# Plot the data
ax.plot(x,y)
```

```
# Show the grid lines as dark grey lines
plt.grid(b=True, which='major', color='#666666', linestyle='-')

plt.show()
```




```
import matplotlib.pyplot as plt

# The Data
x = [1, 2, 3, 4]
y = [234, 124,368, 343]

# Create the figure and axes objects
fig, ax = plt.subplots(1, figsize=(8, 6))
fig.suptitle('Example Of Plot With Major and Minor Grid Lines')

# Plot the data
ax.plot(x,y)

# Show the major grid lines with dark grey lines
plt.grid(b=True, which='major', color='#666666', linestyle='-')
```

```
# Show the minor grid lines with very faint and almost transparent grey lines
plt.minorticks_on()
plt.grid(b=True, which='minor', color='#999999', linestyle='-', alpha=0.2)

plt.show()
```

https://riptutorial.com/zh-TW/matplotlib/topic/4029/

15: TeX / LaTeX

- MatplotlibLaTeXLaTeXdvipngLaTeXGhostscriptGPL Ghostscript 8.60。
- MatplotlibpgfLaTeXTikZ / PGFTeXLiveXeLaTeXLuaLaTeX。

Examples

TeX

`rc`TeX

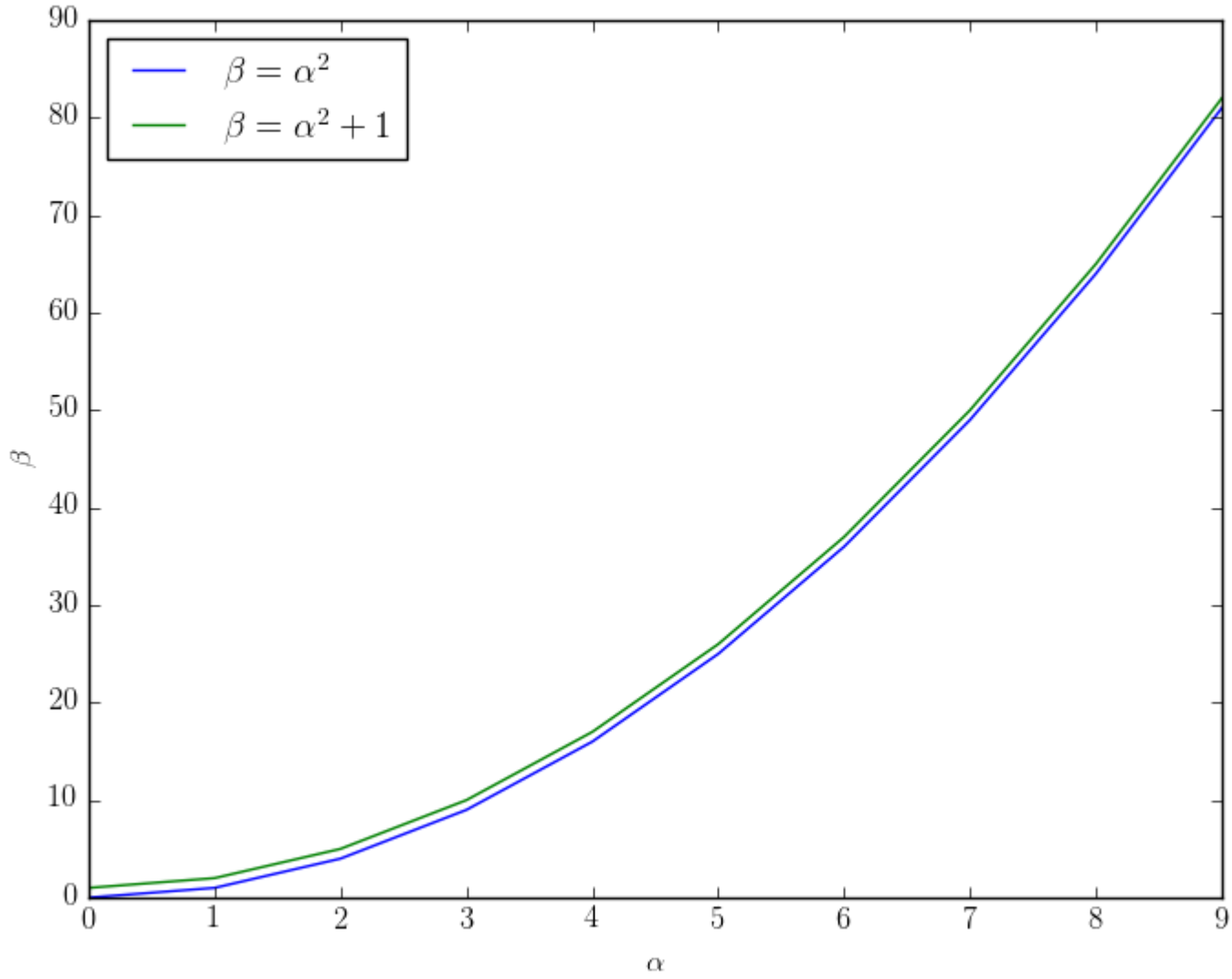
```
import matplotlib.pyplot as plt
plt.rc(usetex = True)
```

`rcParams`

