Matplotlib simple test

```
library(reticulate)
reticulate::use_python("..\\..\\python-3.6.7.amd64\\python.exe")
reticulate::py_config()
```

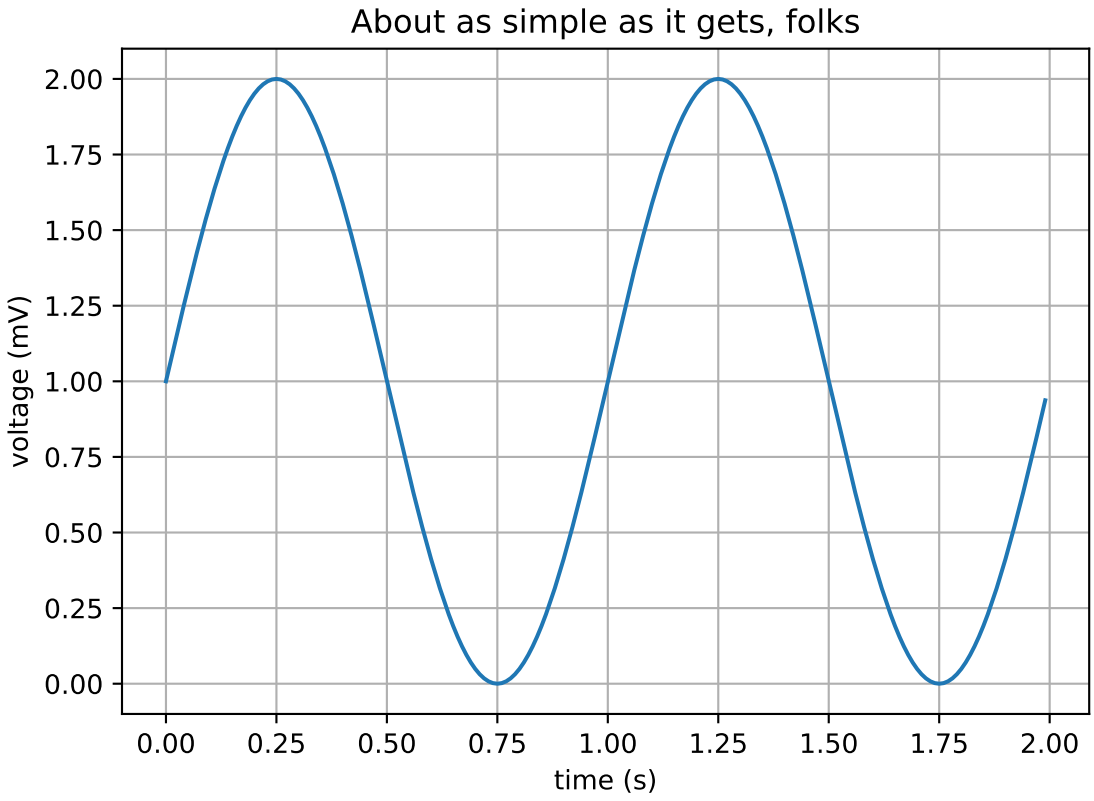
```
python:         ..\..\python-3.6.7.amd64\python.exe
libpython:      ../../python-3.6.7.amd64/python36.dll
pythonhome:     C:\Users\ipm\WPY-36~1\PYTHON~1.AMD
version:        3.6.7 (v3.6.7:6ec5cf24b7, Oct 20 2018, 13:35:33) [MSC v.1900 64 bit (AMD64)]
Architecture:   64bit
numpy:          C:\Users\ipm\WPY-36~1\PYTHON~1.AMD\lib\site-packages\numpy
numpy_version:  1.15.4

python versions found:
 ..\..\python-3.6.7.amd64\python.exe
 C:\Users\ipm\WPY-36~1\PYTHON~1.AMD\python.exe
 C:\Users\ipm\ANACON~2\python.exe
 C:\Users\ipm\Anaconda2\python.exe
 C:\Users\ipm\Anaconda2\envs\py27\python.exe
 C:\Users\ipm\Anaconda2\envs\py27-qt5\python.exe
```

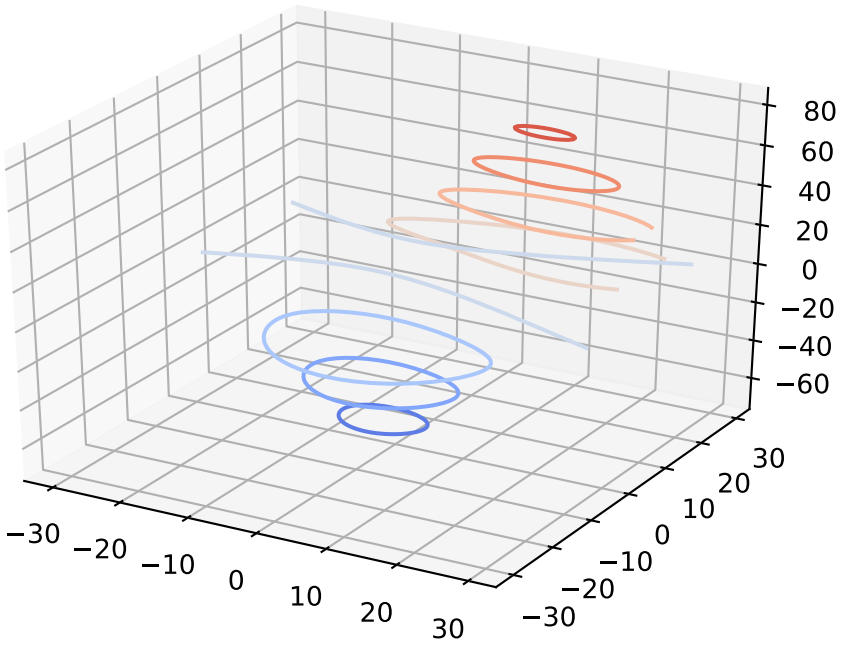
```
reticulate::py_available()
```

```
[1] TRUE
```

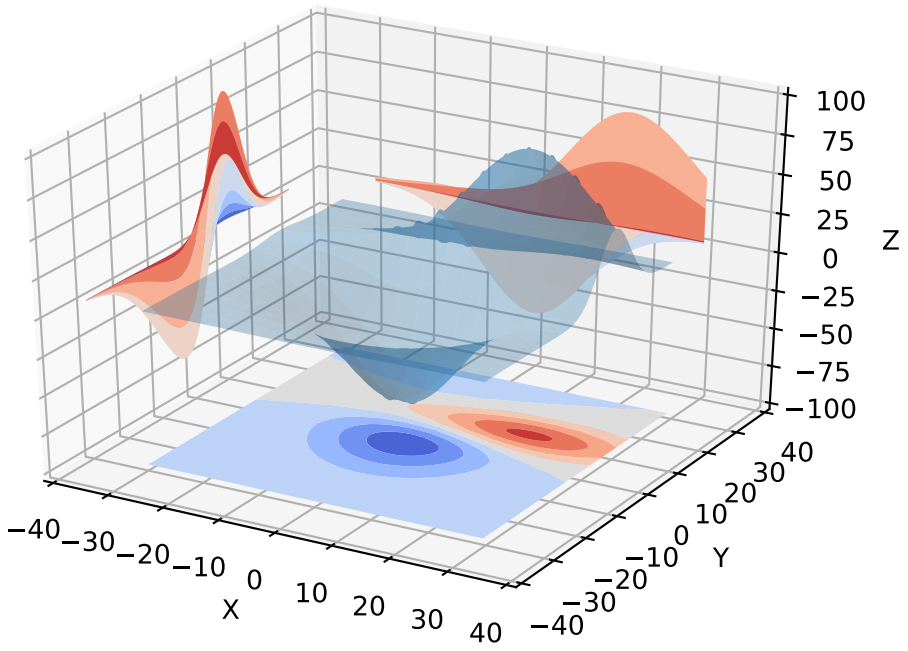
```
import matplotlib.pyplot as plt
import numpy as np
t = np.arange(0.0, 2.0, 0.01)
s = 1 + np.sin(2*np.pi*t)
plt.plot(t, s)
plt.xlabel('time (s)')
plt.ylabel('voltage (mV)')
plt.title('About as simple as it gets, folks')
plt.grid(True)
plt.savefig("test.png")
plt.show()
```




```
# https://matplotlib.org/2.0.2/examples/mplot3d/contour3d_demo.html
from mpl_toolkits.mplot3d import axes3d
import matplotlib.pyplot as plt
from matplotlib import cm
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
X, Y, Z = axes3d.get_test_data(0.05)
cset = ax.contour(X, Y, Z, cmap=cm.coolwarm)
ax.clabel(cset, fontsize=9, inline=1)
plt.show()
```

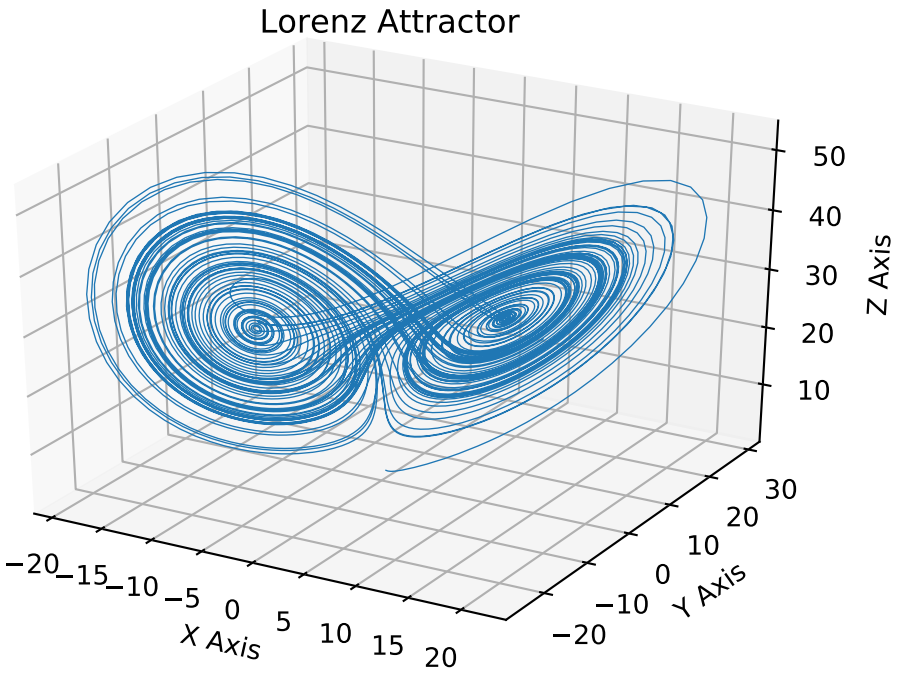



```
from mpl_toolkits.mplot3d import axes3d
import matplotlib.pyplot as plt
from matplotlib import cm
fig = plt.figure()
ax = fig.gca(projection='3d')
X, Y, Z = axes3d.get_test_data(0.05)
ax.plot_surface(X, Y, Z, rstride=8, cstride=8, alpha=0.3)
cset = ax.contourf(X, Y, Z, zdir='z', offset=-100, cmap=cm.coolwarm)
cset = ax.contourf(X, Y, Z, zdir='x', offset=-40, cmap=cm.coolwarm)
cset = ax.contourf(X, Y, Z, zdir='y', offset=40, cmap=cm.coolwarm)
ax.set_xlabel('X')
ax.set_xlim(-40, 40)
ax.set_ylabel('Y')
ax.set_ylim(-40, 40)
ax.set_zlabel('Z')
ax.set_zlim(-100, 100)
plt.show()
```



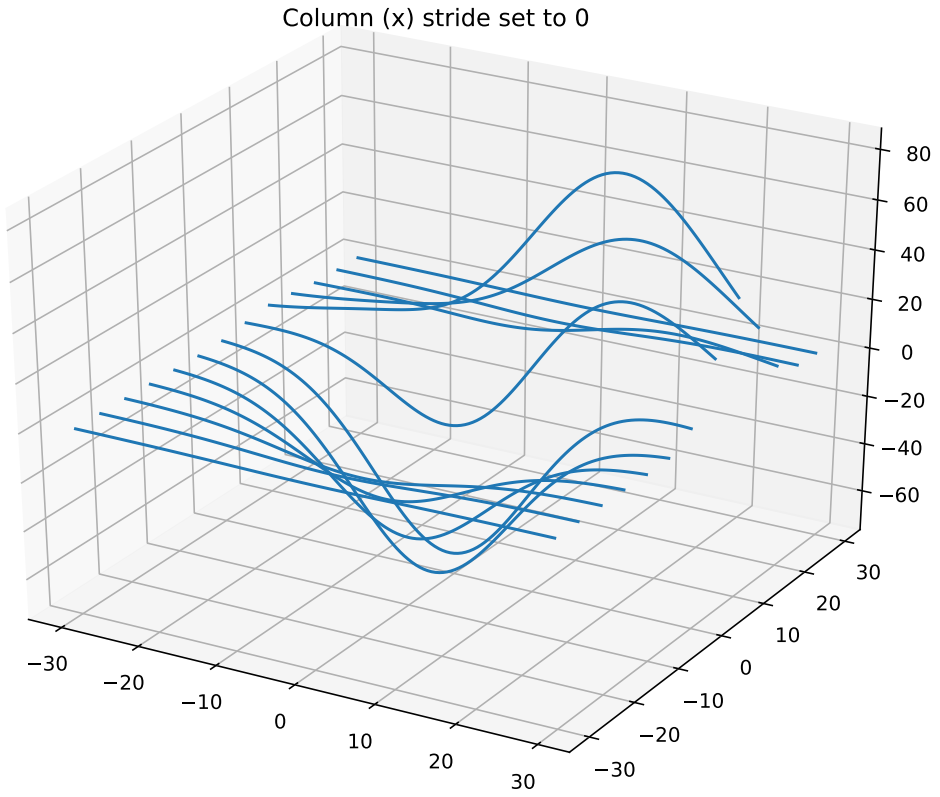

```
# Plot of the Lorenz Attractor based on Edward Lorenz's 1963 "Deterministic
# Nonperiodic Flow" publication.
# http://journals.ametsoc.org/doi/abs/10.1175/1520-0469%281963%29020%3C0130%3ADNF%3E2.0.CO%3B2
import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
def lorenz(x, y, z, s=10, r=28, b=2.667):
    x_dot = s*(y - x)
    y_dot = r*x - y - x*z
    z_dot = x*y - b*z
    return x_dot, y_dot, z_dot
dt = 0.01
stepCnt = 10000
# Need one more for the initial values
xs = np.empty((stepCnt + 1,))
ys = np.empty((stepCnt + 1,))
zs = np.empty((stepCnt + 1,))
# Setting initial values
xs[0], ys[0], zs[0] = (0., 1., 1.05)
# Stepping through "time".
for i in range(stepCnt):
    # Derivatives of the X, Y, Z state
    x_dot, y_dot, z_dot = lorenz(xs[i], ys[i], zs[i])
    xs[i + 1] = xs[i] + (x_dot * dt)
    ys[i + 1] = ys[i] + (y_dot * dt)
    zs[i + 1] = zs[i] + (z_dot * dt)
```

