intro_Matplotlib

September 6, 2017

```
In [1]: # The following is to know when this notebook has been run and with which python version
        import time, sys
        print(time.ctime())
        print(sys.version.split('|')[0])
```

```
Wed Sep  6 20:43:44 2017
3.6.1
```

This is part of the Python lecture given by Veronica Gomez Llanos and Christophe Morisset at IA-UNAM. More informations at: http://python-astro.blogspot.mx/

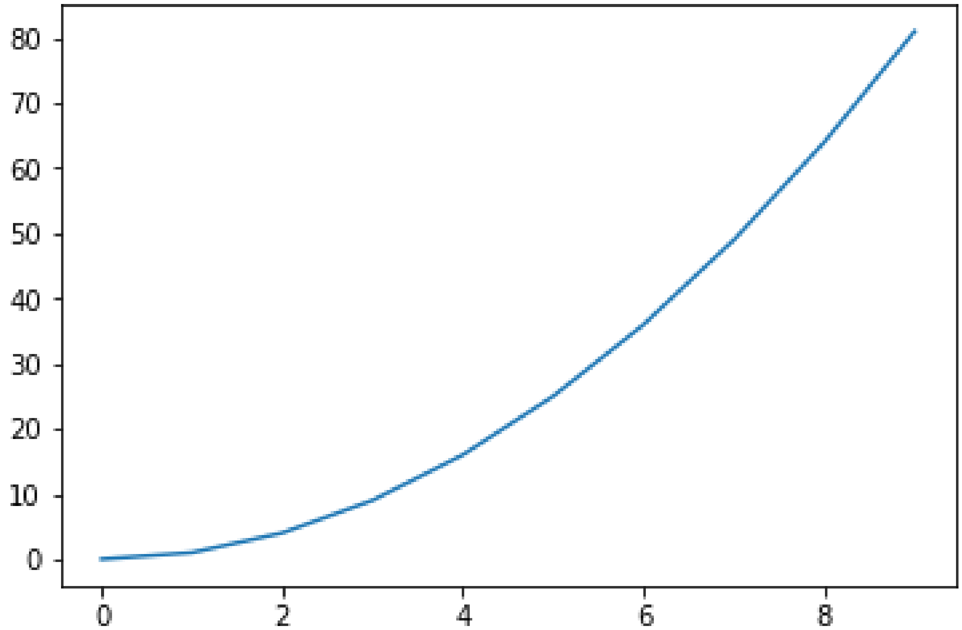
1 D: How to make plots, images, 3D, etc, using Matplotlib

```
In [2]: # this allows the plots to appear in the Notebook webpage:
        %matplotlib inline
        import numpy as np
        import matplotlib.pyplot as plt # this is the plotting library
```

Very well done tutorials on the mail Matplotlib web page: http://matplotlib.org/

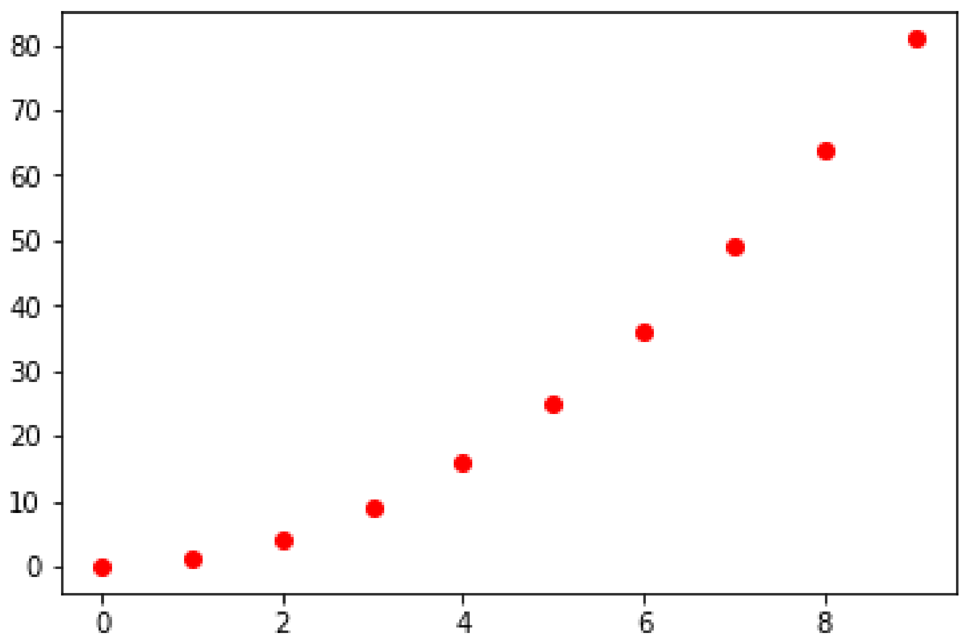
Simple plot In the following cell, we plot a function

```
In [3]: # Just to convince that things are easy:
        x = np.arange(10) # define an array
        plt.plot(x, x**2); # so quickly plotted... Notice the ";" at the end of the line -> ;
```