```
import matplotlib.pyplot as plt
params = {'tex.usetex': True}
plt.rcParams.update(params)
```

TeX\ Python。 Python

```
plt.xlabel('\\alpha')
plt.xlabel(r'\alpha')
```




```
import matplotlib.pyplot as plt
plt.rc(usetex = True)
x = range(0,10)
y = [t**2 for t in x]
z = [t**2+1 for t in x]
plt.plot(x, y, label = r'$\beta=\alpha^2$')
plt.plot(x, z, label = r'$\beta=\alpha^2+1$')
plt.xlabel(r'$\alpha$')
plt.ylabel(r'$\beta$')
plt.legend(loc=0)
plt.show()
```

```
$$...$$\begin{equation}...\end{equation} ◦ \displaystyle◦
```

```
tex.latex.preamble
```

```
params = {'text.latex.preamble' : [r'\usepackage{siunitx}', r'\usepackage{amsmath}']}
plt.rcParams.update(params)
```

matplotlibrc

```
#text.latex.preamble : # IMPROPER USE OF THIS FEATURE WILL LEAD TO LATEX FAILURES
                       # AND IS THEREFORE UNSUPPORTED. PLEASE DO NOT ASK FOR HELP
                       # IF THIS FEATURE DOES NOT DO WHAT YOU EXPECT IT TO.
                       # preamble is a comma separated list of LaTeX statements
                       # that are included in the LaTeX document preamble.
                       # An example:
                       # text.latex.preamble : \usepackage{bm},\usepackage{euler}
                       # The following packages are always loaded with usetex, so
                       # beware of package collisions: color, geometry, graphicx,
                       # type1cm, textcomp. Adobe Postscript (PSSNFS) font packages
                       # may also be loaded, depending on your font settings
```

TeX

TeXmatplotlib`pdfeps`。 TeX。

```
import matplotlib.pyplot as plt
plt.rc(usetex=True)
x = range(0, 10)
y = [t**2 for t in x]
z = [t**2+1 for t in x]
plt.plot(x, y, label=r'$\beta=\alpha^2$')
plt.plot(x, z, label=r'$\beta=\alpha^2+1$')
plt.xlabel(r'$\alpha$')
plt.ylabel(r'$\beta$')
plt.legend(loc=0)
plt.savefig('my_pdf_plot.pdf')  # Saving plot to pdf file
plt.savefig('my_eps_plot.eps')  # Saving plot to eps file
```

`pgf`matplotlibTeX。

```
import matplotlib.pyplot as plt
plt.rc(usetex=True)
x = range(0, 10)
y = [t**2 for t in x]
z = [t**2+1 for t in x]
plt.plot(x, y, label=r'$\beta=\alpha^2$')
plt.plot(x, z, label=r'$\beta=\alpha^2+1$')
plt.xlabel(r'$\alpha$')
plt.ylabel(r'$\beta$')
plt.legend(loc=0)
plt.savefig('my_pgf_plot.pgf')
```

`rc`TeX

```
plt.rc('pgf', texsystem='pdflatex')  # or luatex, xelatex...
```

`.pgf`LaTeX