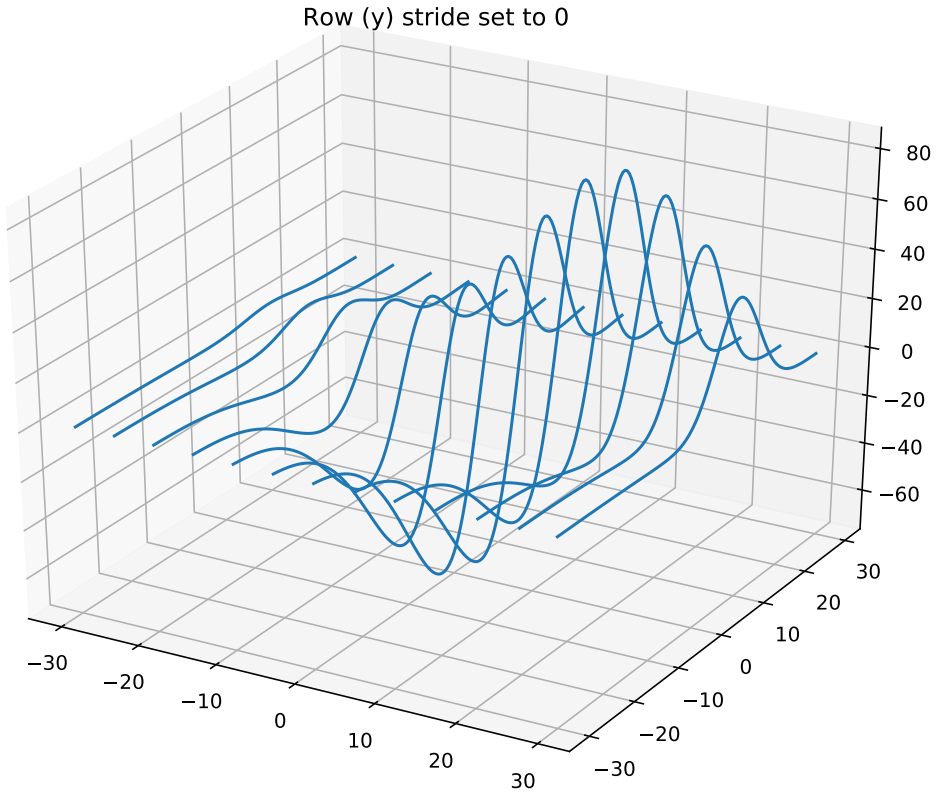
```
fig = plt.figure()
ax = fig.gca(projection='3d')
ax.plot(xs, ys, zs, lw=0.5)
ax.set_xlabel("X Axis")
ax.set_ylabel("Y Axis")
ax.set_zlabel("Z Axis")
ax.set_title("Lorenz Attractor")
plt.show()
```



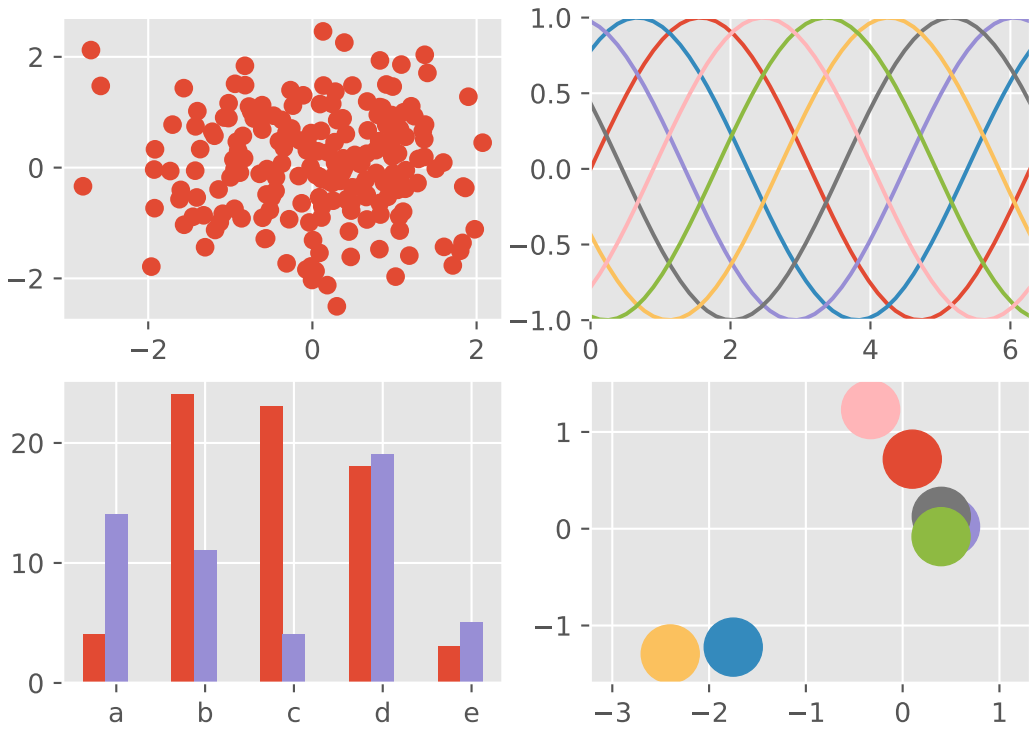

```
# ====================================
# 3D wireframe plots in one direction
# ====================================
# Demonstrates that setting rstride or cstride to 0 causes wires to not be
# generated in the corresponding direction.
from mpl_toolkits.mplot3d import axes3d
import matplotlib.pyplot as plt
fig, [ax1, ax2] = plt.subplots(2, 1, figsize=(8, 12), subplot_kw={'projection': '3d'})
# Get the test data
X, Y, Z = axes3d.get_test_data(0.05)
# Give the first plot only wireframes of the type y = c
ax1.plot_wireframe(X, Y, Z, rstride=10, cstride=0)
ax1.set_title("Column (x) stride set to 0")
# Give the second plot only wireframes of the type x = c
ax2.plot_wireframe(X, Y, Z, rstride=0, cstride=10)
ax2.set_title("Row (y) stride set to 0")
plt.tight_layout()
```

```
plt.show()
```


Column (x) stride set to 0
80
60
40
20
0
−20
−40
−60
−30
−20
−10
0
10
20
30
−30
−20
−10
0
10
20
30

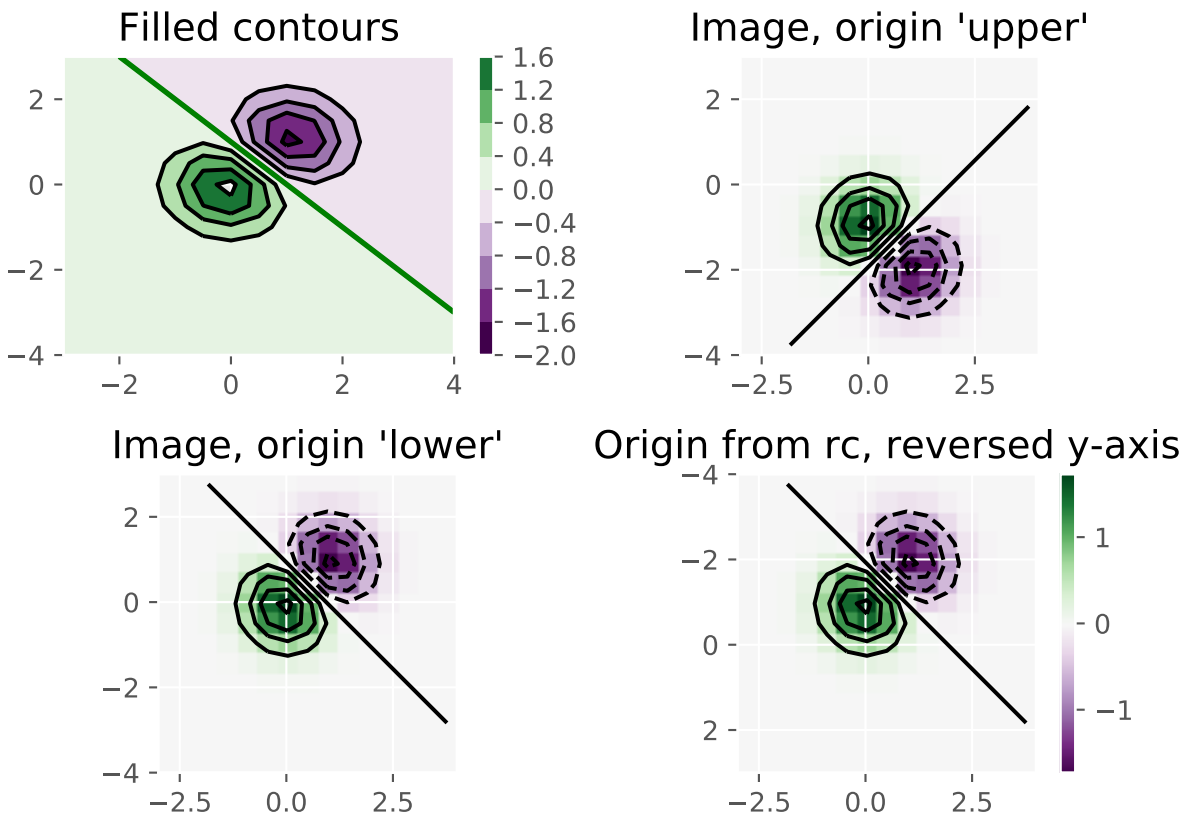

Row (y) stride set to 0
80
60
40
20
0
−20
−40
−60
−30
−20
−10
0
10
20
30
−30
−20
−10
0
10
20
30

```
import numpy as np
import matplotlib.pyplot as plt
plt.style.use('ggplot')
fig, axes = plt.subplots(ncols=2, nrows=2)
ax1, ax2, ax3, ax4 = axes.ravel()
# scatter plot (Note: `plt.scatter` doesn't use default colors)
x, y = np.random.normal(size=(2, 200))
ax1.plot(x, y, 'o')
# sinusoidal lines with colors from default color cycle
L = 2*np.pi
x = np.linspace(0, L)
ncolors = len(plt.rcParams['axes.prop_cycle'])
shift = np.linspace(0, L, ncolors, endpoint=False)
for s in shift:
    ax2.plot(x, np.sin(x + s), '-')
ax2.margins(0)
# bar graphs
x = np.arange(5)
y1, y2 = np.random.randint(1, 25, size=(2, 5))
width = 0.25
ax3.bar(x, y1, width)
ax3.bar(x + width, y2, width,
        color=list(plt.rcParams['axes.prop_cycle'])[2]['color'])
ax3.set_xticks(x + width)
ax3.set_xticklabels(['a', 'b', 'c', 'd', 'e'])
# circles with colors from default color cycle
for i, color in enumerate(plt.rcParams['axes.prop_cycle']):
    xy = np.random.normal(size=2)
    ax4.add_patch(plt.Circle(xy, radius=0.3, color=color['color']))
ax4.axis('equal')
ax4.margins(0)
plt.show()
```

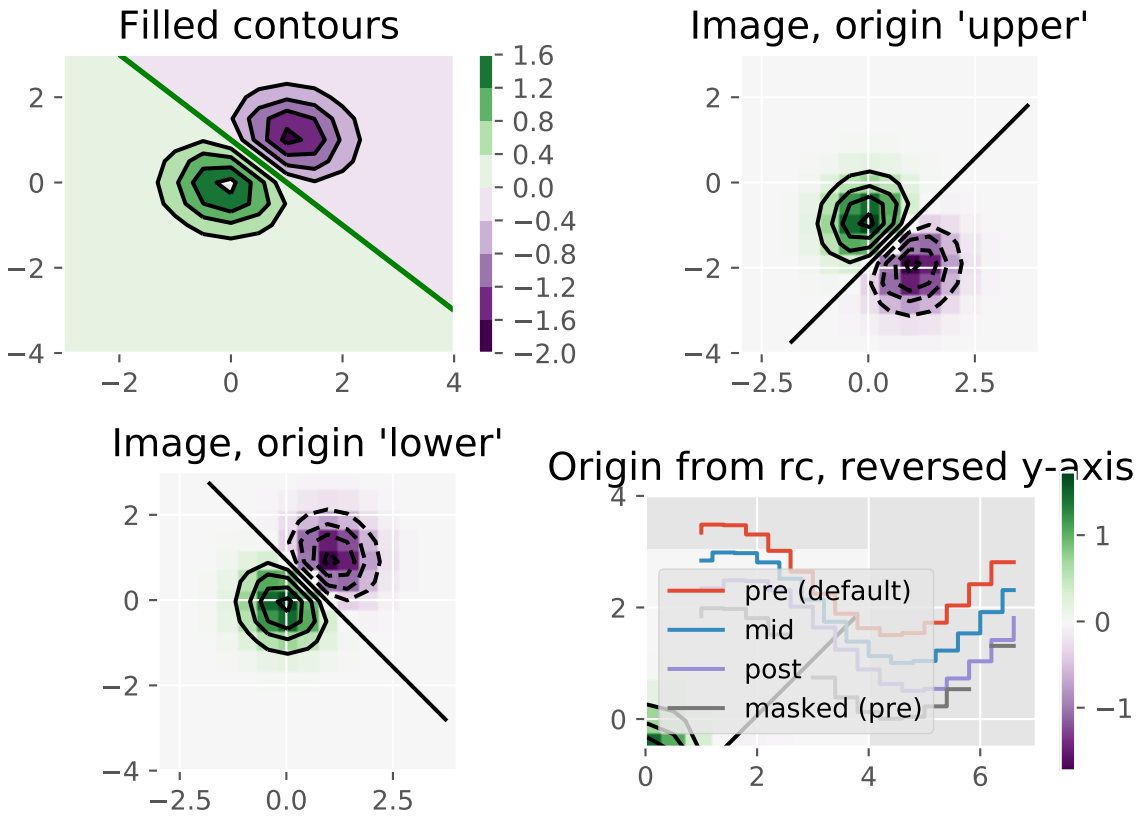



```
# https://matplotlib.org/gallery/images_contours_and_fields/contour_image.html#sphx-glr-gallery-images-
import matplotlib.pyplot as plt
import numpy as np
from matplotlib import cm
# Default delta is large because that makes it fast, and it illustrates
# the correct registration between image and contours.
delta = 0.5
extent = (-3, 4, -4, 3)
x = np.arange(-3.0, 4.001, delta)
y = np.arange(-4.0, 3.001, delta)
X, Y = np.meshgrid(x, y)
Z1 = np.exp(-X**2 - Y**2)
Z2 = np.exp(-(X - 1)**2 - (Y - 1)**2)
Z = (Z1 - Z2) * 2
# Boost the upper limit to avoid truncation errors.
levels = np.arange(-2.0, 1.601, 0.4)
norm = cm.colors.Normalize(vmax=abs(Z).max(), vmin=-abs(Z).max())
cmap = cm.PRGn
fig, _axs = plt.subplots(nrows=2, ncols=2)
fig.subplots_adjust(hspace=0.3)
axs = _axs.flatten()
cset1 = axs[0].contourf(X, Y, Z, levels, norm=norm,
                        cmap=cm.get_cmap(cmap, len(levels) - 1))
# It is not necessary, but for the colormap, we need only the
# number of levels minus 1.  To avoid discretization error, use
# either this number or a large number such as the default (256).
```