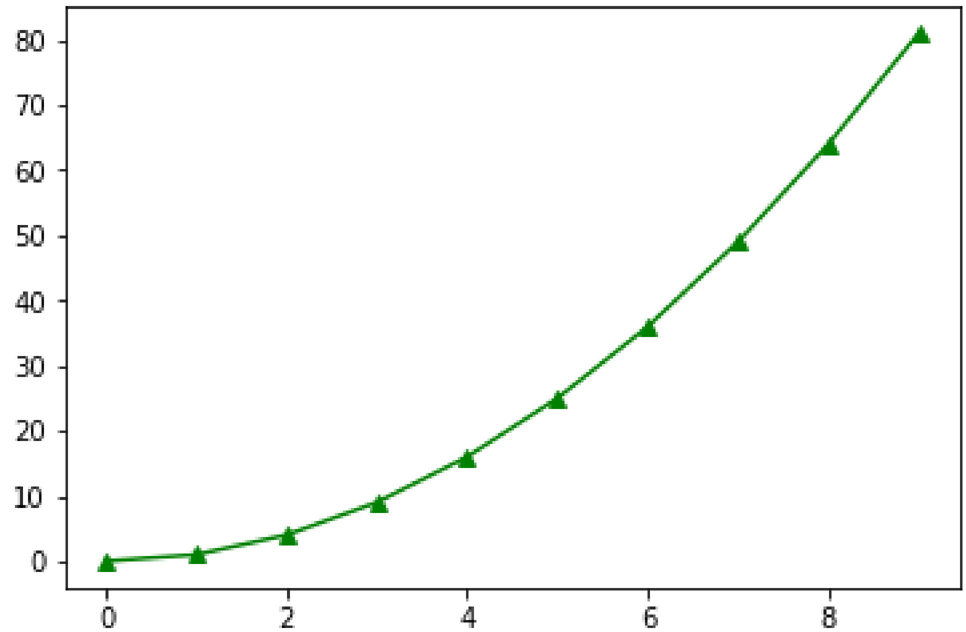


Controling colors and symbols

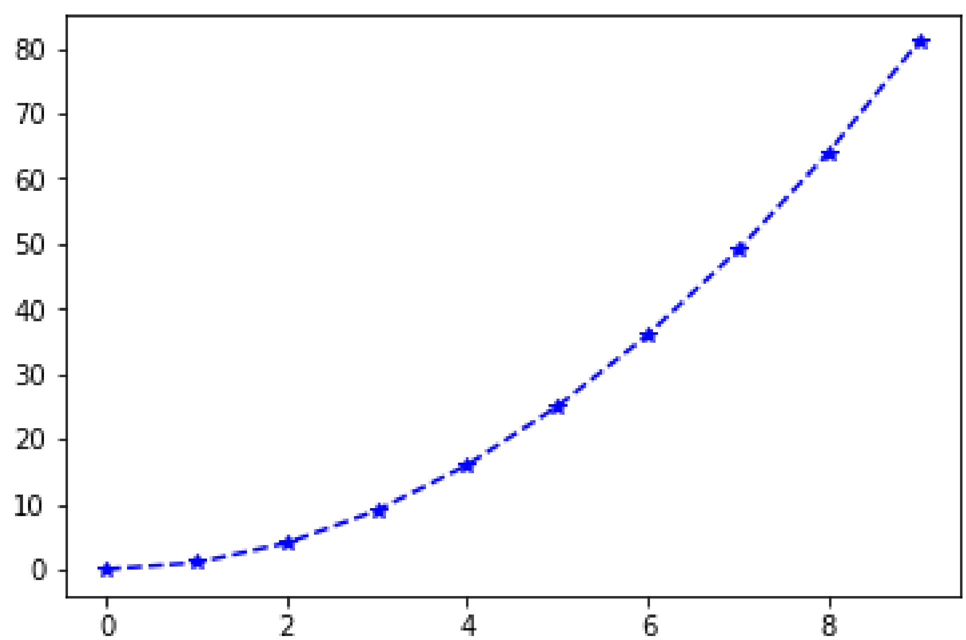
```
In [4]: f = lambda x: x**2
        plt.plot(x, f(x), 'or');
```



In [5]:
```
plt.plot(x, f(x), c='green', marker='^');
```



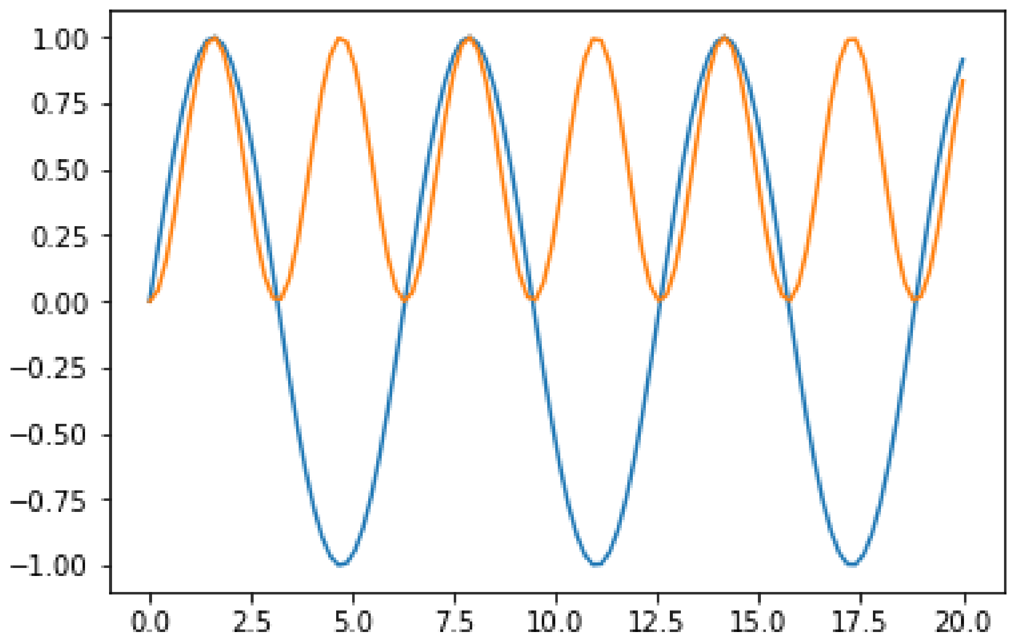
In [6]:
```
# To illustrate the possibilities of the interactive window:
%matplotlib tk
plt.plot(x, f(x), '*b', linestyle='--') ;
```



```
In [7]: # Back to the inline graphics mode
        %matplotlib inline
```

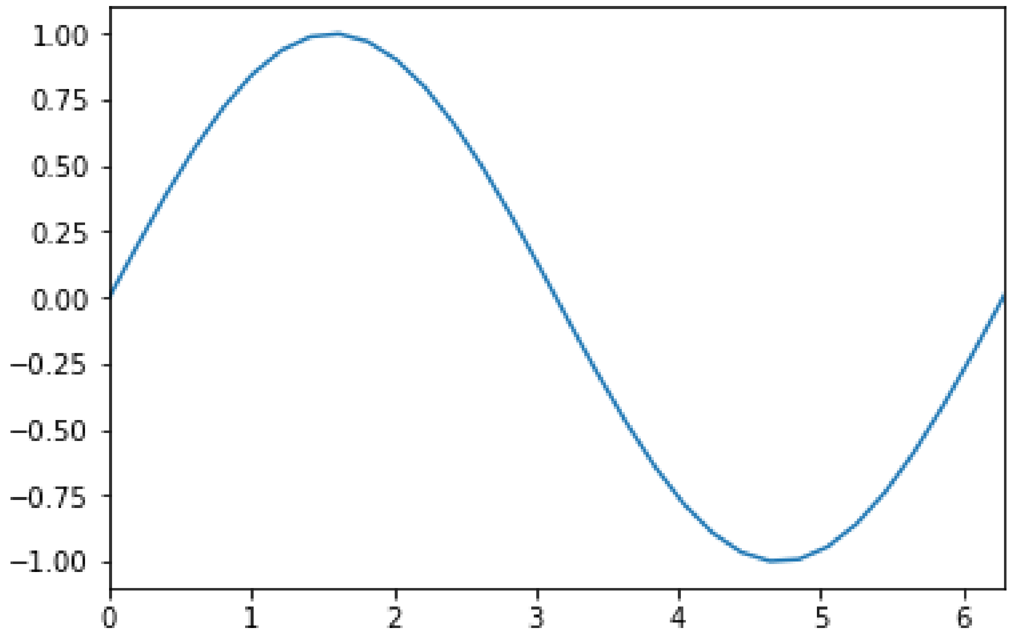
Overplot

```
In [8]: x = np.linspace(0, 20, 100)  # 100 evenly-spaced values from 0 to 20
        y = np.sin(x)

        plt.plot(x, y)
        plt.plot(x, y**2); # overplot by default;
```



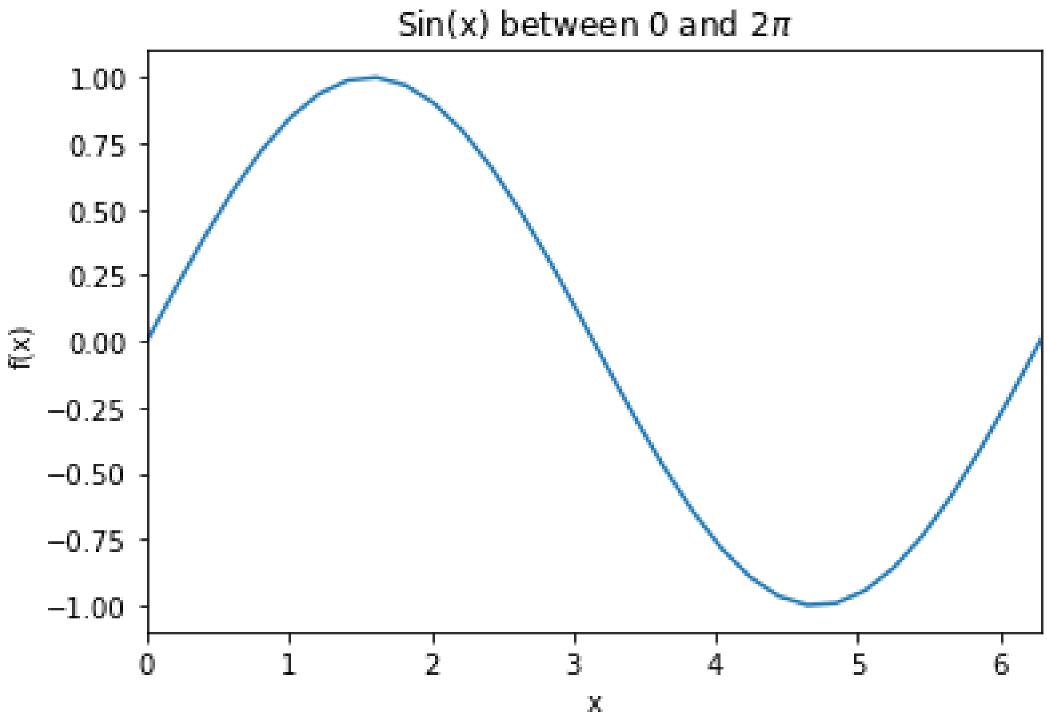
Fixing axes limits

```
In [9]: plt.plot(x, y)
        plt.xlim(0., np.pi*2); # Take car, it's NOT plt.xlim = (1, 2), this would ERASE the xlim
```