```
\usepackage{pgf}
\input{my_pgf_plot.pgf}
```

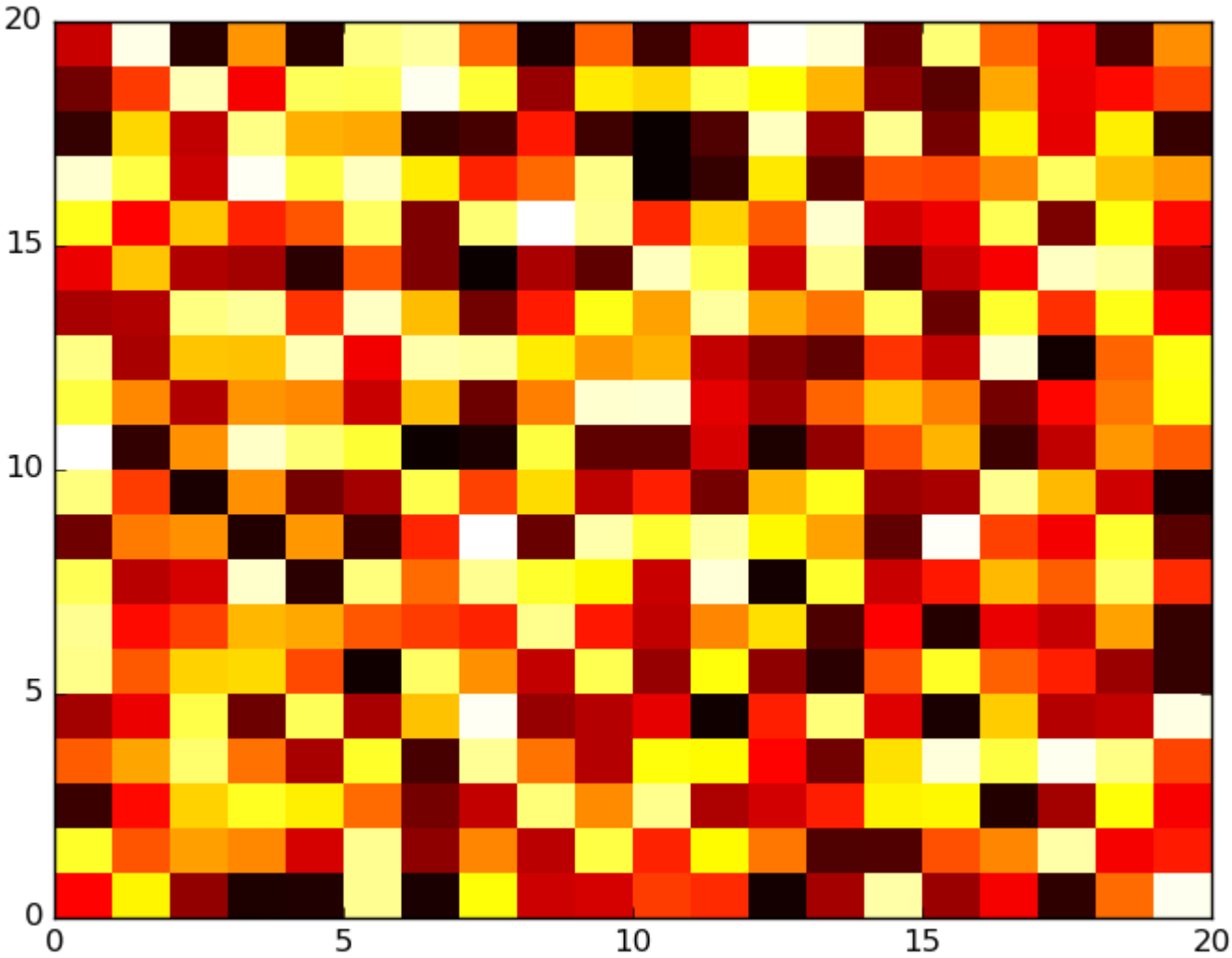
TeX / LaTeX https://riptutorial.com/zh-TW/matplotlib/topic/2962/tex---latex

16:

Examples

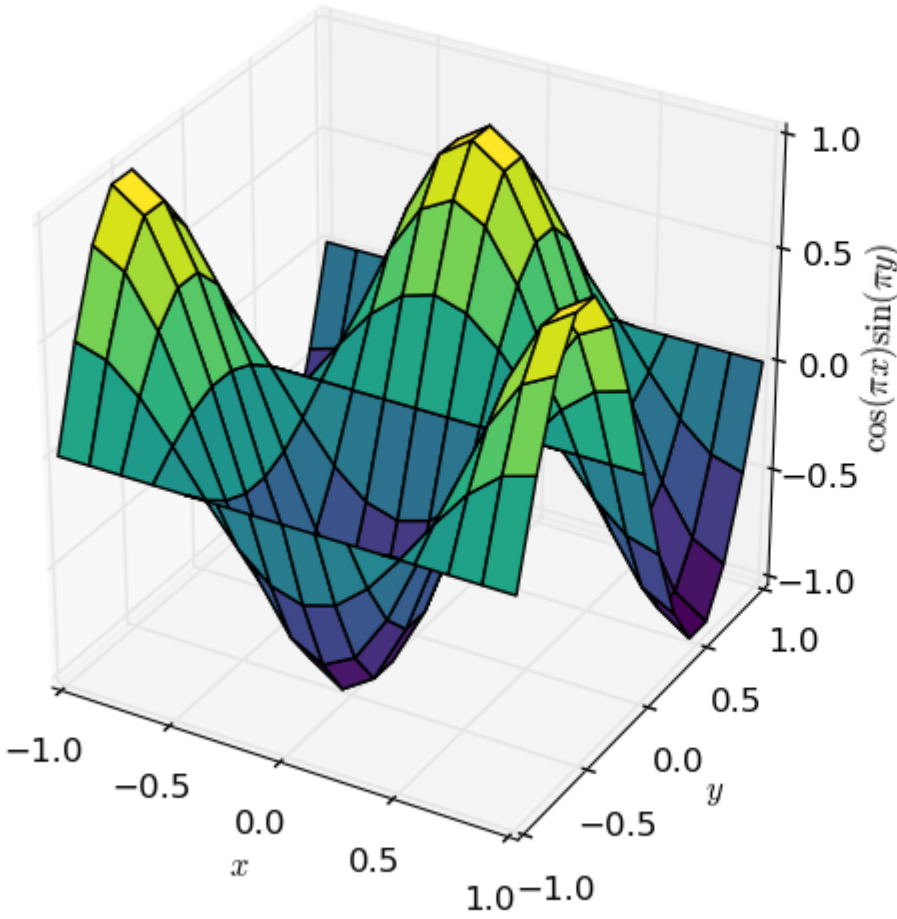
colormaps `pcolormeshcontourf` `cmap`

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

plt.figure()
plt.pcolormesh(np.random.rand(20,20),cmap='hot')
plt.show()
```




```
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
from matplotlib.ticker import LinearLocator

# generate example data
```

```
import numpy as np
x,y = np.meshgrid(np.linspace(-1,1,15),np.linspace(-1,1,15))
z = np.cos(x*np.pi)*np.sin(y*np.pi)

# actual plotting example
fig = plt.figure()
ax1 = fig.add_subplot(121, projection='3d')
ax1.plot_surface(x,y,z,rstride=1,cstride=1,cmap='viridis')
ax2 = fig.add_subplot(122)
cf = ax2.contourf(x,y,z,51,vmin=-1,vmax=1,cmap='viridis')
cbar = fig.colorbar(cf)
cbar.locator = LinearLocator(numticks=11)
cbar.update_ticks()
for ax in {ax1, ax2}:
    ax.set_xlabel(r'$x$')
    ax.set_ylabel(r'$y$')
    ax.set_xlim([-1,1])
    ax.set_ylim([-1,1])
    ax.set_aspect('equal')

ax1.set_zlim([-1,1])
ax1.set_zlabel(r'$\cos(\pi x) \sin(\p    i y)$')

plt.show()
```