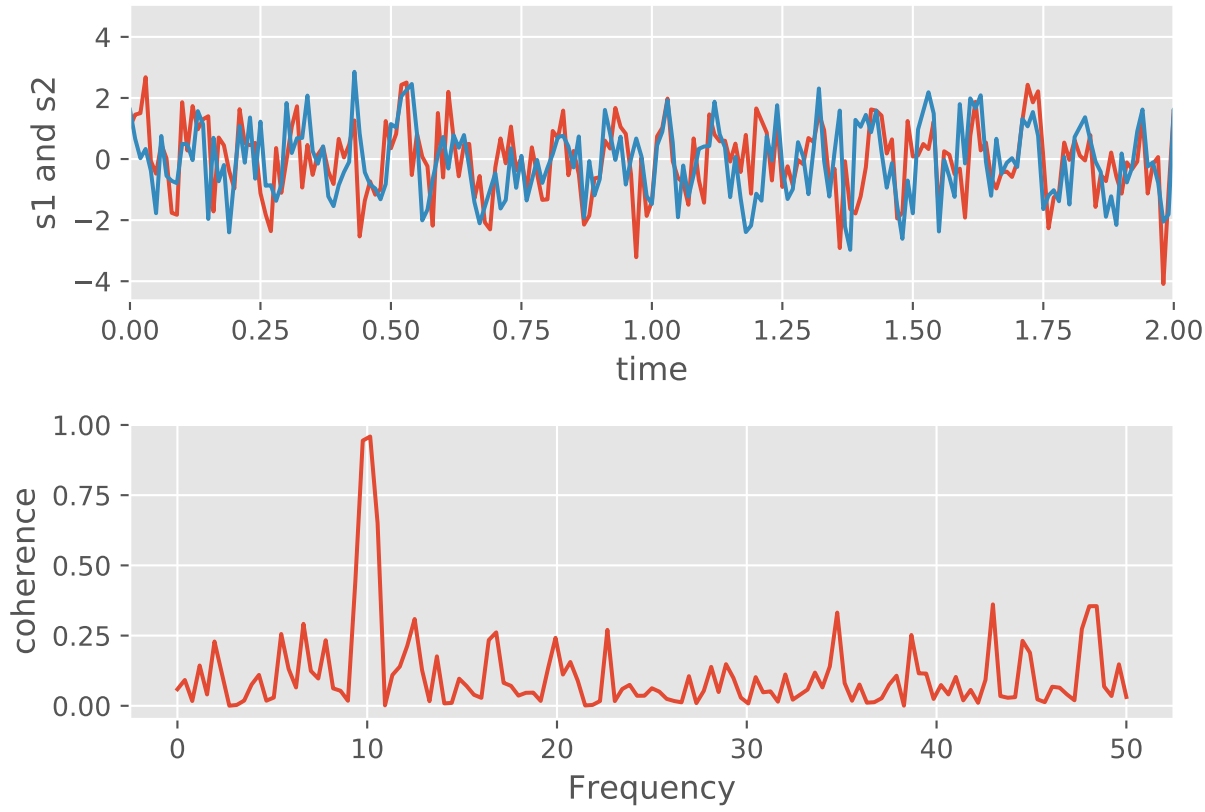
```
# If we want lines as well as filled regions, we need to call
# contour separately; don't try to change the edgecolor or edgewidth
# of the polygons in the collections returned by contourf.
# Use levels output from previous call to guarantee they are the same.
cset2 = axs[0].contour(X, Y, Z, cset1.levels, colors='k')
# We don't really need dashed contour lines to indicate negative
# regions, so let's turn them off.
for c in cset2.collections:
    c.set_linestyle('solid')
# It is easier here to make a separate call to contour than
# to set up an array of colors and linewidths.
# We are making a thick green line as a zero contour.
# Specify the zero level as a tuple with only 0 in it.
cset3 = axs[0].contour(X, Y, Z, (0,), colors='g', linewidths=2)
axs[0].set_title('Filled contours')
fig.colorbar(cset1, ax=axs[0])
axs[1].imshow(Z, extent=extent, cmap=cmap, norm=norm)
axs[1].contour(Z, levels, colors='k', origin='upper', extent=extent)
axs[1].set_title("Image, origin 'upper'")
axs[2].imshow(Z, origin='lower', extent=extent, cmap=cmap, norm=norm)
axs[2].contour(Z, levels, colors='k', origin='lower', extent=extent)
axs[2].set_title("Image, origin 'lower'")
# We will use the interpolation "nearest" here to show the actual
# image pixels.
# Note that the contour lines don't extend to the edge of the box.
# This is intentional. The Z values are defined at the center of each
# image pixel (each color block on the following subplot), so the
# domain that is contoured does not extend beyond these pixel centers.
im = axs[3].imshow(Z, interpolation='nearest', extent=extent,
                   cmap=cmap, norm=norm)
axs[3].contour(Z, levels, colors='k', origin='image', extent=extent)
ylim = axs[3].get_ylim()
axs[3].set_ylim(ylim[::-1])
axs[3].set_title("Origin from rc, reversed y-axis")
fig.colorbar(im, ax=axs[3])
fig.tight_layout()
plt.show()
```




```
# https://matplotlib.org/gallery/lines_bars_and_markers/step_demo.html#sphx-glr-gallery-lines-bars-and-
import numpy as np
from numpy import ma
import matplotlib.pyplot as plt
x = np.arange(1, 7, 0.4)
y0 = np.sin(x)
y = y0.copy() + 2.5
plt.step(x, y, label='pre (default)')
y -= 0.5
plt.step(x, y, where='mid', label='mid')
y -= 0.5
plt.step(x, y, where='post', label='post')
y = ma.masked_where((y0 > -0.15) & (y0 < 0.15), y - 0.5)
plt.step(x, y, label='masked (pre)')
plt.legend()
plt.xlim(0, 7)
plt.ylim(-0.5, 4)
plt.show()
```

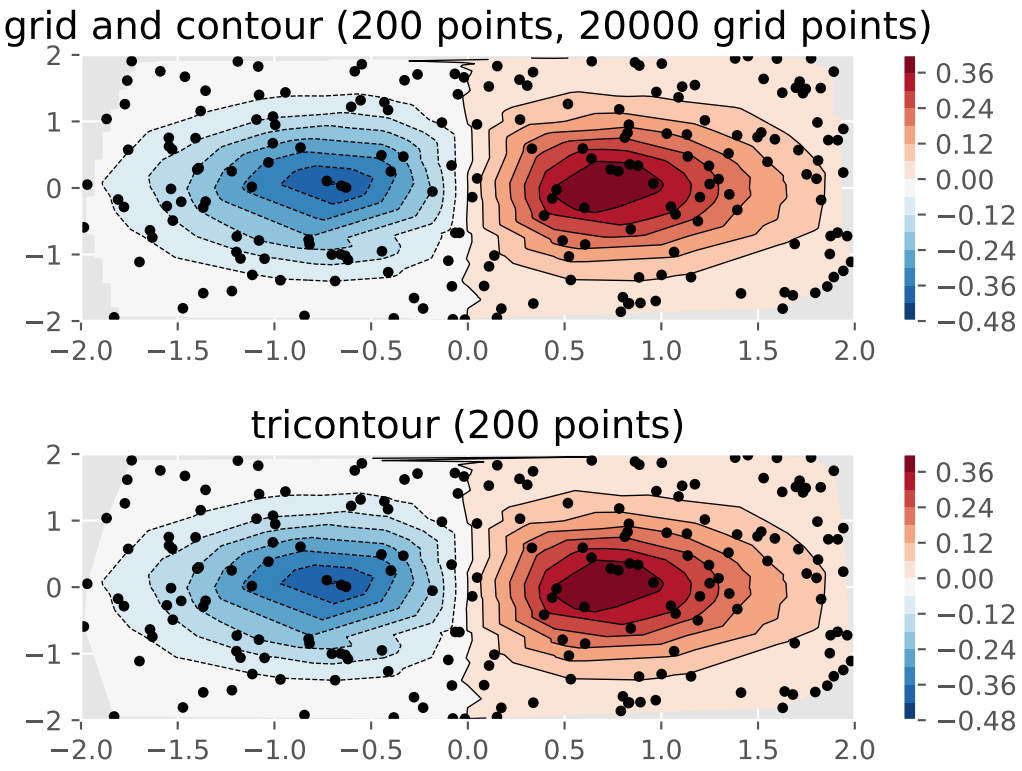



```
# https://matplotlib.org/gallery/lines_bars_and_markers/cohere.html#sphx-glr-gallery-lines-bars-and-mar
import numpy as np
import matplotlib.pyplot as plt
# Fixing random state for reproducibility
np.random.seed(19680801)
dt = 0.01
t = np.arange(0, 30, dt)
nse1 = np.random.randn(len(t))                 # white noise 1
nse2 = np.random.randn(len(t))                 # white noise 2
# Two signals with a coherent part at 10Hz and a random part
s1 = np.sin(2 * np.pi * 10 * t) + nse1
s2 = np.sin(2 * np.pi * 10 * t) + nse2
fig, axs = plt.subplots(2, 1)
axs[0].plot(t, s1, t, s2)
axs[0].set_xlim(0, 2)
axs[0].set_xlabel('time')
axs[0].set_ylabel('s1 and s2')
axs[0].grid(True)
cxy, f = axs[1].cohere(s1, s2, 256, 1. / dt)
axs[1].set_ylabel('coherence')
fig.tight_layout()
plt.show()
```



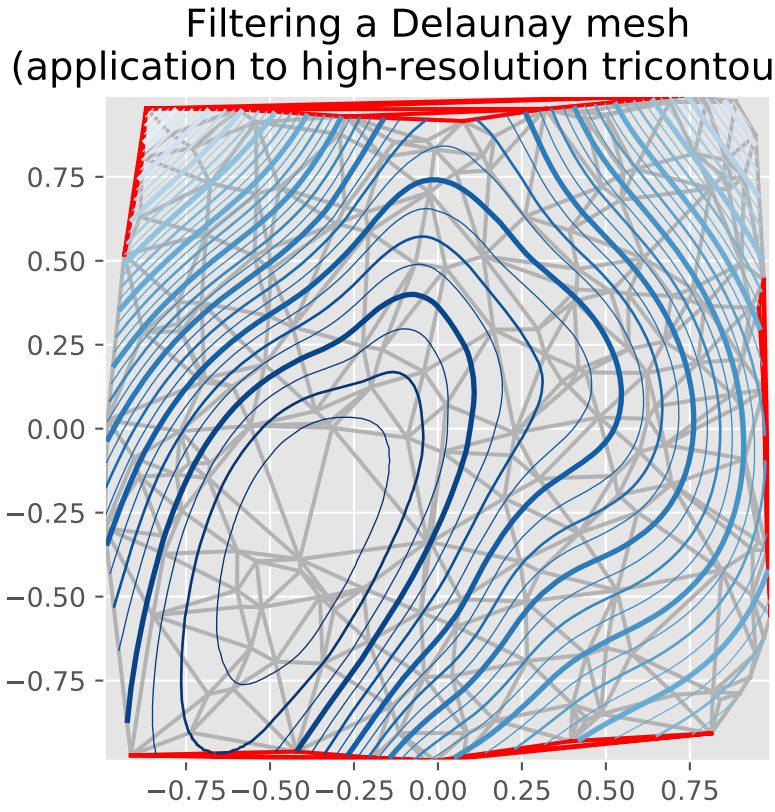

```
# https://matplotlib.org/gallery/images_contours_and_fields/irregulardatagrid.html#sphx-glr-gallery-ima
import matplotlib.pyplot as plt
import matplotlib.tri as tri
import numpy as np
np.random.seed(19680801)
npts = 200
ngridx = 100
ngridy = 200
x = np.random.uniform(-2, 2, npts)
y = np.random.uniform(-2, 2, npts)
z = x * np.exp(-x**2 - y**2)
fig, (ax1, ax2) = plt.subplots(nrows=2)
# ----------------------
# Interpolation on a grid
# ----------------------
# A contour plot of irregularly spaced data coordinates
# via interpolation on a grid.
# Create grid values first.
xi = np.linspace(-2.1, 2.1, ngridx)
yi = np.linspace(-2.1, 2.1, ngridy)
# Perform linear interpolation of the data (x,y)
# on a grid defined by (xi,yi)
triang = tri.Triangulation(x, y)
interpolator = tri.LinearTriInterpolator(triang, z)
Xi, Yi = np.meshgrid(xi, yi)
zi = interpolator(Xi, Yi)
```

```
# Note that scipy.interpolate provides means to interpolate data on a grid
# as well. The following would be an alternative to the four lines above:
#from scipy.interpolate import griddata
#zi = griddata((x, y), z, (xi[None,:], yi[:,None]), method='linear')
ax1.contour(xi, yi, zi, 14, linewidths=0.5, colors='k')
cntr1 = ax1.contourf(xi, yi, zi, 14, cmap="RdBu_r")
fig.colorbar(cntr1, ax=ax1)
ax1.plot(x, y, 'ko', ms=3)
ax1.axis((-2, 2, -2, 2))
ax1.set_title('grid and contour (%d points, %d grid points)' %
              (npts, ngridx * ngridy))
# ----------
# Tricontour
# ----------
# Directly supply the unordered, irregularly spaced coordinates
# to tricontour.
ax2.tricontour(x, y, z, 14, linewidths=0.5, colors='k')
cntr2 = ax2.tricontourf(x, y, z, 14, cmap="RdBu_r")
fig.colorbar(cntr2, ax=ax2)
ax2.plot(x, y, 'ko', ms=3)
ax2.axis((-2, 2, -2, 2))
ax2.set_title('tricontour (%d points)' % npts)
plt.subplots_adjust(hspace=0.5)
plt.show()
```