Labels, titles

```
In [10]: plt.plot(x, y)
         plt.xlim((0., np.pi*2))
         plt.title(r'Sin(x) between 0 and $2\pi$')
         plt.xlabel('x')
         plt.ylabel('f(x)');
```



plot method documentation

```
In [11]: help(plt.plot)
```

```
Help on function plot in module matplotlib.pyplot:

plot(*args, **kwargs)
    Plot lines and/or markers to the
    :class:`~matplotlib.axes.Axes`.  *args* is a variable length
    argument, allowing for multiple *x*, *y* pairs with an
    optional format string.  For example, each of the following is
    legal::

        plot(x, y)        # plot x and y using default line style and color
        plot(x, y, 'bo')  # plot x and y using blue circle markers
        plot(y)           # plot y using x as index array 0..N-1
        plot(y, 'r+')     # ditto, but with red plusses

    If *x* and/or *y* is 2-dimensional, then the corresponding columns
    will be plotted.

    If used with labeled data, make sure that the color spec is not
    included as an element in data, as otherwise the last case
```

```
``plot("v","r", data={"v":..., "r":...)``
can be interpreted as the first case which would do ``plot(v, r)``
using the default line style and color.

If not used with labeled data (i.e., without a data argument),
an arbitrary number of *x*, *y*, *fmt* groups can be specified, as in::

    a.plot(x1, y1, 'g^', x2, y2, 'g-')

Return value is a list of lines that were added.

By default, each line is assigned a different style specified by a
'style cycle'.  To change this behavior, you can edit the
axes.prop_cycle rcParam.

The following format string characters are accepted to control
the line style or marker:

================    ===============================
character           description
================    ===============================
``'-'``             solid line style
``'--'``            dashed line style
``'-.'``            dash-dot line style
``':'``             dotted line style
``'.'``             point marker
``','``             pixel marker
``'o'``             circle marker
``'v'``             triangle_down marker
``'^'``             triangle_up marker
``'<'``             triangle_left marker
``'>'``             triangle_right marker
``'1'``             tri_down marker
``'2'``             tri_up marker
``'3'``             tri_left marker
``'4'``             tri_right marker
``'s'``             square marker
``'p'``             pentagon marker
``'*'``             star marker
``'h'``             hexagon1 marker
``'H'``             hexagon2 marker
``'+'``             plus marker
``'x'``             x marker
``'D'``             diamond marker
``'d'``             thin_diamond marker
``'|'``             vline marker
``'_'``             hline marker
================    ===============================
```

The following color abbreviations are supported:

character	color
'b'	blue
'g'	green
'r'	red
'c'	cyan
'm'	magenta
'y'	yellow
'k'	black
'w'	white

In addition, you can specify colors in many weird and wonderful ways, including full names (``'green'``), hex strings (``'#008000'``), RGB or RGBA tuples (``(0,1,0,1)``) or grayscale intensities as a string (``'0.8'``). Of these, the string specifications can be used in place of a ``fmt`` group, but the tuple forms can be used only as ``kwargs``.

Line styles and colors are combined in a single format string, as in ``'bo'`` for blue circles.

The *kwargs* can be used to set line properties (any property that has a ``set_*`` method). You can use this to set a line label (for auto legends), linewidth, anitialising, marker face color, etc. Here is an example::

```
plot([1,2,3], [1,2,3], 'go-', label='line 1', linewidth=2)
plot([1,2,3], [1,4,9], 'rs',  label='line 2')
axis([0, 4, 0, 10])
legend()
```

If you make multiple lines with one plot command, the kwargs apply to all those lines, e.g.::

```
plot(x1, y1, x2, y2, antialiased=False)
```

Neither line will be antialiased.

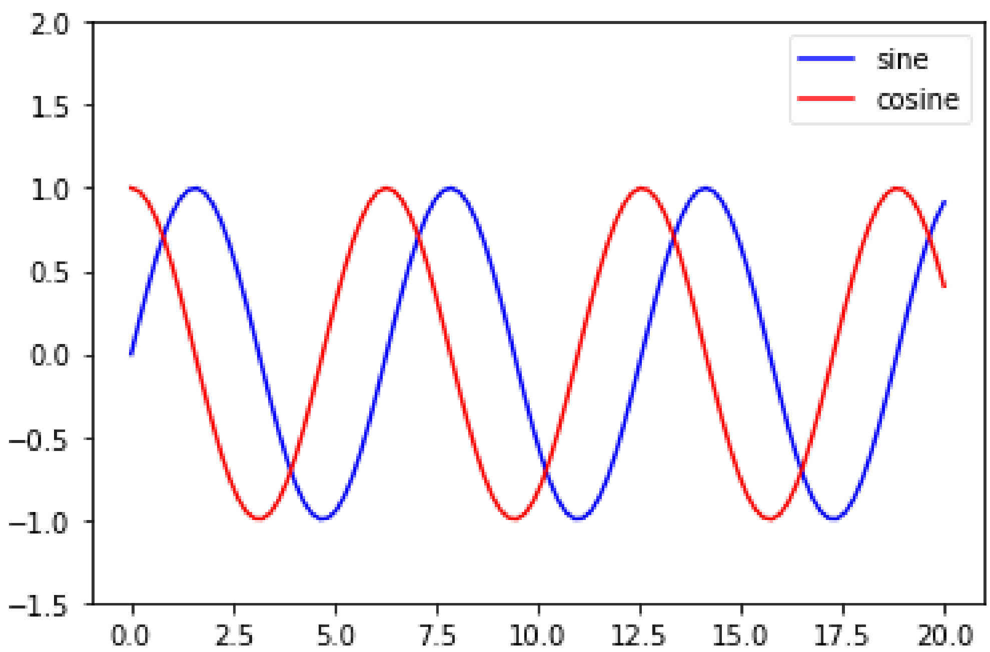
You do not need to use format strings, which are just abbreviations. All of the line properties can be controlled by keyword arguments. For example, you can set the color, marker, linestyle, and markercolor with::

```
    plot(x, y, color='green', linestyle='dashed', marker='o',
         markerfacecolor='blue', markersize=12).

See :class:`~matplotlib.lines.Line2D` for details.

The kwargs are :class:`~matplotlib.lines.Line2D` properties:

  agg_filter: unknown
  alpha: float (0.0 transparent through 1.0 opaque)
  animated: [True | False]
  antialiased or aa: [True | False]
  axes: an :class:`~matplotlib.axes.Axes` instance
  clip_box: a :class:`matplotlib.transforms.Bbox` instance
  clip_on: [True | False]
  clip_path: [ (:class:`~matplotlib.path.Path`, :class:`~matplotlib.transforms.Transform`) |
  color or c: any matplotlib color
  contains: a callable function
  dash_capstyle: ['butt' | 'round' | 'projecting']
  dash_joinstyle: ['miter' | 'round' | 'bevel']
  dashes: sequence of on/off ink in points
  drawstyle: ['default' | 'steps' | 'steps-pre' | 'steps-mid' | 'steps-post']
  figure: a :class:`matplotlib.figure.Figure` instance
  fillstyle: ['full' | 'left' | 'right' | 'bottom' | 'top' | 'none']
  gid: an id string
  label: string or anything printable with '%s' conversion.
  linestyle or ls: ['solid' | 'dashed', 'dashdot', 'dotted' | (offset, on-off-dash-seq) | ``
  linewidth or lw: float value in points
  marker: :mod:`A valid marker style <matplotlib.markers>`
  markeredgecolor or mec: any matplotlib color
  markeredgewidth or mew: float value in points
  markerfacecolor or mfc: any matplotlib color
  markerfacecoloralt or mfcalt: any matplotlib color
  markersize or ms: float
  markevery: [None | int | length-2 tuple of int | slice | list/array of int | float | lengt
  path_effects: unknown
  picker: float distance in points or callable pick function ``fn(artist, event)``
  pickradius: float distance in points
  rasterized: [True | False | None]
  sketch_params: unknown
  snap: unknown
  solid_capstyle: ['butt' | 'round' |  'projecting']
  solid_joinstyle: ['miter' | 'round' | 'bevel']
  transform: a :class:`matplotlib.transforms.Transform` instance
  url: a url string
  visible: [True | False]
  xdata: 1D array
  ydata: 1D array
```

```
  zorder: any number

kwargs *scalex* and *scaley*, if defined, are passed on to
:meth:`~matplotlib.axes.Axes.autoscale_view` to determine
whether the *x* and *y* axes are autoscaled; the default is
*True*.

.. note::
    In addition to the above described arguments, this function can take a
    **data** keyword argument. If such a **data** argument is given, the
    following arguments are replaced by **data[<arg>]**:

    * All arguments with the following names: 'x', 'y'.
```