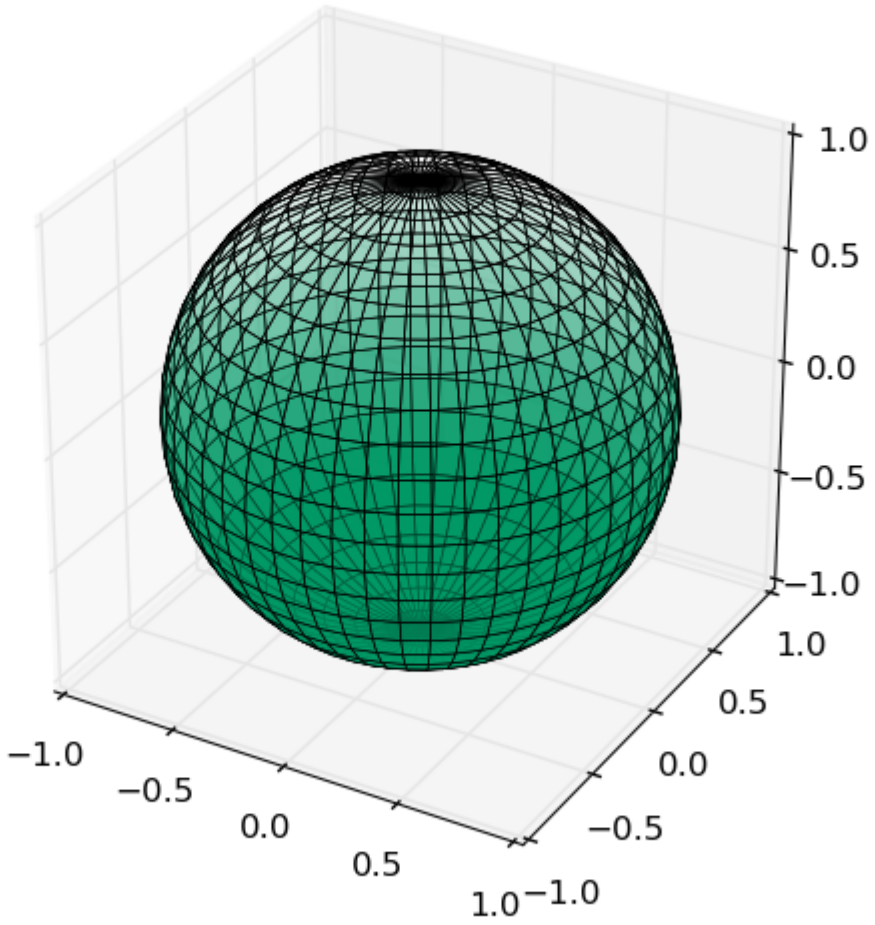


colormaps`'_r''_r'` ◦ `matplotlib.cm`◦

`cm.register_cmap`alpha◦ colormap`cm`register_cmapcolormap`plot_surface` ◦

```
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
import matplotlib.cm as cm

# generate data for sphere
from numpy import pi,meshgrid,linspace,sin,cos
th,ph = meshgrid(linspace(0,pi,25),linspace(0,2*pi,51))
x,y,z = sin(th)*cos(ph),sin(th)*sin(ph),cos(th)

# define custom colormap with fixed colour and alpha gradient
# use simple linear interpolation in the entire scale
cm.register_cmap(name='alpha_gradient',
                 data={'red':   [(0.,0,0),
                                 (1.,0,0)],

                       'green': [(0.,0.6,0.6),
                                 (1.,0.6,0.6)],
```

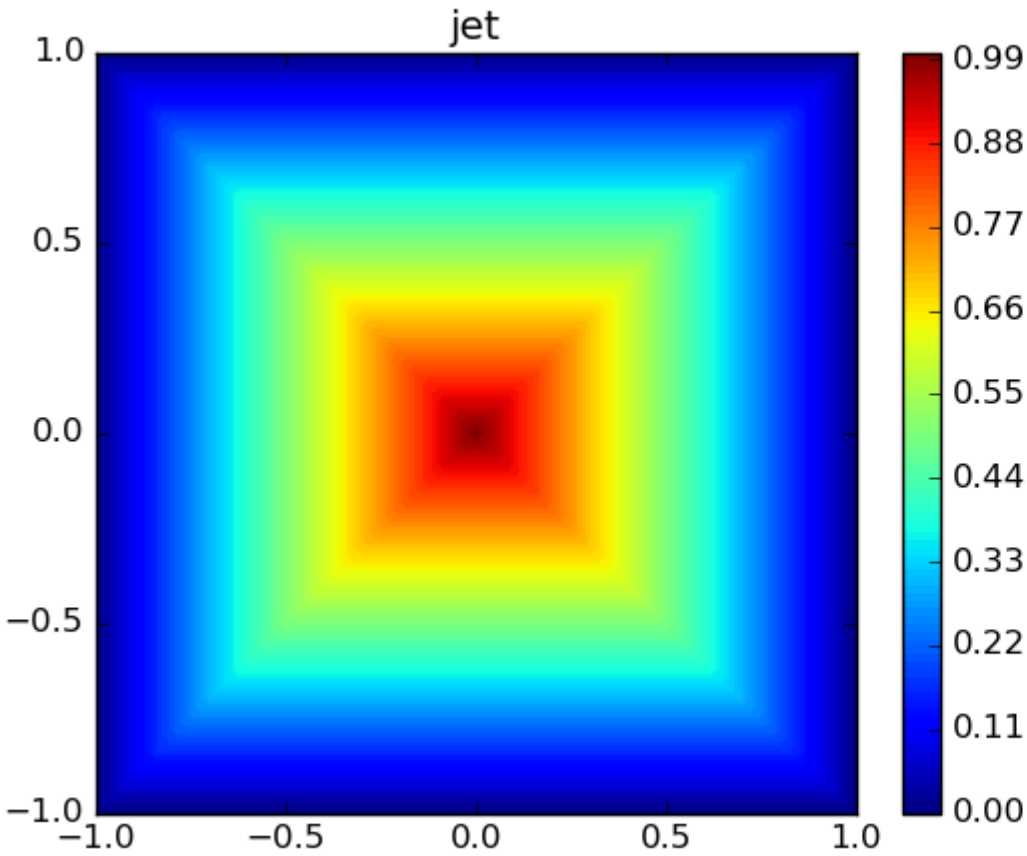
```
                        'blue':  [(0.,0.4,0.4),
                                  (1.,0.4,0.4)],

                        'alpha': [(0.,1,1),
                                  (1.,0,0)]})

# plot sphere with custom colormap; constrain mapping to between |z|=0.7 for enhanced effect
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
ax.plot_surface(x,y,z,cmap='alpha_gradient',vmin=-
0.7,vmax=0.7,rstride=1,cstride=1,linewidth=0.5,edgecolor='b')
ax.set_xlim([-1,1])
ax.set_ylim([-1,1])
ax.set_zlim([-1,1])
ax.set_aspect('equal')

plt.show()
```