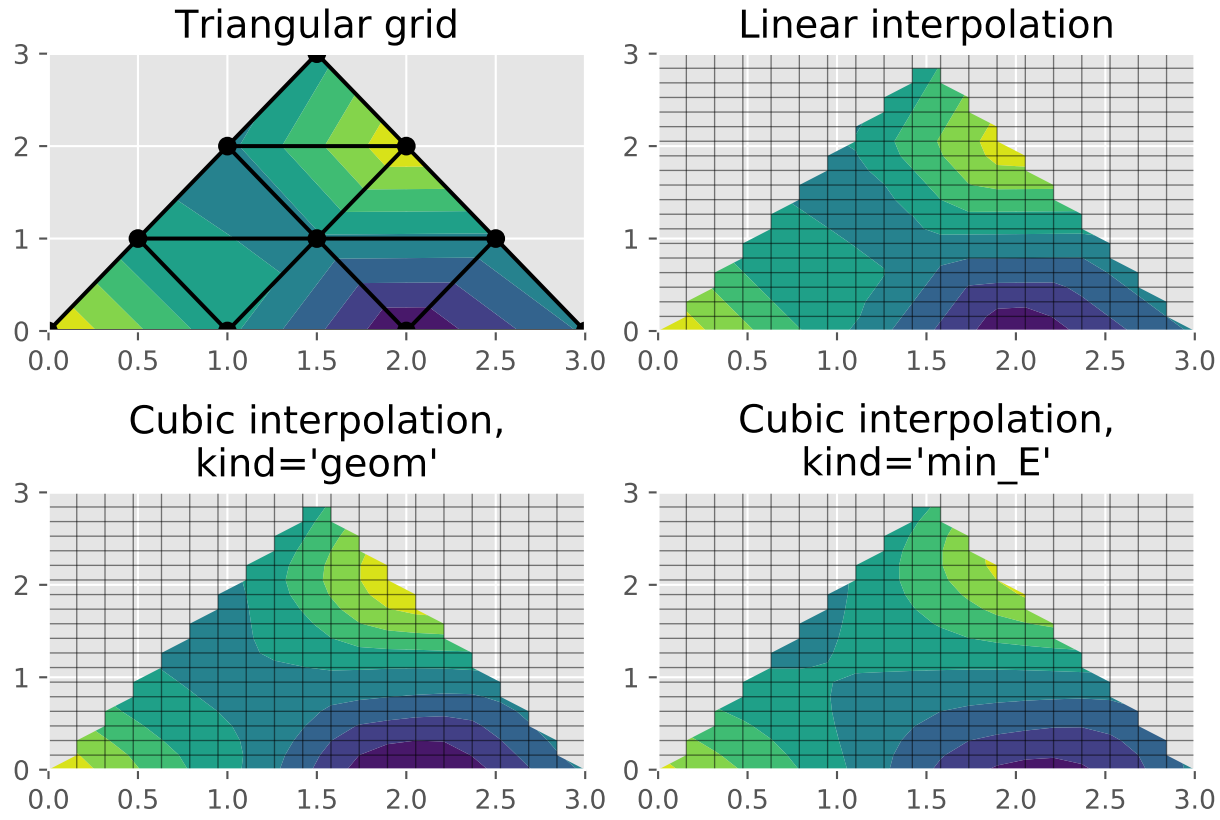
```
from matplotlib.tri import Triangulation, TriAnalyzer, UniformTriRefiner
import matplotlib.pyplot as plt
import matplotlib.cm as cm
import numpy as np
#-----------------------------------------------------------------------------
# Analytical test function
#-----------------------------------------------------------------------------
def experiment_res(x, y):
    """ An analytic function representing experiment results """
    x = 2. * x
    r1 = np.sqrt((0.5 - x)**2 + (0.5 - y)**2)
    theta1 = np.arctan2(0.5 - x, 0.5 - y)
    r2 = np.sqrt((-x - 0.2)**2 + (-y - 0.2)**2)
    theta2 = np.arctan2(-x - 0.2, -y - 0.2)
    z = (4 * (np.exp((r1 / 10)**2) - 1) * 30. * np.cos(3 * theta1) +
         (np.exp((r2 / 10)**2) - 1) * 30. * np.cos(5 * theta2) +
         2 * (x**2 + y**2))
    return (np.max(z) - z) / (np.max(z) - np.min(z))
#-----------------------------------------------------------------------------
# Generating the initial data test points and triangulation for the demo
#-----------------------------------------------------------------------------
# User parameters for data test points
n_test = 200  # Number of test data points, tested from 3 to 5000 for subdiv=3
subdiv = 3  # Number of recursive subdivisions of the initial mesh for smooth
            # plots. Values >3 might result in a very high number of triangles
            # for the refine mesh: new triangles numbering = (4**subdiv)*ntri
init_mask_frac = 0.0    # Float > 0. adjusting the proportion of
                        # (invalid) initial triangles which will be masked
                        # out. Enter 0 for no mask.
min_circle_ratio = .01  # Minimum circle ratio - border triangles with circle
                        # ratio below this will be masked if they touch a
                        # border. Suggested value 0.01; use -1 to keep
                        # all triangles.
# Random points
random_gen = np.random.RandomState(seed=19680801)
x_test = random_gen.uniform(-1., 1., size=n_test)
y_test = random_gen.uniform(-1., 1., size=n_test)
z_test = experiment_res(x_test, y_test)
# meshing with Delaunay triangulation
tri = Triangulation(x_test, y_test)
ntri = tri.triangles.shape[0]
# Some invalid data are masked out
mask_init = np.zeros(ntri, dtype=bool)
masked_tri = random_gen.randint(0, ntri, int(ntri * init_mask_frac))
mask_init[masked_tri] = True
tri.set_mask(mask_init)
#-----------------------------------------------------------------------------
# Improving the triangulation before high-res plots: removing flat triangles
#-----------------------------------------------------------------------------
# masking badly shaped triangles at the border of the triangular mesh.
mask = TriAnalyzer(tri).get_flat_tri_mask(min_circle_ratio)
tri.set_mask(mask)
# refining the data
```

```
refiner = UniformTriRefiner(tri)
tri_refi, z_test_refi = refiner.refine_field(z_test, subdiv=subdiv)
# analytical 'results' for comparison
z_expected = experiment_res(tri_refi.x, tri_refi.y)
# for the demo: loading the 'flat' triangles for plot
flat_tri = Triangulation(x_test, y_test)
flat_tri.set_mask(~mask)
#-----------------------------------------------------------------------------
# Now the plots
#-----------------------------------------------------------------------------
# User options for plots
plot_tri = True          # plot of base triangulation
plot_masked_tri = True   # plot of excessively flat excluded triangles
plot_refi_tri = False    # plot of refined triangulation
plot_expected = False    # plot of analytical function values for comparison
# Graphical options for tricontouring
levels = np.arange(0., 1., 0.025)
cmap = cm.get_cmap(name='Blues', lut=None)
fig, ax = plt.subplots()
ax.set_aspect('equal')
ax.set_title("Filtering a Delaunay mesh\n" +
          "(application to high-resolution tricontouring)")
# 1) plot of the refined (computed) data contours:
ax.tricontour(tri_refi, z_test_refi, levels=levels, cmap=cmap,
              linewidths=[2.0, 0.5, 1.0, 0.5])
# 2) plot of the expected (analytical) data contours (dashed):
if plot_expected:
    ax.tricontour(tri_refi, z_expected, levels=levels, cmap=cmap,
                  linestyles='--')
# 3) plot of the fine mesh on which interpolation was done:
if plot_refi_tri:
    ax.triplot(tri_refi, color='0.97')
# 4) plot of the initial 'coarse' mesh:
if plot_tri:
    ax.triplot(tri, color='0.7')
# 4) plot of the unvalidated triangles from naive Delaunay Triangulation:
if plot_masked_tri:
    ax.triplot(flat_tri, color='red')
plt.show()
```



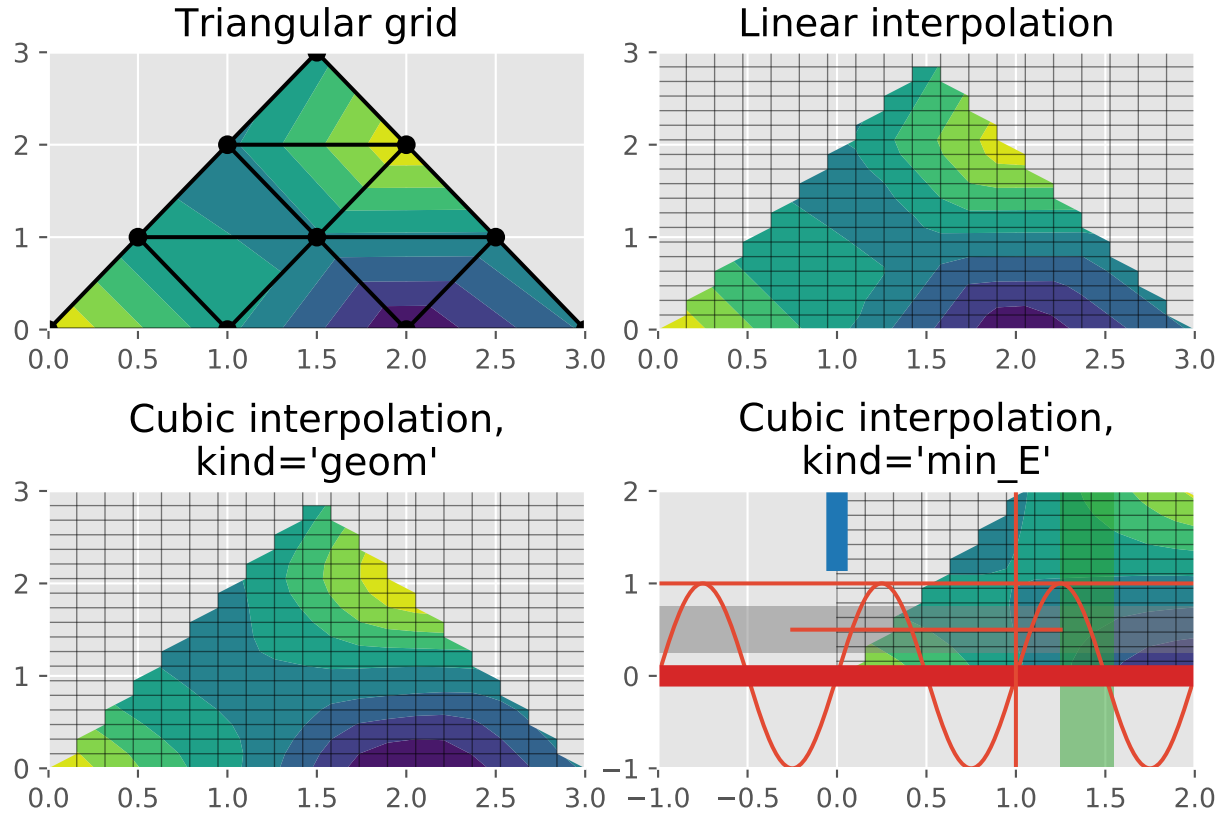

```python
# https://matplotlib.org/gallery/images_contours_and_fields/triinterp_demo.html#sphx-glr-gallery-images
import matplotlib.pyplot as plt
import matplotlib.tri as mtri
import numpy as np
# Create triangulation.
x = np.asarray([0, 1, 2, 3, 0.5, 1.5, 2.5, 1, 2, 1.5])
y = np.asarray([0, 0, 0, 0, 1.0, 1.0, 1.0, 2, 2, 3.0])
triangles = [[0, 1, 4], [1, 2, 5], [2, 3, 6], [1, 5, 4], [2, 6, 5], [4, 5, 7],
             [5, 6, 8], [5, 8, 7], [7, 8, 9]]
triang = mtri.Triangulation(x, y, triangles)
# Interpolate to regularly-spaced quad grid.
z = np.cos(1.5 * x) * np.cos(1.5 * y)
xi, yi = np.meshgrid(np.linspace(0, 3, 20), np.linspace(0, 3, 20))
interp_lin = mtri.LinearTriInterpolator(triang, z)
zi_lin = interp_lin(xi, yi)
interp_cubic_geom = mtri.CubicTriInterpolator(triang, z, kind='geom')
zi_cubic_geom = interp_cubic_geom(xi, yi)
interp_cubic_min_E = mtri.CubicTriInterpolator(triang, z, kind='min_E')
zi_cubic_min_E = interp_cubic_min_E(xi, yi)
# Set up the figure
fig, axs = plt.subplots(nrows=2, ncols=2)
axs = axs.flatten()
# Plot the triangulation.
axs[0].tricontourf(triang, z)
axs[0].triplot(triang, 'ko-')
axs[0].set_title('Triangular grid')
```

```
# Plot linear interpolation to quad grid.
axs[1].contourf(xi, yi, zi_lin)
axs[1].plot(xi, yi, 'k-', lw=0.5, alpha=0.5)
axs[1].plot(xi.T, yi.T, 'k-', lw=0.5, alpha=0.5)
axs[1].set_title("Linear interpolation")
# Plot cubic interpolation to quad grid, kind=geom
axs[2].contourf(xi, yi, zi_cubic_geom)
axs[2].plot(xi, yi, 'k-', lw=0.5, alpha=0.5)
axs[2].plot(xi.T, yi.T, 'k-', lw=0.5, alpha=0.5)
axs[2].set_title("Cubic interpolation,\nkind='geom'")
# Plot cubic interpolation to quad grid, kind=min_E
axs[3].contourf(xi, yi, zi_cubic_min_E)
axs[3].plot(xi, yi, 'k-', lw=0.5, alpha=0.5)
axs[3].plot(xi.T, yi.T, 'k-', lw=0.5, alpha=0.5)
axs[3].set_title("Cubic interpolation,\nkind='min_E'")
fig.tight_layout()
plt.show()
```