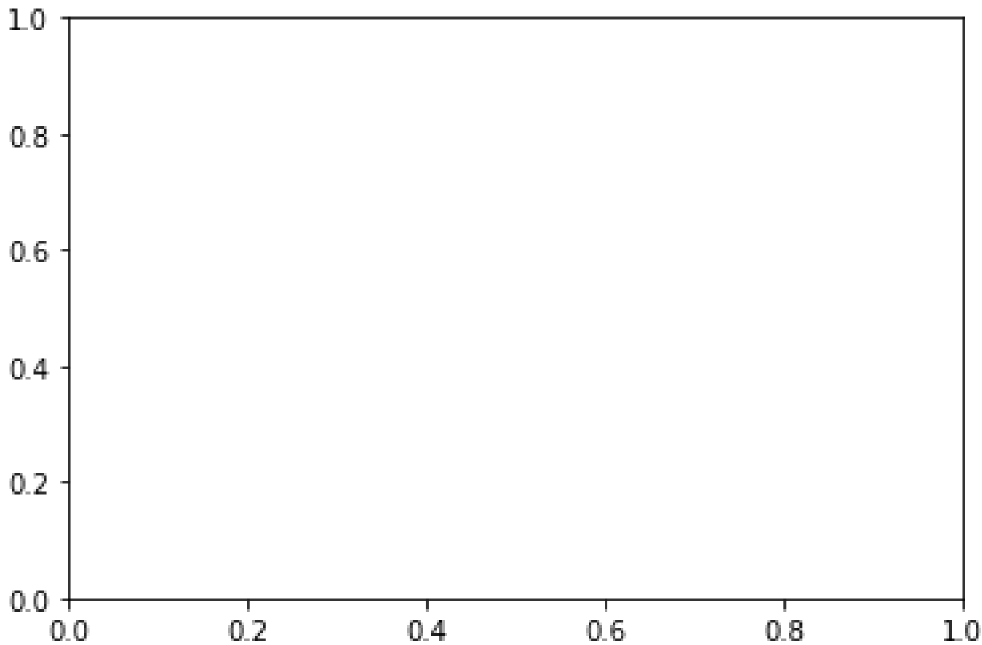
Legends

In [12]:
```python
x = np.linspace(0, 20, 100)
y1 = np.sin(x)
y2 = np.cos(x)

plt.plot(x, y1, '-b', label='sine')
plt.plot(x, y2, '-r', label='cosine')
plt.legend(loc='upper right', fancybox=True, framealpha=0.5)
plt.ylim((-1.5, 2.0));
```

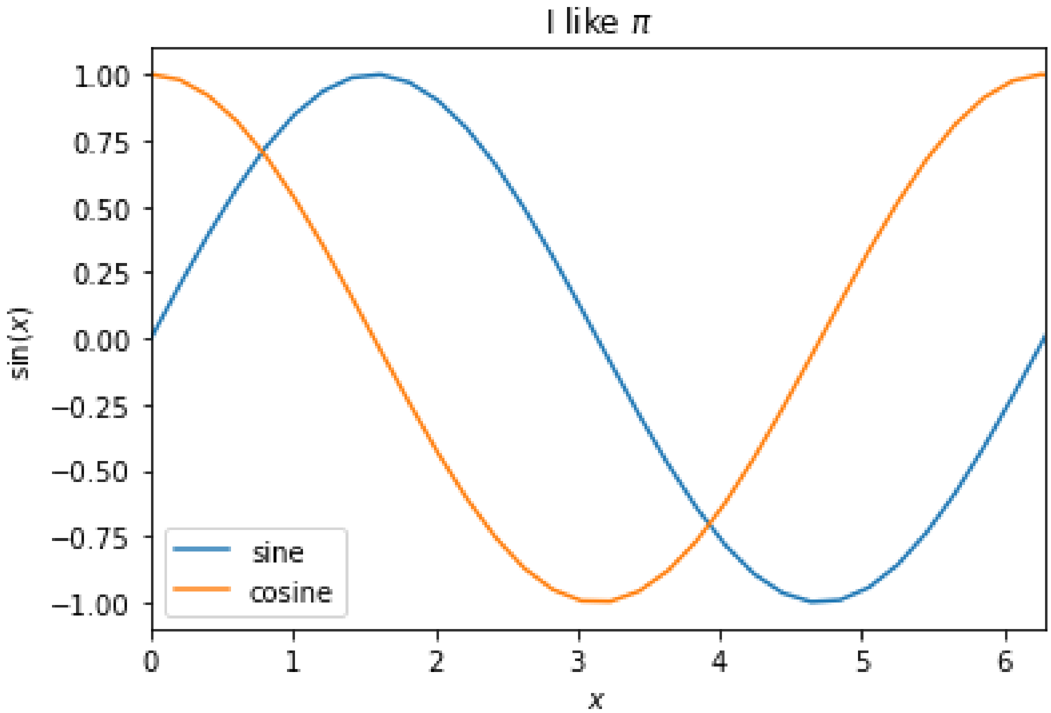


Object oriented way

```
In [13]: fig = plt.figure()  # a new figure window
         ax = fig.add_subplot(1,1,1)  # specify (nrows, ncols, axnum)
         #ax2 = fig.add_subplot(3, 2, 6)  # specify (nrows, ncols, axnum)
         # same as ax = fig.add_subplot()
```