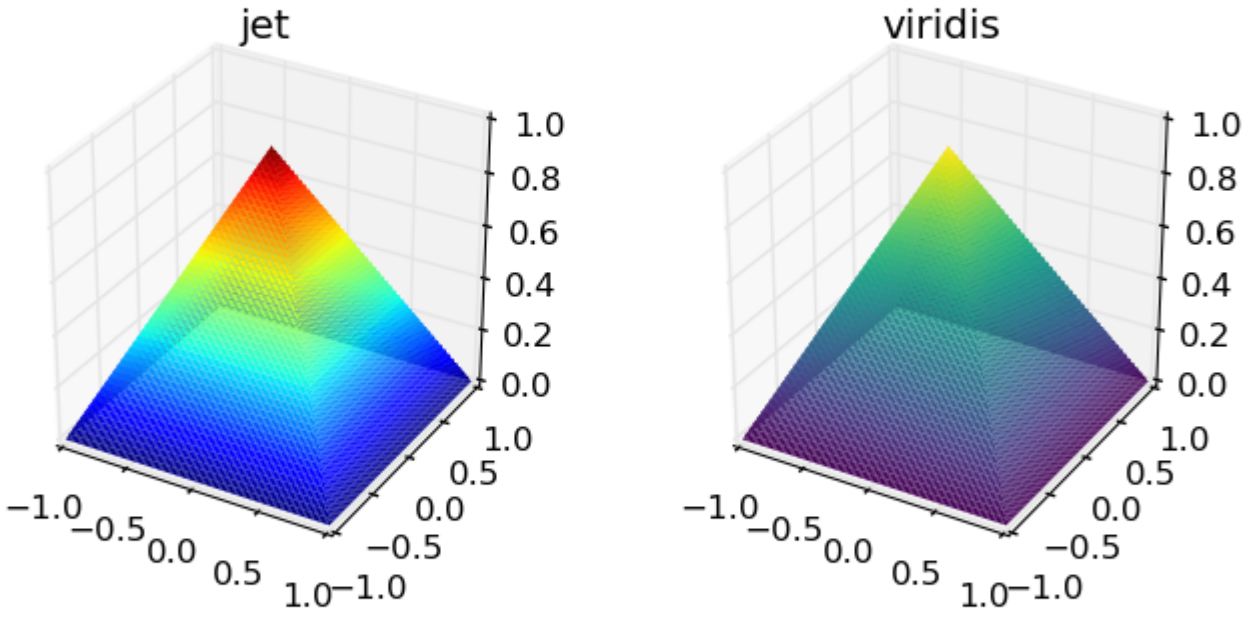
R / G / B/ Amatplotlib。

MATLABR2014b`jet` matplotlib。 。 ;。

◦ Matplotlib1.5 `viridis` 2.0◦ `viridis` `inferno` `plasmamagma` ◦ ◦



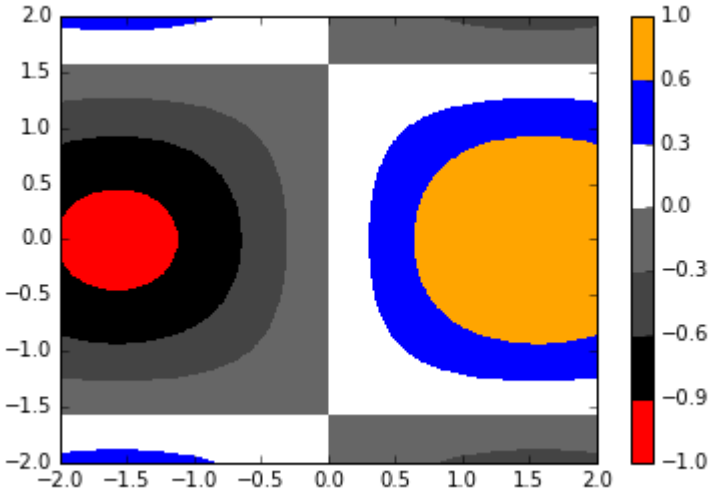
`jet` colormap



。

。

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

x = np.linspace(-2,2,500)
y = np.linspace(-2,2,500)
XX, YY = np.meshgrid(x, y)
Z = np.sin(XX) * np.cos(YY)

cmap = colors.ListedColormap(['red', '#000000','#444444', '#666666', '#ffffff', 'blue',
'orange'])
boundaries = [-1, -0.9, -0.6, -0.3, 0, 0.3, 0.6, 1]
norm = colors.BoundaryNorm(boundaries, cmap.N, clip=True)

plt.pcolormesh(x,y,Z, cmap=cmap, norm=norm)
plt.colorbar()
plt.show()
```



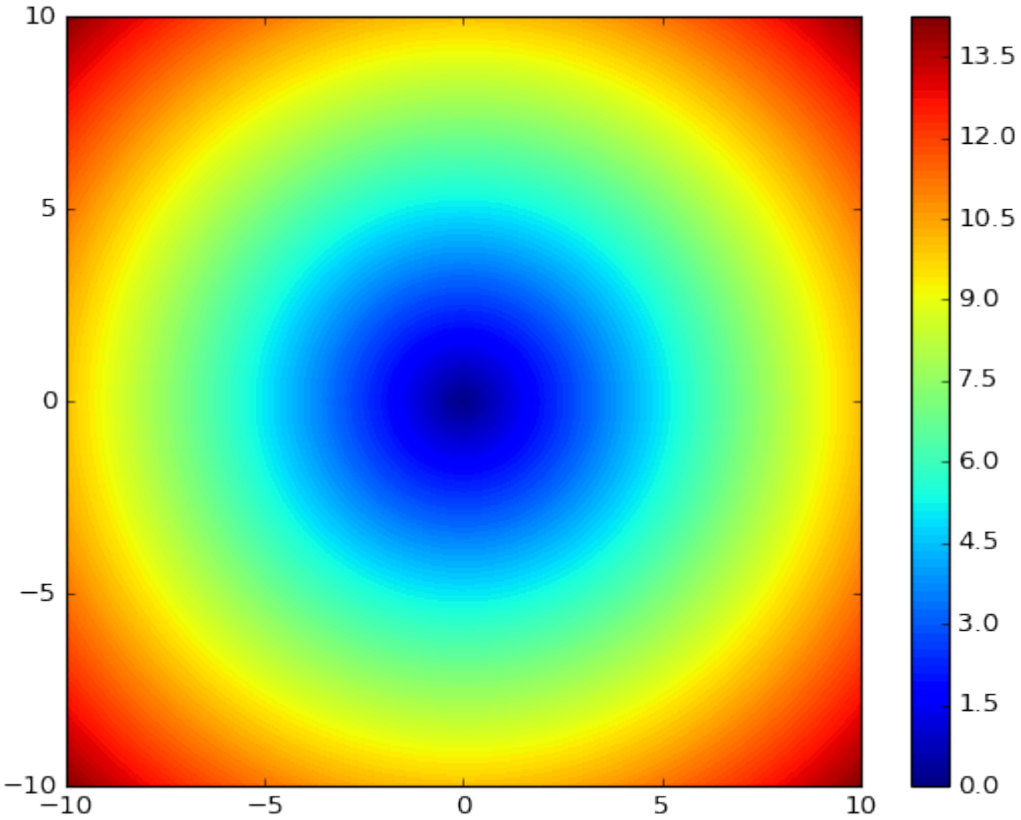