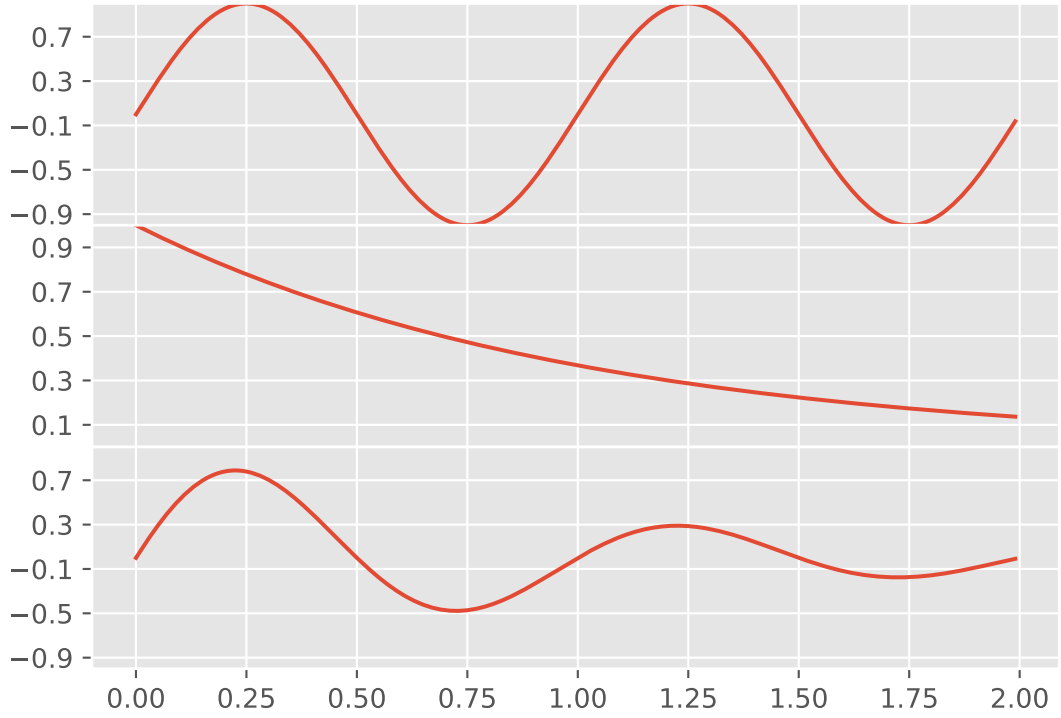

```
# https://matplotlib.org/gallery/subplots_axes_and_figures/axhspan_demo.html#sphx-glr-gallery-subplots-
import numpy as np
import matplotlib.pyplot as plt
t = np.arange(-1, 2, .01)
s = np.sin(2 * np.pi * t)
plt.plot(t, s)
# Draw a thick red hline at y=0 that spans the xrange
plt.axhline(linewidth=8, color='#d62728')
```

```
# Draw a default hline at y=1 that spans the xrange
plt.axhline(y=1)
# Draw a default vline at x=1 that spans the yrange
plt.axvline(x=1)
# Draw a thick blue vline at x=0 that spans the upper quadrant of the yrange
plt.axvline(x=0, ymin=0.75, linewidth=8, color='#1f77b4')
# Draw a default hline at y=.5 that spans the middle half of the axes
plt.axhline(y=.5, xmin=0.25, xmax=0.75)
plt.axhspan(0.25, 0.75, facecolor='0.5', alpha=0.5)
plt.axvspan(1.25, 1.55, facecolor='#2ca02c', alpha=0.5)
plt.axis([-1, 2, -1, 2])
plt.show()
```

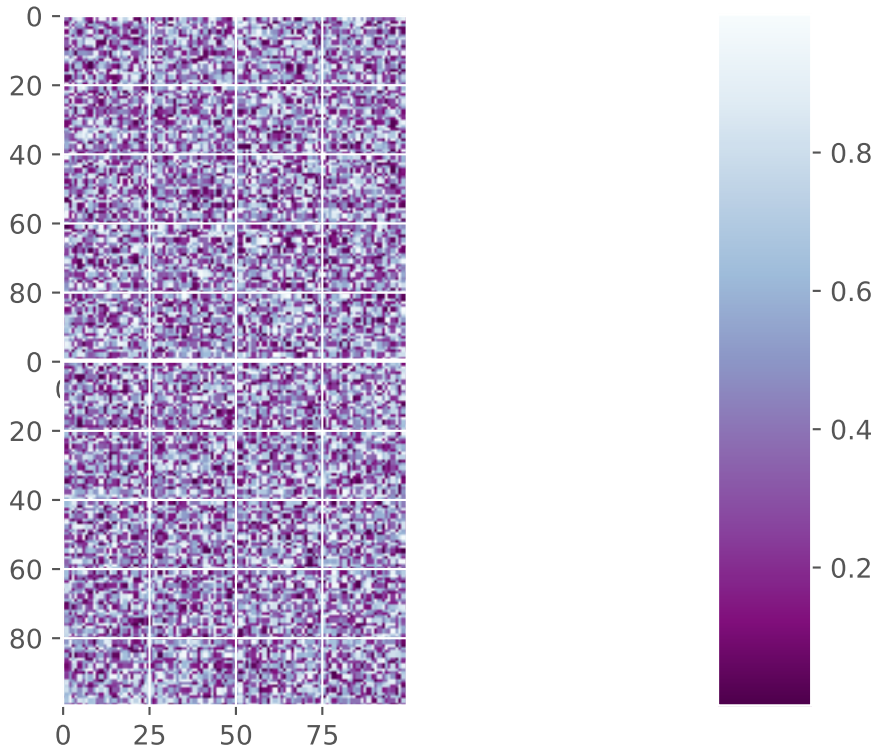



```
import matplotlib.pyplot as plt
import numpy as np
t = np.arange(0.0, 2.0, 0.01)
s1 = np.sin(2 * np.pi * t)
s2 = np.exp(-t)
s3 = s1 * s2
fig, axs = plt.subplots(3, 1, sharex=True)
# Remove horizontal space between axes
fig.subplots_adjust(hspace=0)
# Plot each graph, and manually set the y tick values
axs[0].plot(t, s1)
axs[0].set_yticks(np.arange(-0.9, 1.0, 0.4))
axs[0].set_ylim(-1, 1)
```

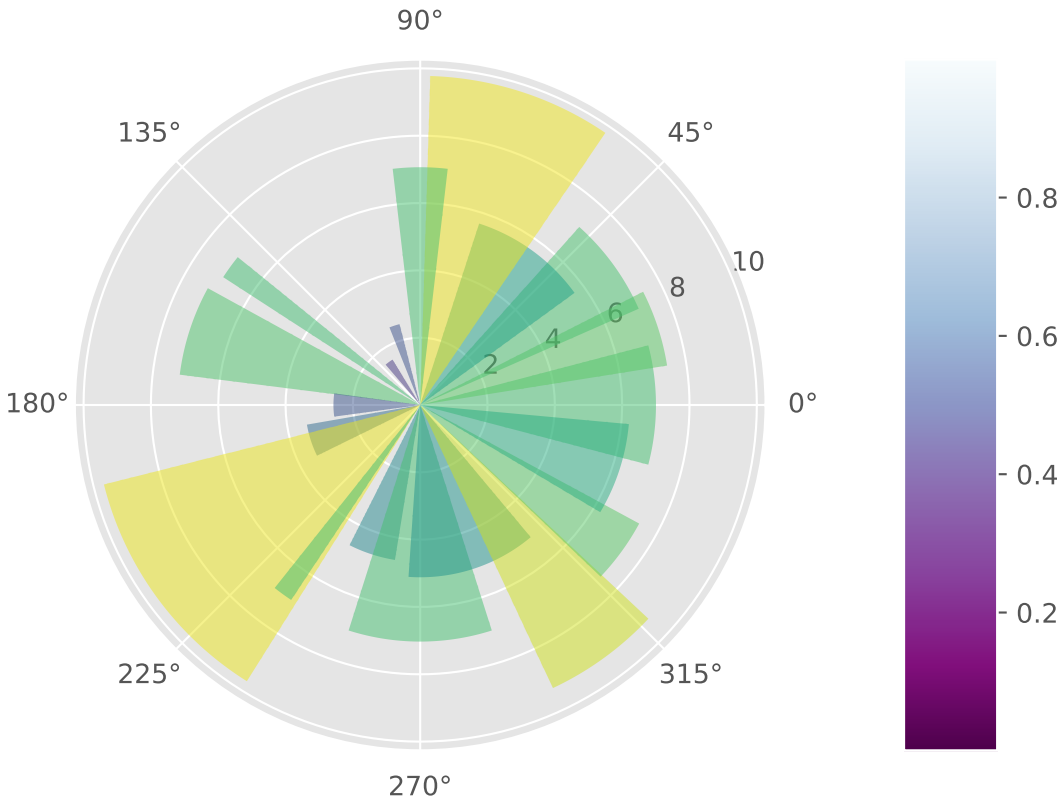
```
axs[1].plot(t, s2)
axs[1].set_yticks(np.arange(0.1, 1.0, 0.2))
axs[1].set_ylim(0, 1)
axs[2].plot(t, s3)
axs[2].set_yticks(np.arange(-0.9, 1.0, 0.4))
axs[2].set_ylim(-1, 1)
plt.show()
```



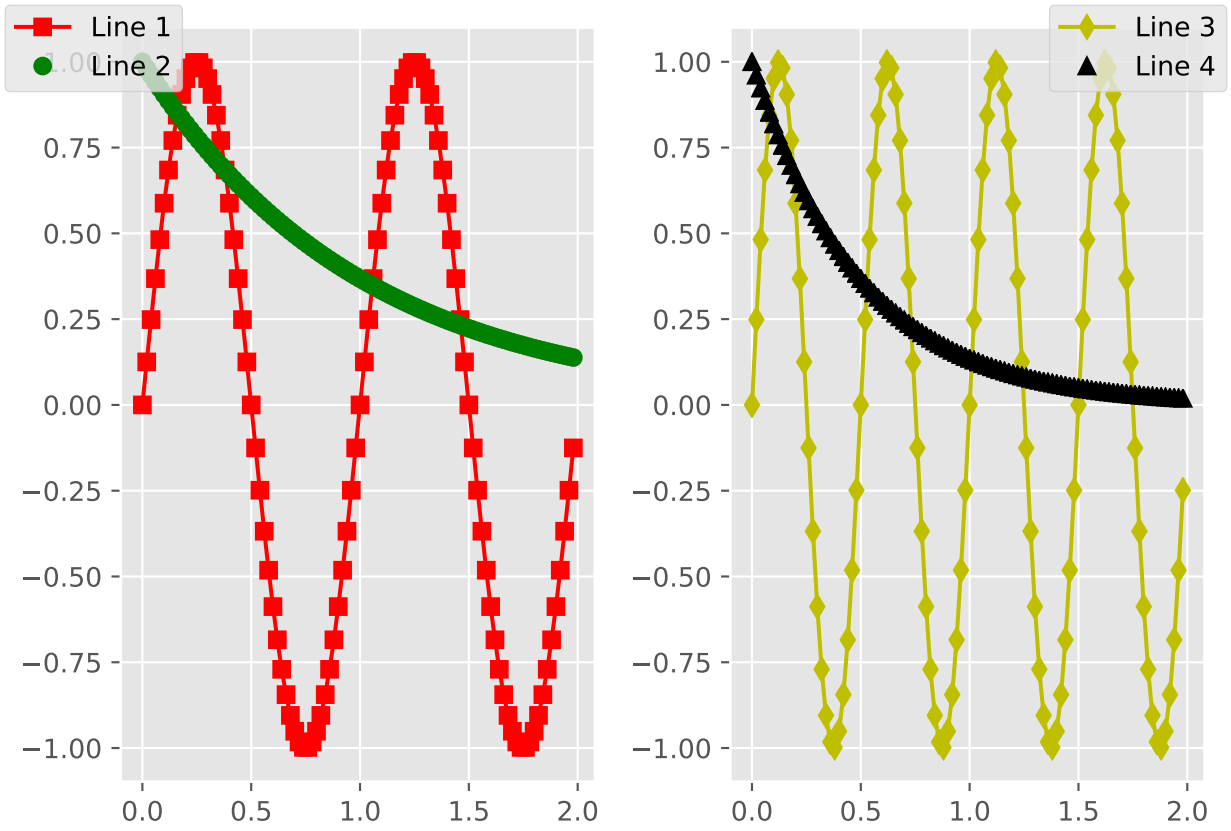

```
# https://matplotlib.org/gallery/subplots_axes_and_figures/subplots_adjust.html#sphx-glr-gallery-subplo
import matplotlib.pyplot as plt
import numpy as np
# Fixing random state for reproducibility
np.random.seed(19680801)
plt.subplot(211)
plt.imshow(np.random.random((100, 100)), cmap=plt.cm.BuPu_r)
plt.subplot(212)
plt.imshow(np.random.random((100, 100)), cmap=plt.cm.BuPu_r)
plt.subplots_adjust(bottom=0.1, right=0.8, top=0.9)
cax = plt.axes([0.85, 0.1, 0.075, 0.8])
plt.colorbar(cax=cax)
plt.show()
```