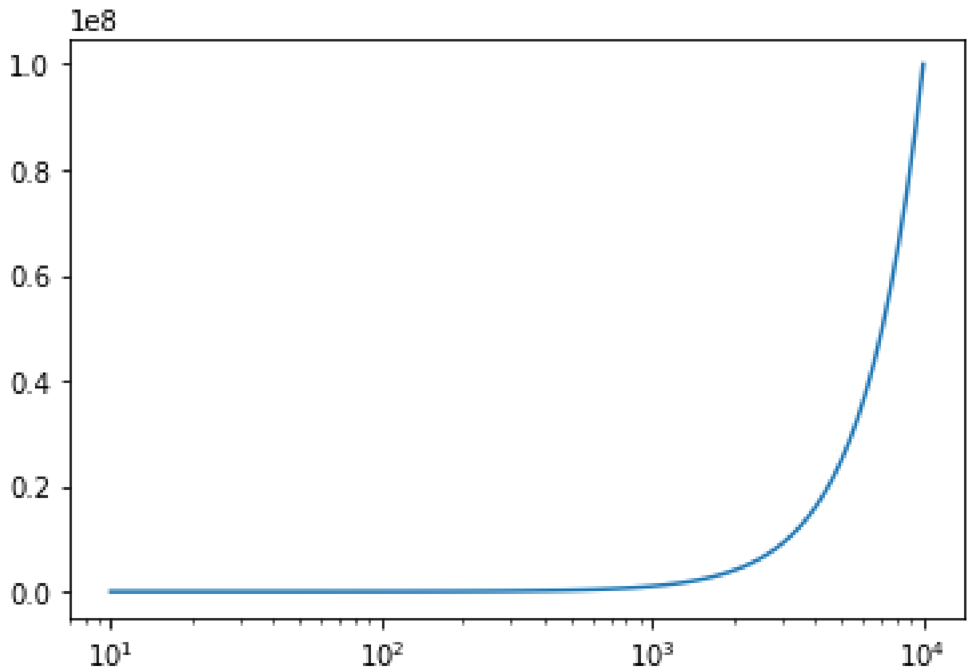

```
In [14]: fig, ax = plt.subplots()  # one command way
         ax.plot(x, y1)
         ax.plot(x, y2)
         ax.set_xlim(0., 2*np.pi)
         ax.legend(['sine', 'cosine'], loc='best') # If the legends are not already defined in t
         ax.set_xlabel("$x$")
         ax.set_ylabel("$\sin(x)$")
         ax.set_title("I like $\pi$");
```



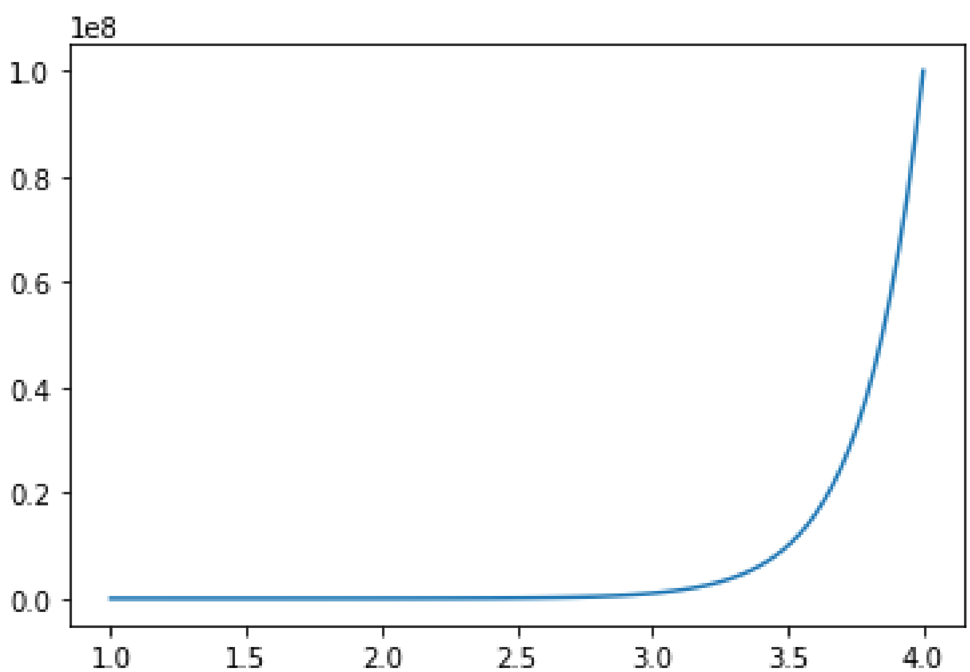

```
In [15]: # The following outputs a HUGE quantity of information! I comment it for now
         #help(ax)
```

log plots

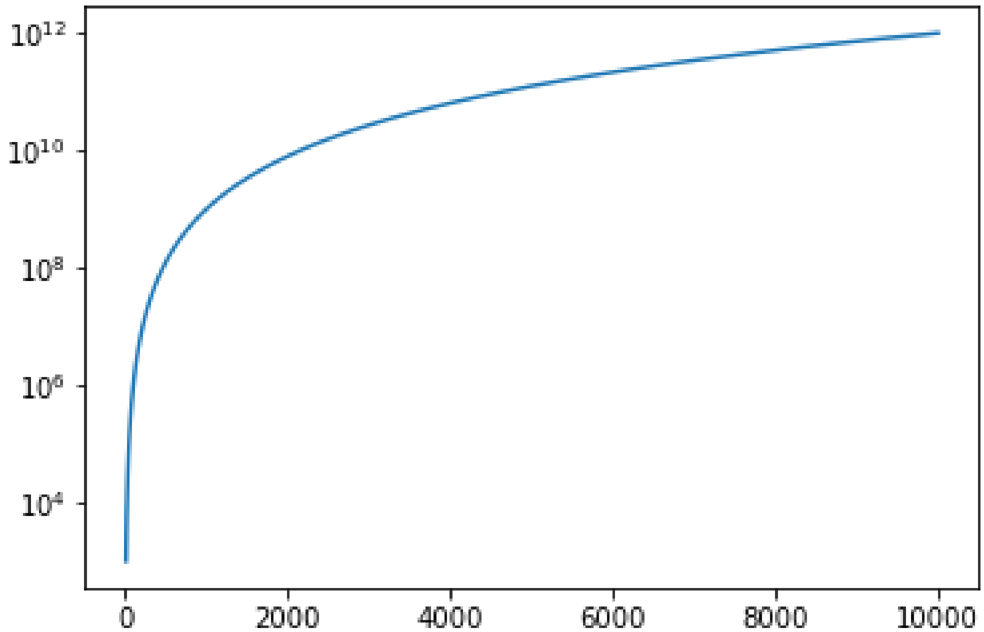
```
In [16]: xl = np.logspace(1, 4, 100)
         fig, ax = plt.subplots()
         ax.semilogx(xl, xl**2);
```