iii + *1*。 `'red'` `'green'` HTML `'#ffaa44'` `'#441188'` RGB `(0.2, 0.9, 0.45)` `'#441188'` `(0.2, 0.9, 0.45)` 。

https://riptutorial.com/zh-TW/matplotlib/topic/3385/

17:

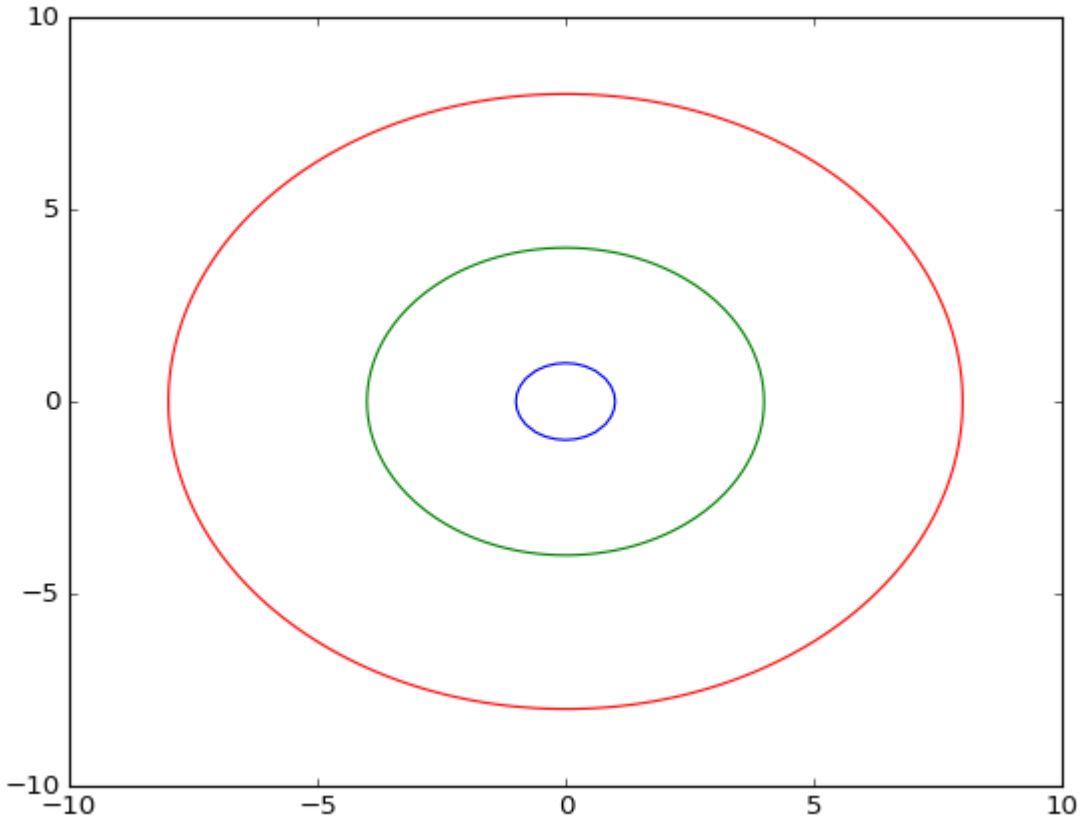
Examples

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

# generate 101 x and y values between -10 and 10
x = np.linspace(-10, 10, 101)
y = np.linspace(-10, 10, 101)

# make X and Y matrices representing x and y values of 2d plane
X, Y = np.meshgrid(x, y)

# compute z value of a point as a function of x and y (z = l2 distance form 0,0)
Z = np.sqrt(X ** 2 + Y ** 2)

# plot filled contour map with 100 levels
cs = plt.contourf(X, Y, Z, 100)

# add default colorbar for the map
plt.colorbar(cs)
```