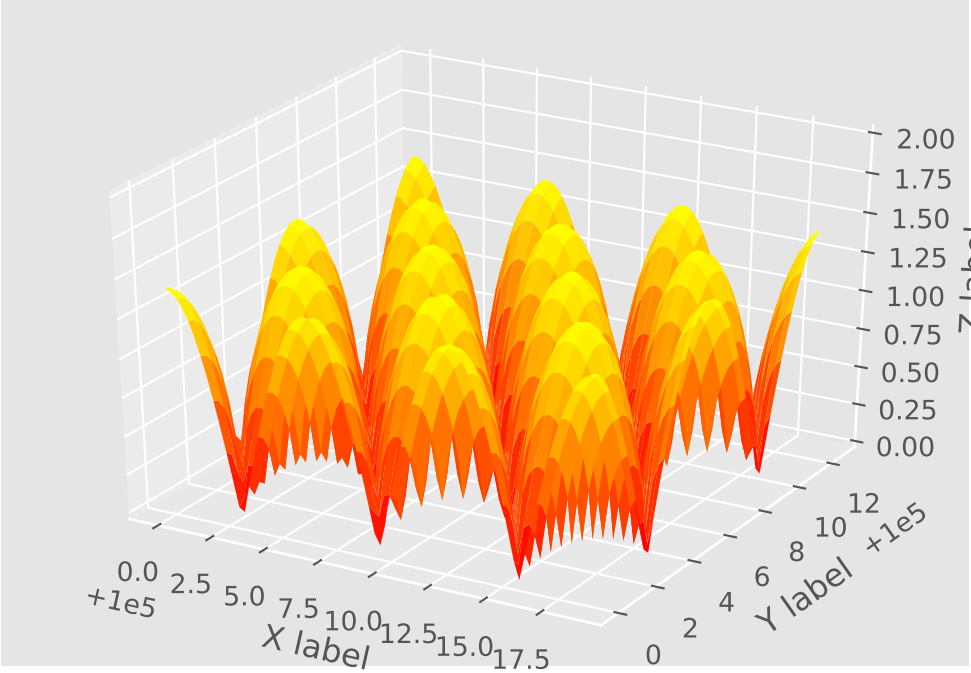

```
# https://matplotlib.org/gallery/pie_and_polar_charts/polar_bar.html#sphx-glr-gallery-pie-and-polar-cha
import numpy as np
import matplotlib.pyplot as plt
# Fixing random state for reproducibility
np.random.seed(19680801)
# Compute pie slices
N = 20
theta = np.linspace(0.0, 2 * np.pi, N, endpoint=False)
radii = 10 * np.random.rand(N)
width = np.pi / 4 * np.random.rand(N)
ax = plt.subplot(111, projection='polar')
bars = ax.bar(theta, radii, width=width, bottom=0.0)
# Use custom colors and opacity
for r, bar in zip(radii, bars):
    bar.set_facecolor(plt.cm.viridis(r / 10.))
    bar.set_alpha(0.5)
plt.show()
```



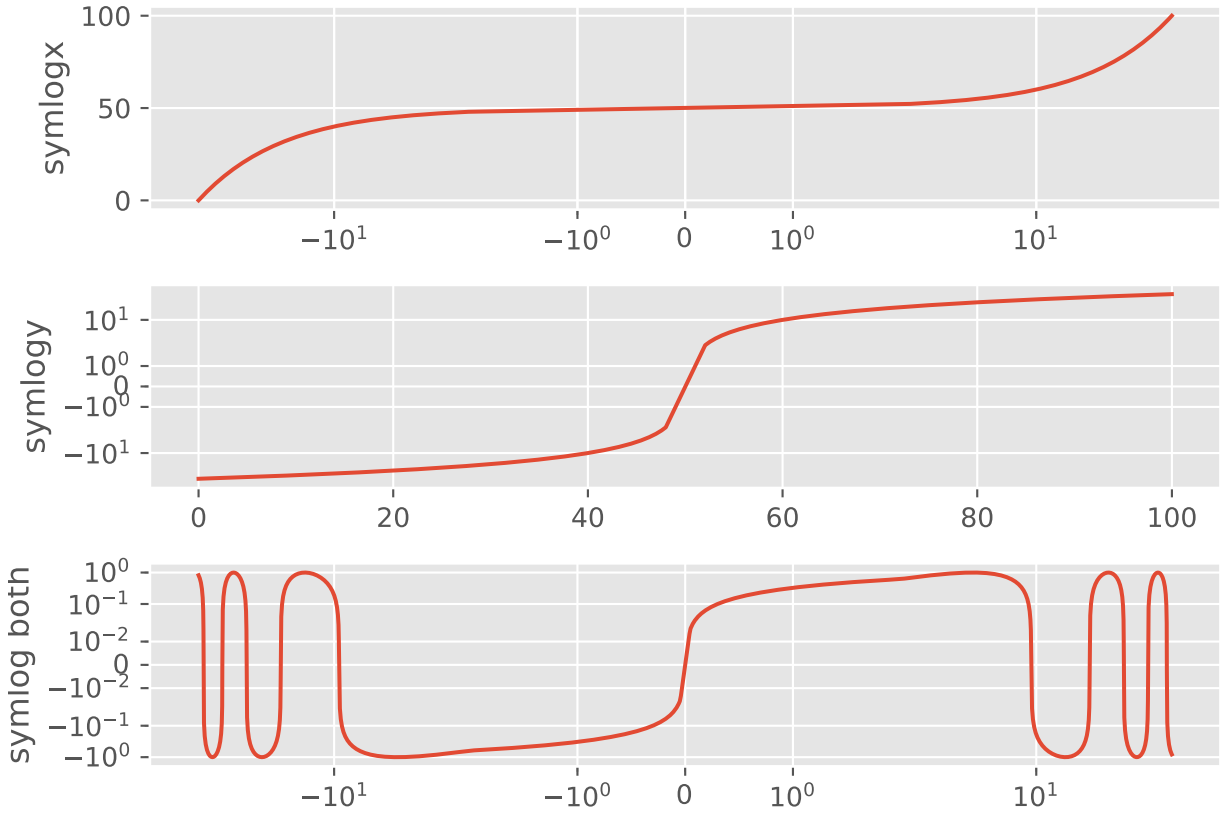

```
# https://matplotlib.org/gallery/text_labels_and_annotations/figlegend_demo.html#sphx-glr-gallery-text-
import numpy as np
import matplotlib.pyplot as plt
fig, axs = plt.subplots(1, 2)
x = np.arange(0.0, 2.0, 0.02)
y1 = np.sin(2 * np.pi * x)
y2 = np.exp(-x)
l1, l2 = axs[0].plot(x, y1, 'rs-', x, y2, 'go')
y3 = np.sin(4 * np.pi * x)
y4 = np.exp(-2 * x)
l3, l4 = axs[1].plot(x, y3, 'yd-', x, y4, 'k^')
fig.legend((l1, l2), ('Line 1', 'Line 2'), 'upper left')
fig.legend((l3, l4), ('Line 3', 'Line 4'), 'upper right')
plt.tight_layout()
plt.show()
```




```
# https://matplotlib.org/gallery/mplot3d/offset.html#sphx-glr-gallery-mplot3d-offset-py
# This import registers the 3D projection, but is otherwise unused.
from mpl_toolkits.mplot3d import Axes3D  # noqa: F401 unused import
import matplotlib.pyplot as plt
import numpy as np
fig = plt.figure()
ax = fig.gca(projection='3d')
X, Y = np.mgrid[0:6*np.pi:0.25, 0:4*np.pi:0.25]
Z = np.sqrt(np.abs(np.cos(X) + np.cos(Y)))
ax.plot_surface(X + 1e5, Y + 1e5, Z, cmap='autumn', cstride=2, rstride=2)
ax.set_xlabel("X label")
ax.set_ylabel("Y label")
ax.set_zlabel("Z label")
ax.set_zlim(0, 2)
plt.show()
```



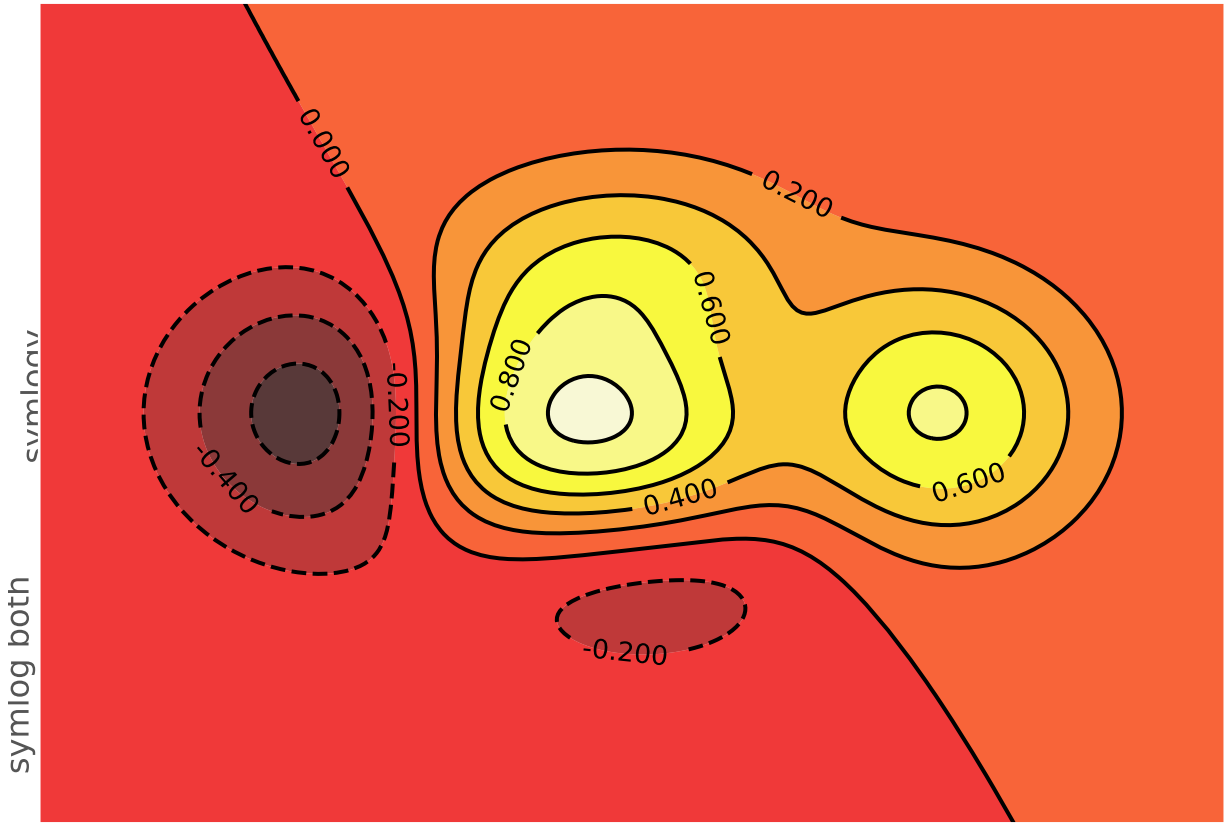

```python
# https://matplotlib.org/gallery/scales/symlog_demo.html#sphx-glr-gallery-scales-symlog-demo-py
import matplotlib.pyplot as plt
import numpy as np
dt = 0.01
x = np.arange(-50.0, 50.0, dt)
y = np.arange(0, 100.0, dt)
plt.subplot(311)
plt.plot(x, y)
plt.xscale('symlog')
plt.ylabel('symlogx')
plt.grid(True)
plt.gca().xaxis.grid(True, which='minor')  # minor grid on too
plt.subplot(312)
plt.plot(y, x)
plt.yscale('symlog')
plt.ylabel('symlogy')
plt.subplot(313)
plt.plot(x, np.sin(x / 3.0))
plt.xscale('symlog')
plt.yscale('symlog', linthreshy=0.015)
plt.grid(True)
plt.ylabel('symlog both')
plt.tight_layout()
plt.show()
```