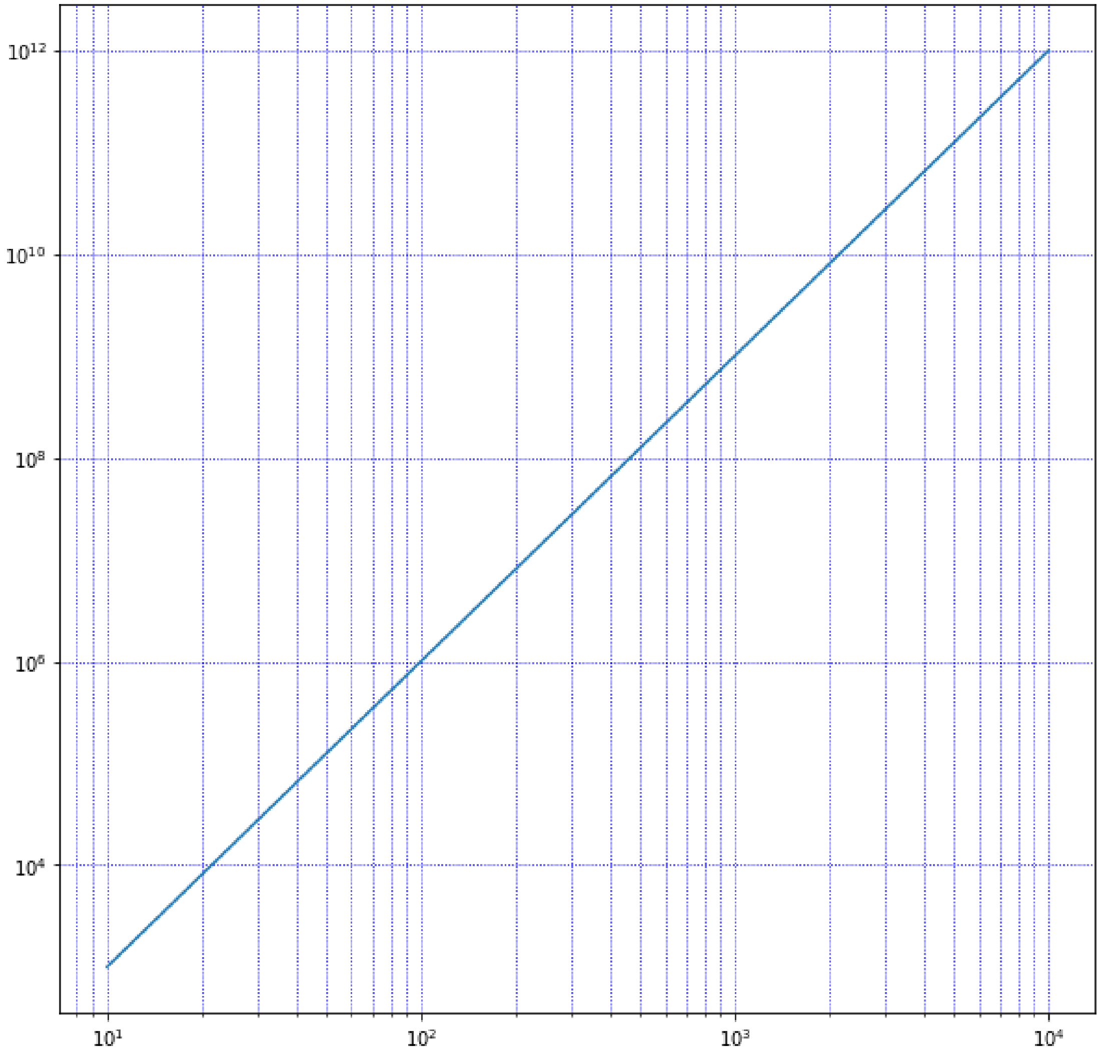
In [17]:
```
xl = np.logspace(1, 4, 100)
fig, ax = plt.subplots()
ax.plot(np.log10(xl), xl**2);
```



```
In [18]: fig, ax = plt.subplots()
         ax.semilogy(xl, xl**3);
```

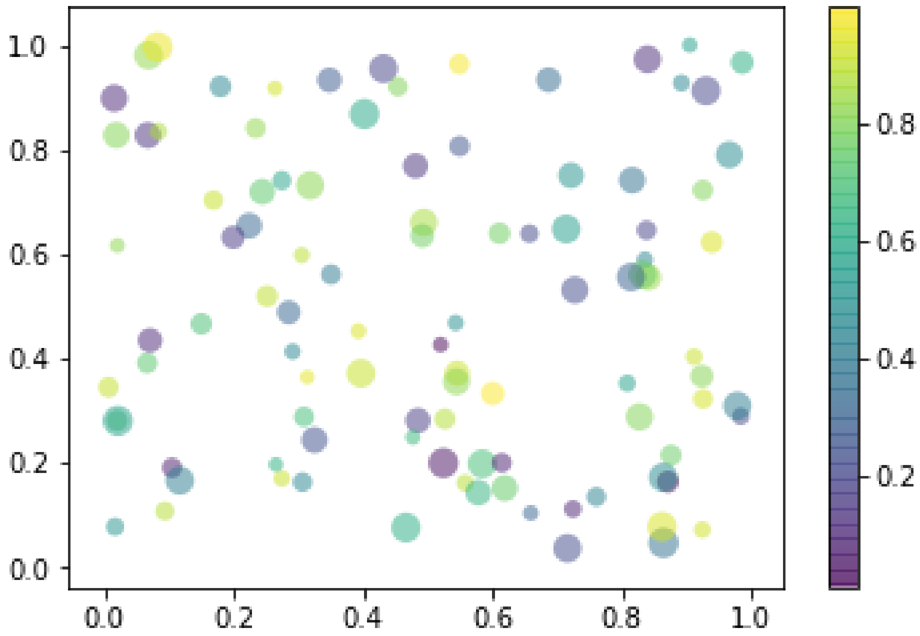



```
In [19]: fig, ax = plt.subplots(figsize=(10,10))
         ax.loglog(xl, xl**3);
         ax.grid(which="both",ls=":", c='blue')
```

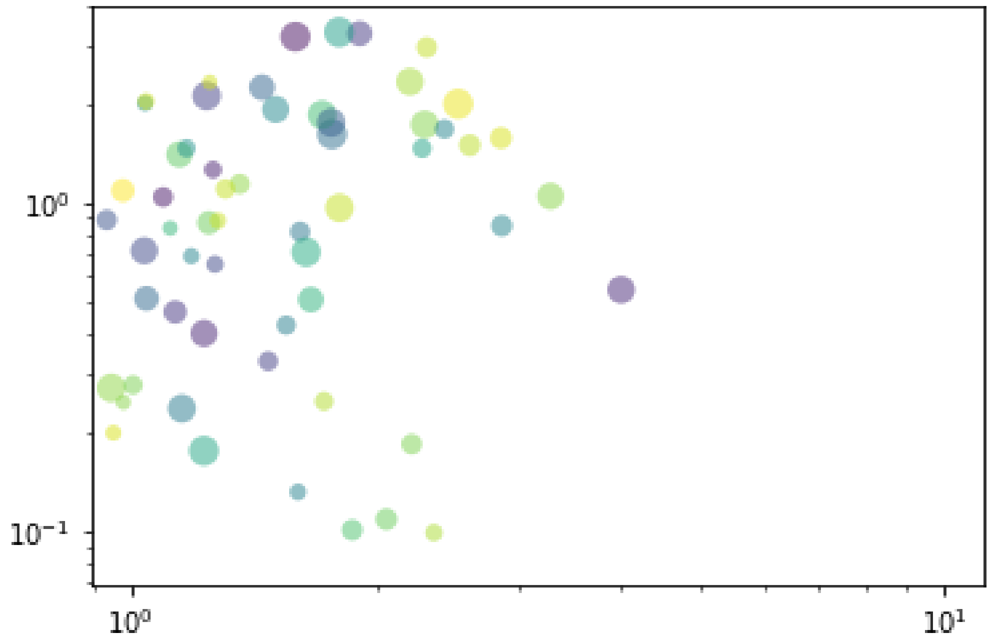


Scatter

In [20]:
```
xr = np.random.rand(100)
yr = np.random.rand(100)
cr = np.random.rand(100)
sr = np.random.rand(100)

fig, ax = plt.subplots()
sc = ax.scatter(xr, yr, c=cr, s=30+sr*100, edgecolor='none', alpha=0.5); # Sizes and co
fig.colorbar(sc);
```