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

```
# generate 101 x and y values between -10 and 10
x = np.linspace(-10, 10, 101)
y = np.linspace(-10, 10, 101)

# make X and Y matrices representing x and y values of 2d plane
X, Y = np.meshgrid(x, y)

# compute z value of a point as a function of x and y (z = l2 distance form 0,0)
Z = np.sqrt(X ** 2 + Y ** 2)

# plot contour map with 3 levels
# colors: up to 1 - blue,  from 1 to 4 - green, from 4 to 8 - red
plt.contour(X, Y, Z, [1, 4, 8], colors=['b', 'g', 'r'])
```



https://riptutorial.com/zh-TW/matplotlib/topic/8644/

18:

- plt.close
- plt.close'fig'
- plt.closenum'num'
- plt.closename'name'
- plt.close'all'

Examples

pyplot

`matplotlib`pyplot。

```
import matplotlib.pyplot as plt
plt.plot([0, 1], [0, 1])
plt.close()
```

plt.close

```
import matplotlib.pyplot as plt

fig1 = plt.figure() # create first figure
plt.plot([0, 1], [0, 1])

fig2 = plt.figure() # create second figure
plt.plot([0, 1], [0, 1])

plt.close(fig1) # close first figure although second one is active
```

https://riptutorial.com/zh-TW/matplotlib/topic/6628/

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