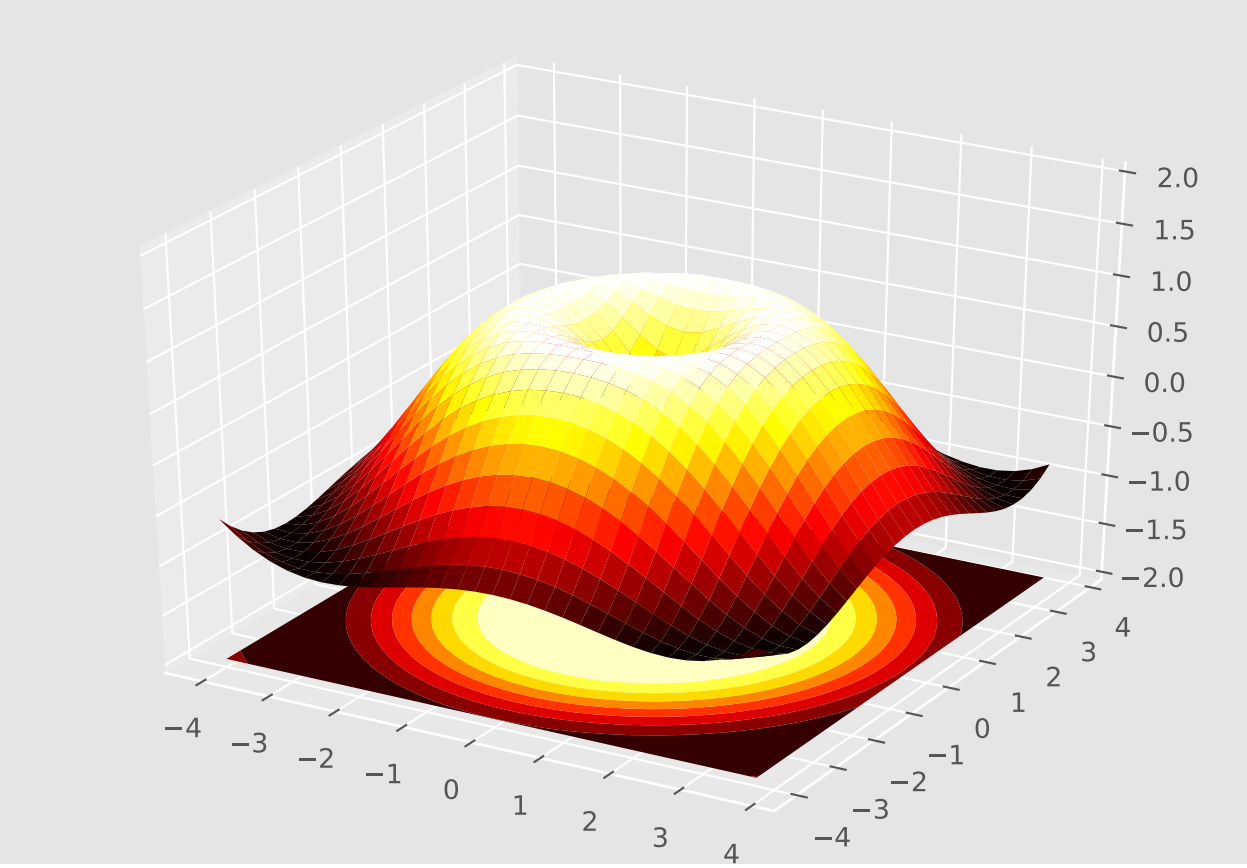

```
import matplotlib.pyplot as plt
import numpy as np
# http://www.scipy-lectures.org/intro/matplotlib/auto_examples/plot_contour_ex.html
def f(x, y):
    return (1 - x / 2 + x ** 5 + y ** 3) * np.exp(-x ** 2 -y ** 2)
n = 256
x = np.linspace(-3, 3, n)
y = np.linspace(-3, 3, n)
X,Y = np.meshgrid(x, y)
plt.axes([0.025, 0.025, 0.95, 0.95])
plt.contourf(X, Y, f(X, Y), 8, alpha=.75, cmap=plt.cm.hot)
C = plt.contour(X, Y, f(X, Y), 8, colors='black', linewidth=.5)
```

```
C:\Users\ipm\WPY-36~1\PYTHON~1.AMD\lib\site-packages\matplotlib\contour.py:1000: UserWarning: The follow
  s)
```

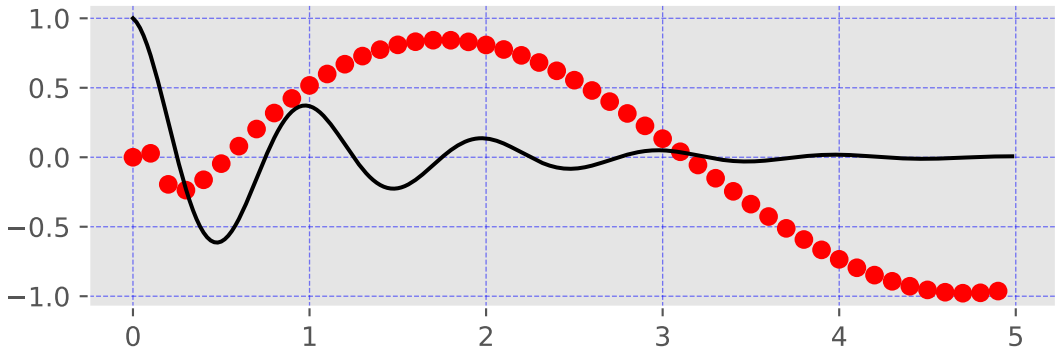
```
plt.clabel(C, inline=1, fontsize=10)
plt.xticks(())
plt.yticks(())
plt.show()
```



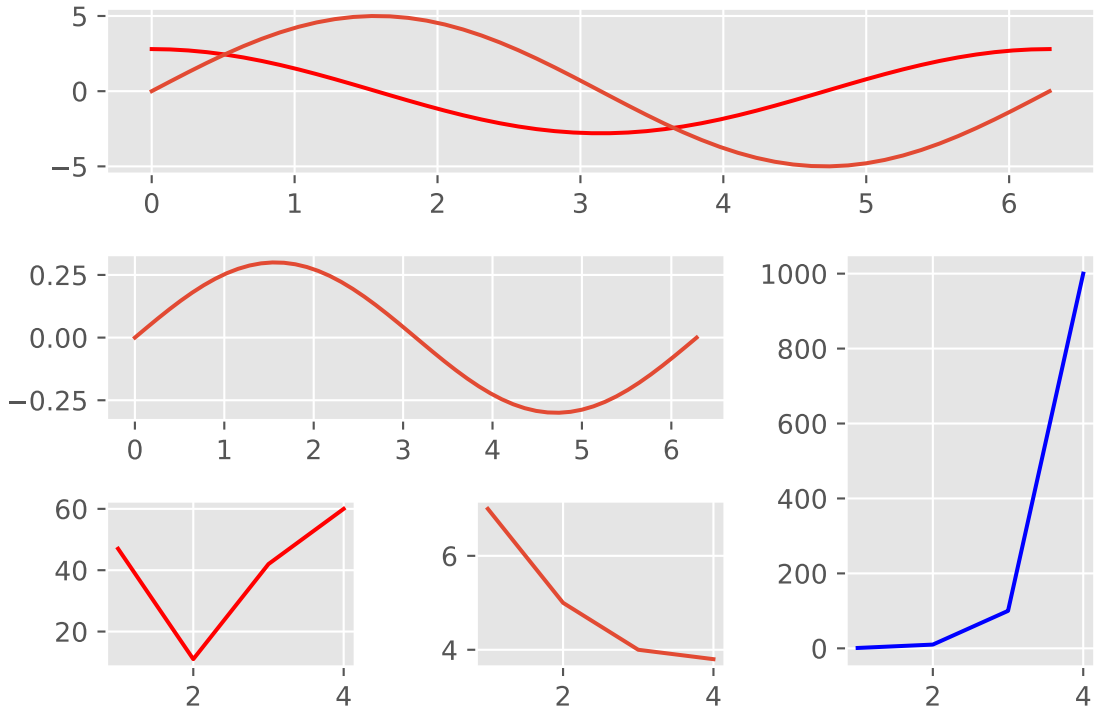

```
# http://www.scipy-lectures.org/intro/matplotlib/auto_examples/plot_plot3d_ex.html
import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
fig = plt.figure()
ax = Axes3D(fig)
X = np.arange(-4, 4, 0.25)
Y = np.arange(-4, 4, 0.25)
X, Y = np.meshgrid(X, Y)
R = np.sqrt(X ** 2 + Y ** 2)
Z = np.sin(R)
ax.plot_surface(X, Y, Z, rstride=1, cstride=1, cmap=plt.cm.hot)
ax.contourf(X, Y, Z, zdir='z', offset=-2, cmap=plt.cm.hot)
ax.set_zlim(-2, 2)
plt.show()
```



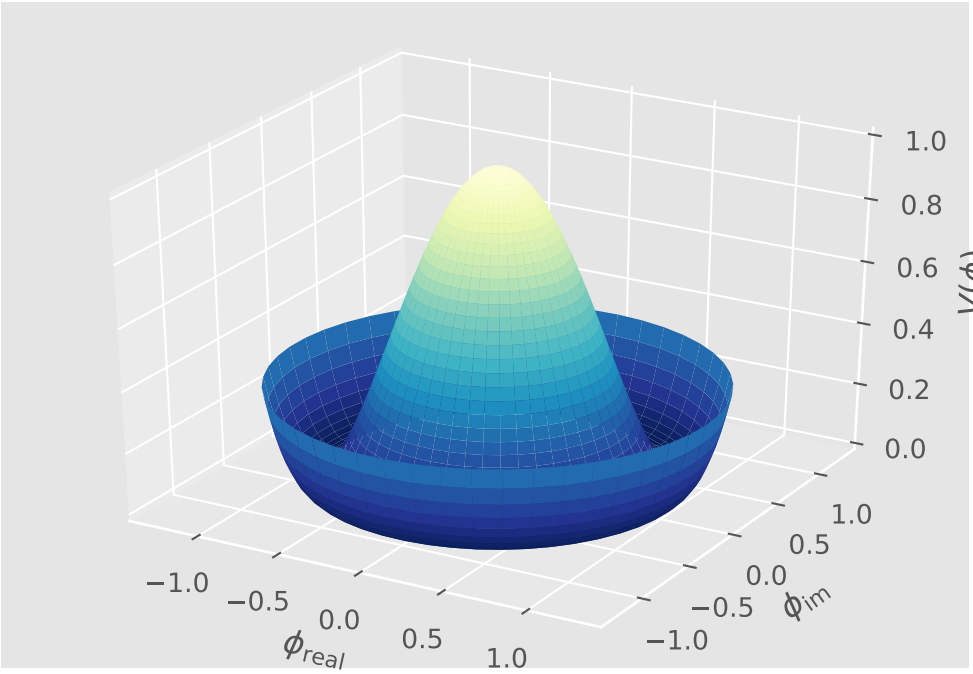

```
# https://www.python-course.eu/matplotlib_multiple_figures.php
import numpy as np
import matplotlib.pyplot as plt
def f(t):
    return np.exp(-t) * np.cos(2*np.pi*t)
def g(t):
    return np.sin(t) * np.cos(1/(t+0.1))
t1 = np.arange(0.0, 5.0, 0.1)
t2 = np.arange(0.0, 5.0, 0.02)
plt.subplot(212)
plt.plot(t1, g(t1), 'ro', t2, f(t2), 'k')
plt.grid(color='b', alpha=0.5, linestyle='dashed', linewidth=0.5)
plt.show()
```




```
# https://www.python-course.eu/matplotlib_multiple_figures.php
import matplotlib.gridspec as gridspec
import matplotlib.pyplot as plt
import numpy as np
plt.figure(figsize=(6, 4))
G = gridspec.GridSpec(3, 3)
X = np.linspace(0, 2 * np.pi, 50, endpoint=True)
F1 = 2.8 * np.cos(X)
F2 = 5 * np.sin(X)
F3 = 0.3 * np.sin(X)
axes_1 = plt.subplot(G[0, :])
axes_1.plot(X, F1, 'r-', X, F2)
axes_2 = plt.subplot(G[1, :-1])
axes_2.plot(X, F3)
axes_3 = plt.subplot(G[1:, -1])
axes_3.plot([1,2,3,4], [1,10,100,1000], 'b-')
axes_4 = plt.subplot(G[-1, 0])
axes_4.plot([1,2,3,4], [47, 11, 42, 60], 'r-')
axes_5 = plt.subplot(G[-1, -2])
axes_5.plot([1,2,3,4], [7, 5, 4, 3.8])
plt.tight_layout()
plt.show()
```



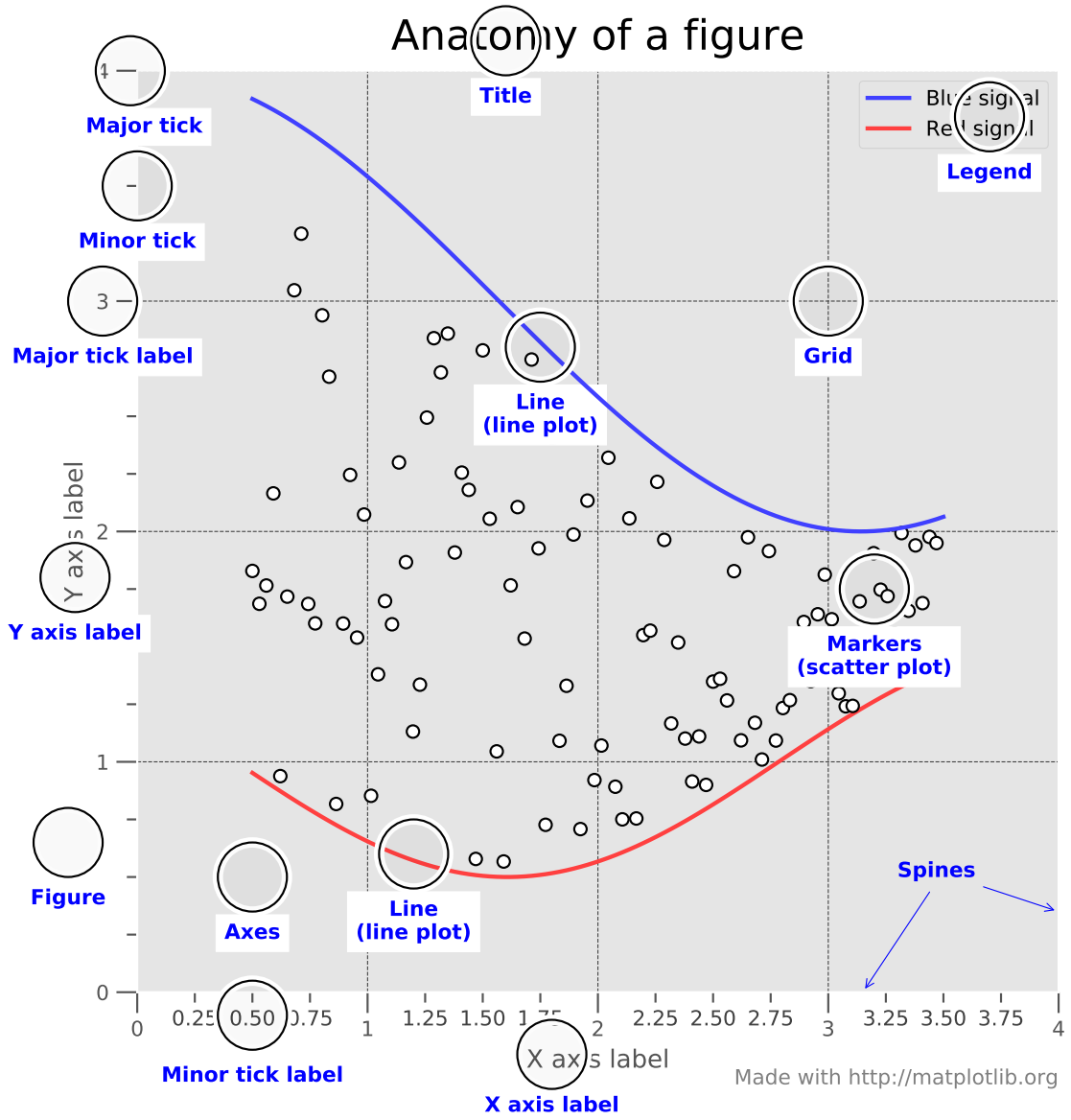

```
# https://github.com/matplotlib/matplotlib/blob/master/examples/mplot3d/surface3d_radial.py
from mpl_toolkits.mplot3d import Axes3D  # noqa: F401 unused import
import matplotlib.pyplot as plt
import numpy as np
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
# Create the mesh in polar coordinates and compute corresponding Z.
r = np.linspace(0, 1.25, 50)
p = np.linspace(0, 2*np.pi, 50)
R, P = np.meshgrid(r, p)
Z = ((R**2 - 1)**2)
# Express the mesh in the cartesian system.
X, Y = R*np.cos(P), R*np.sin(P)
# Plot the surface.
ax.plot_surface(X, Y, Z, cmap=plt.cm.YlGnBu_r)
# Tweak the limits and add latex math labels.
ax.set_zlim(0, 1)
ax.set_xlabel(r'$\phi_\mathrm{real}$')
ax.set_ylabel(r'$\phi_\mathrm{im}$')
ax.set_zlabel(r'$V(\phi)$')
plt.show()
```