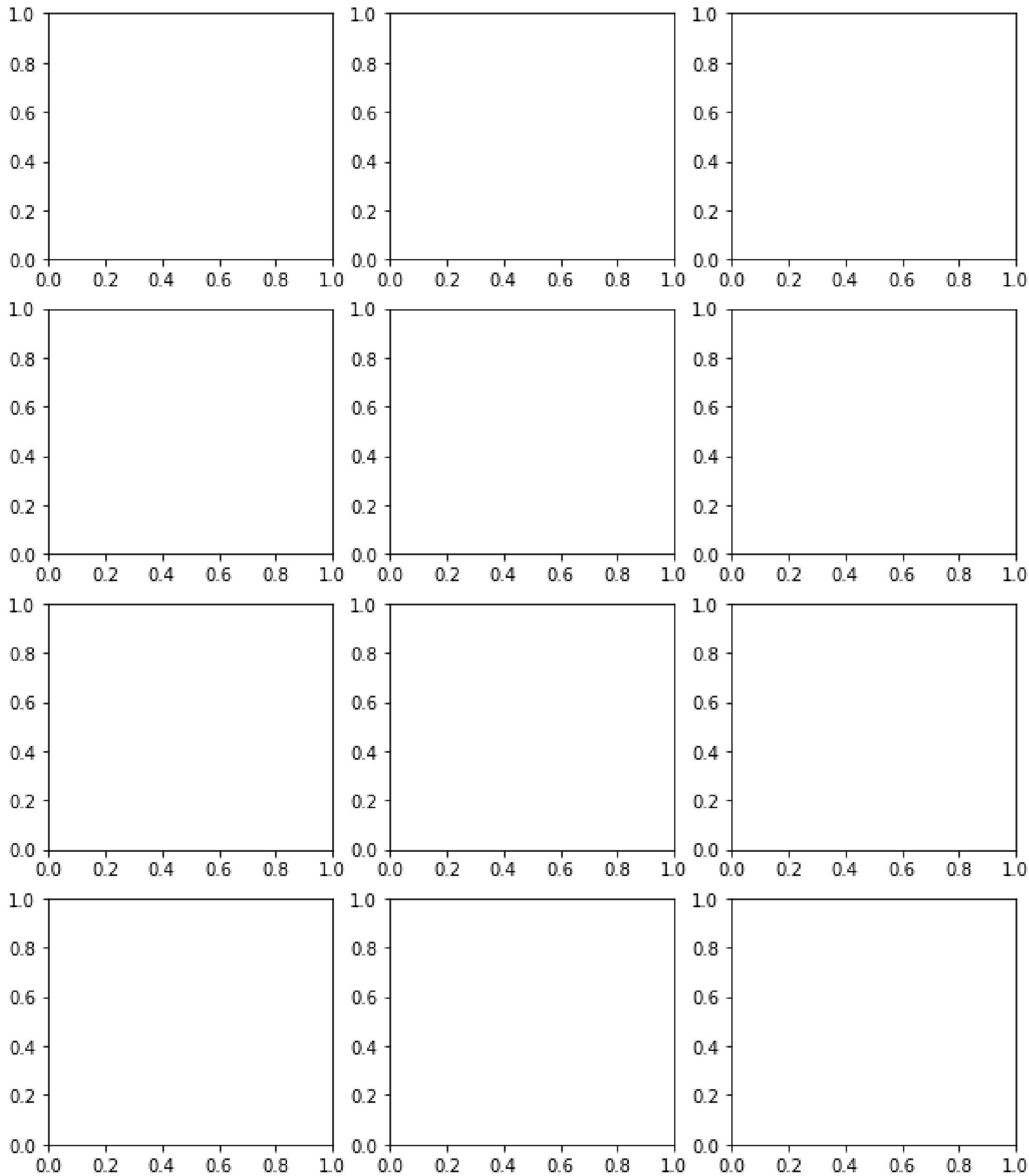
In [21]:
```
# log axes can be defined after the plot
xr = np.abs(1 + np.random.randn(100))
yr = np.abs(1 + np.random.randn(100))
fig, ax = plt.subplots()
sc = ax.scatter(xr, yr, c=cr, s=30+sr*100, edgecolor='none', alpha=0.5); # Sizes and co
ax.set_xscale('log')
ax.set_yscale('log')
```



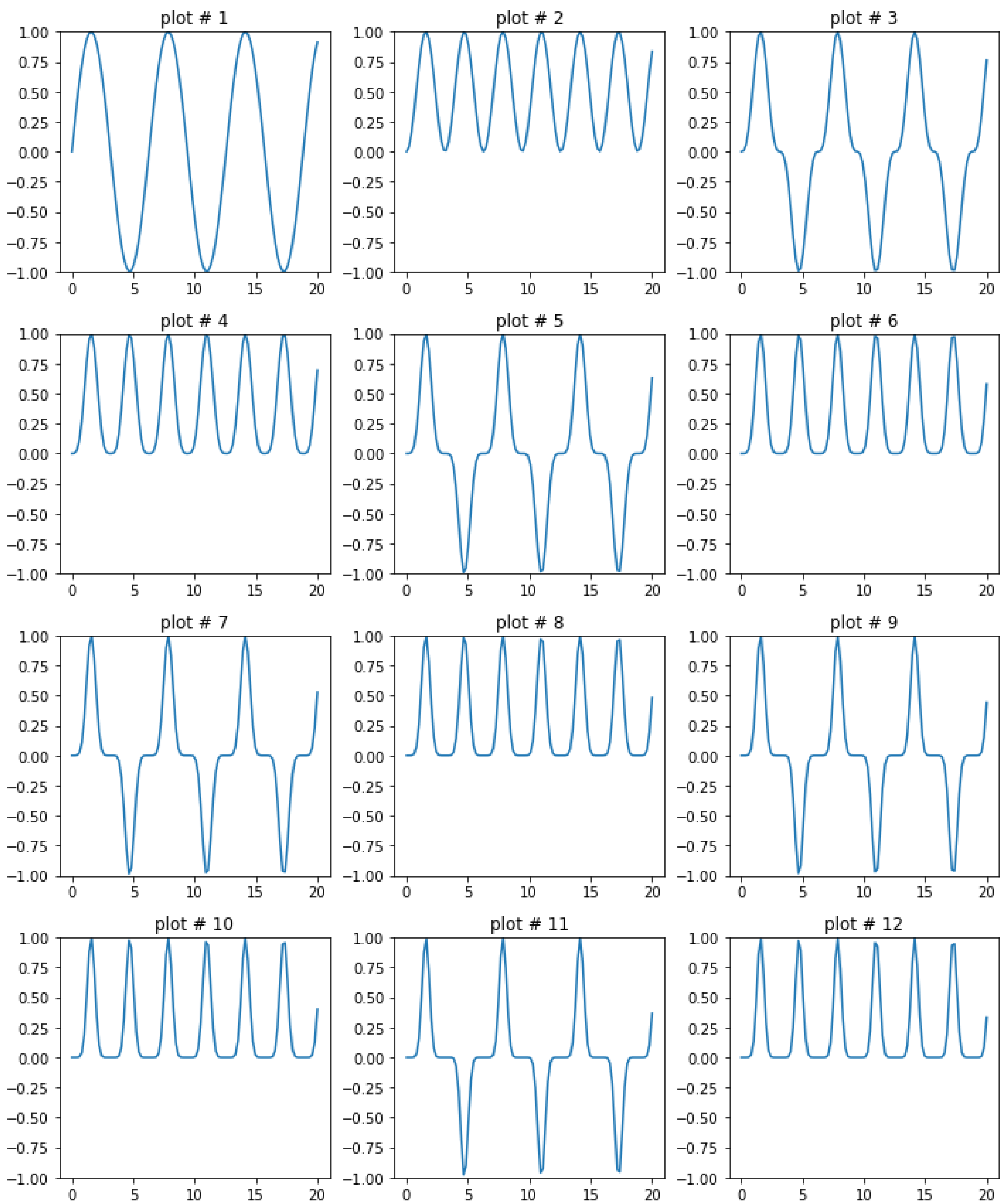
multiple plots

```
In [22]: fig, axes = plt.subplots(4, 3, figsize=(10,12))
         print(axes.shape)
```

```
(4, 3)
```