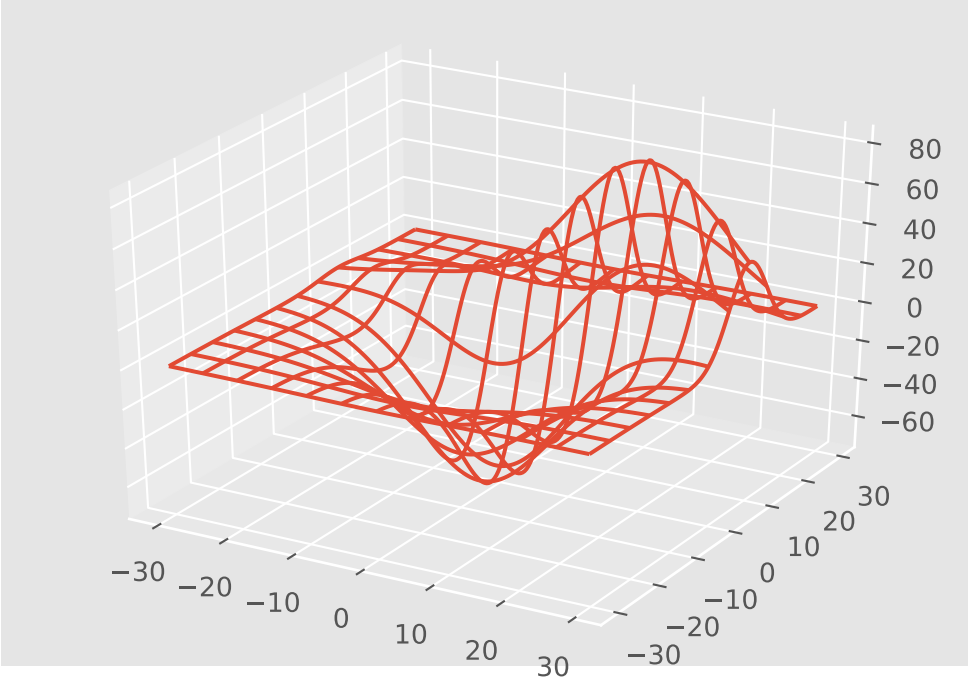

```python
# https://matplotlib.org/gallery/showcase/anatomy.html#sphx-glr-gallery-showcase-anatomy-py
import numpy as np
import matplotlib.pyplot as plt
from matplotlib.ticker import AutoMinorLocator, MultipleLocator, FuncFormatter
np.random.seed(19680801)
X = np.linspace(0.5, 3.5, 100)
Y1 = 3+np.cos(X)
Y2 = 1+np.cos(1+X/0.75)/2
Y3 = np.random.uniform(Y1, Y2, len(X))
fig = plt.figure(figsize=(8, 8))
ax = fig.add_subplot(1, 1, 1, aspect=1)
def minor_tick(x, pos):
    if not x % 1.0:
        return ""
    return "%.2f" % x
ax.xaxis.set_major_locator(MultipleLocator(1.000))
ax.xaxis.set_minor_locator(AutoMinorLocator(4))
ax.yaxis.set_major_locator(MultipleLocator(1.000))
ax.yaxis.set_minor_locator(AutoMinorLocator(4))
ax.xaxis.set_minor_formatter(FuncFormatter(minor_tick))
ax.set_xlim(0, 4)
ax.set_ylim(0, 4)
ax.tick_params(which='major', width=1.0)
ax.tick_params(which='major', length=10)
ax.tick_params(which='minor', width=1.0, labelsize=10)
ax.tick_params(which='minor', length=5, labelsize=10, labelcolor='0.25')
```

```
ax.grid(linestyle="--", linewidth=0.5, color='.25', zorder=-10)
ax.plot(X, Y1, c=(0.25, 0.25, 1.00), lw=2, label="Blue signal", zorder=10)
ax.plot(X, Y2, c=(1.00, 0.25, 0.25), lw=2, label="Red signal")
ax.plot(X, Y3, linewidth=0,
        marker='o', markerfacecolor='w', markeredgecolor='k')
ax.set_title("Anatomy of a figure", fontsize=20, verticalalignment='bottom')
ax.set_xlabel("X axis label")
ax.set_ylabel("Y axis label")
ax.legend()
def circle(x, y, radius=0.15):
    from matplotlib.patches import Circle
    from matplotlib.patheffects import withStroke
    circle = Circle((x, y), radius, clip_on=False, zorder=10, linewidth=1,
                    edgecolor='black', facecolor=(0, 0, 0, .0125),
                    path_effects=[withStroke(linewidth=5, foreground='w')])
    ax.add_artist(circle)
def text(x, y, text):
    ax.text(x, y, text, backgroundcolor="white",
            ha='center', va='top', weight='bold', color='blue')
# Minor tick
circle(0.50, -0.10)
text(0.50, -0.32, "Minor tick label")
# Major tick
circle(-0.03, 4.00)
text(0.03, 3.80, "Major tick")
# Minor tick
circle(0.00, 3.50)
text(0.00, 3.30, "Minor tick")
# Major tick label
circle(-0.15, 3.00)
text(-0.15, 2.80, "Major tick label")
# X Label
circle(1.80, -0.27)
text(1.80, -0.45, "X axis label")
# Y Label
circle(-0.27, 1.80)
text(-0.27, 1.6, "Y axis label")
# Title
circle(1.60, 4.13)
text(1.60, 3.93, "Title")
# Blue plot
circle(1.75, 2.80)
text(1.75, 2.60, "Line\n(line plot)")
# Red plot
circle(1.20, 0.60)
text(1.20, 0.40, "Line\n(line plot)")
# Scatter plot
circle(3.20, 1.75)
text(3.20, 1.55, "Markers\n(scatter plot)")
# Grid
circle(3.00, 3.00)
text(3.00, 2.80, "Grid")
# Legend
```

```
circle(3.70, 3.80)
text(3.70, 3.60, "Legend")
# Axes
circle(0.5, 0.5)
text(0.5, 0.3, "Axes")
# Figure
circle(-0.3, 0.65)
text(-0.3, 0.45, "Figure")
color = 'blue'
ax.annotate('Spines', xy=(4.0, 0.35), xycoords='data',
            xytext=(3.3, 0.5), textcoords='data',
            weight='bold', color=color,
            arrowprops=dict(arrowstyle='->',
                            connectionstyle="arc3",
                            color=color))
ax.annotate('', xy=(3.15, 0.0), xycoords='data',
            xytext=(3.45, 0.45), textcoords='data',
            weight='bold', color=color,
            arrowprops=dict(arrowstyle='->',
                            connectionstyle="arc3",
                            color=color))
ax.text(4.0, -0.4, "Made with http://matplotlib.org",
        fontsize=10, ha="right", color='.5')
plt.show()
```

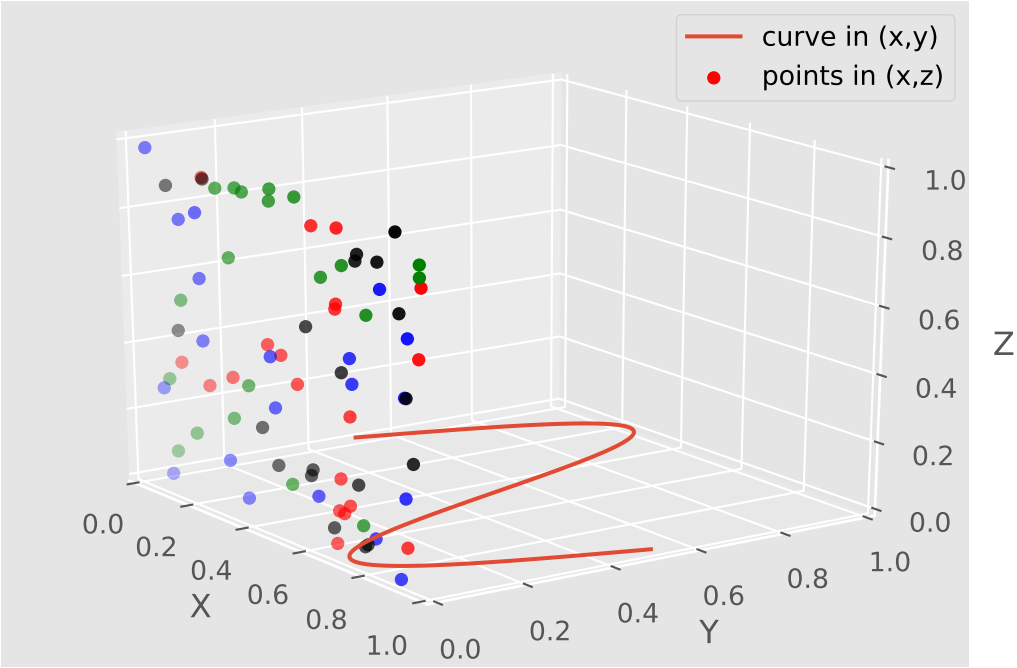



```
# https://github.com/matplotlib/matplotlib/blob/master/examples/mplot3d/wire3d.py
from mpl_toolkits.mplot3d import axes3d
import matplotlib.pyplot as plt
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
# Grab some test data.
X, Y, Z = axes3d.get_test_data(0.05)
# Plot a basic wireframe.
ax.plot_wireframe(X, Y, Z, rstride=10, cstride=10)
plt.show()
```




```
from mpl_toolkits.mplot3d import Axes3D  # noqa: F401 unused import
import numpy as np
import matplotlib.pyplot as plt
fig = plt.figure()
ax = fig.gca(projection='3d')
# Plot a sin curve using the x and y axes.
x = np.linspace(0, 1, 100)
y = np.sin(x * 2 * np.pi) / 2 + 0.5
ax.plot(x, y, zs=0, zdir='z', label='curve in (x,y)')
# Plot scatterplot data (20 2D points per colour) on the x and z axes.
colors = ('r', 'g', 'b', 'k')
# Fixing random state for reproducibility
np.random.seed(19680801)
x = np.random.sample(20 * len(colors))
y = np.random.sample(20 * len(colors))
c_list = []
for c in colors:
    c_list.extend([c] * 20)
# By using zdir='y', the y value of these points is fixed to the zs value 0
# and the (x,y) points are plotted on the x and z axes.
ax.scatter(x, y, zs=0, zdir='y', c=c_list, label='points in (x,z)')
# Make legend, set axes limits and labels
ax.legend()
ax.set_xlim(0, 1)
ax.set_ylim(0, 1)
ax.set_zlim(0, 1)
```

```
ax.set_xlabel('X')
ax.set_ylabel('Y')
ax.set_zlabel('Z')
# Customize the view angle so it's easier to see that the scatter points lie
# on the plane y=0
ax.view_init(elev=20., azim=-35)
plt.show()
```




```
# https://www.kaggle.com/sskiing/matplotlib-showcase-examples
import numpy as np
import matplotlib.pyplot as plt
from matplotlib.patches import Polygon
def func(x):
    return (x - 3) * (x - 5) * (x - 7) + 85
a, b = 2, 9  # integral limits
x = np.linspace(0, 10)
y = func(x)
fig, ax = plt.subplots(dpi=200)
```

```
C:\Users\ipm\WPY-36~1\PYTHON~1.AMD\lib\site-packages\matplotlib\pyplot.py:514: RuntimeWarning: More tha
  max_open_warning, RuntimeWarning)
```

```
plt.plot(x, y, 'r', linewidth=2)
plt.ylim(ymin=0)
# Make the shaded region
```

```
C:\Users\ipm\WPY-36~1\PYTHON~1.AMD\lib\site-packages\matplotlib\axes\_base.py:3604: MatplotlibDeprecati
```

```
The `ymin` argument was deprecated in Matplotlib 3.0 and will be removed in 3.2. Use `bottom` instead.
  alternative='`bottom`', obj_type='argument')
```

```
ix = np.linspace(a, b)
iy = func(ix)
verts = [(a, 0)] + list(zip(ix, iy)) + [(b, 0)]
poly = Polygon(verts, facecolor='0.9', edgecolor='0.5')
ax.add_patch(poly)
plt.text(0.5 * (a + b), 30, r"$\int_a^b f(x)\mathrm{d}x$",
         horizontalalignment='center', fontsize=20)
plt.figtext(0.9, 0.05, '$x$')
plt.figtext(0.1, 0.9, '$y$')
ax.spines['right'].set_visible(False)
ax.spines['top'].set_visible(False)
ax.xaxis.set_ticks_position('bottom')
ax.set_xticks((a, b))
ax.set_xticklabels(('$a$', '$b$'))
ax.set_yticks([])
plt.show()
```