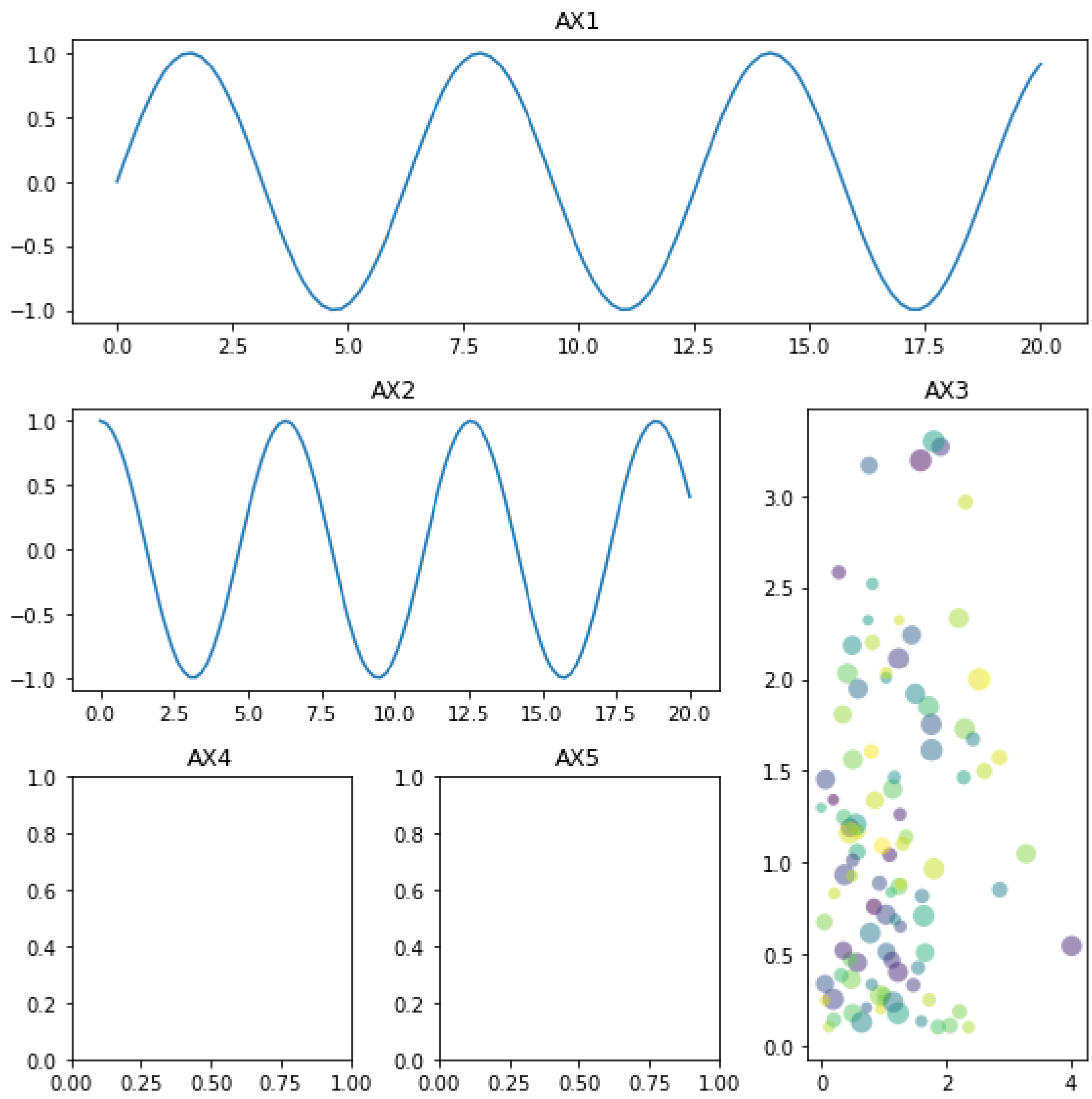


In [23]:
```
fig, axes = plt.subplots(4, 3, figsize=(10,12))
for i, ax in enumerate(axes.ravel()): # axes is a 2D array.. Need to ravel it to run ov
    ax.set_title('plot # {}'.format(i+1))
    ax.plot(x, y1**(i+1))
    ax.set_ylim((-1, 1))
fig.tight_layout() # Better output
```



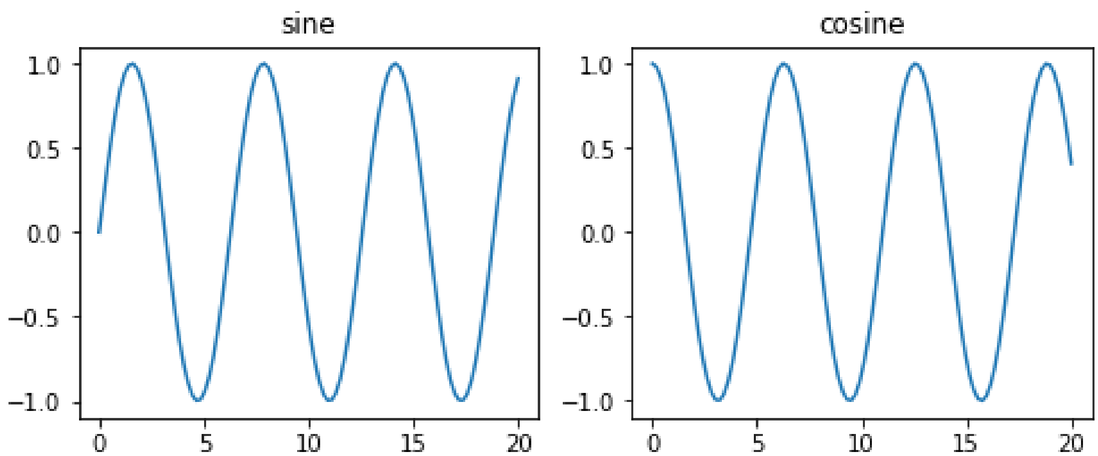

```
In [24]: fig = plt.figure(figsize=(8, 8))
         gs = plt.GridSpec(3, 3)
         ax1 = fig.add_subplot(gs[0, :])
         ax2 = fig.add_subplot(gs[1, :2])
         ax3 = fig.add_subplot(gs[1:, 2])
         ax4 = fig.add_subplot(gs[2, 0])
         ax5 = fig.add_subplot(gs[2, 1])
```

```
ax1.plot(x, y1)
ax1.set_title('AX1')
ax2.plot(x, y2)
ax2.set_title('AX2')
ax3.scatter(xr, yr, c=cr, s=30+sr*100, edgecolor='none', alpha=0.5)
ax3.set_title('AX3')
ax4.set_title('AX4')
ax5.set_title('AX5')
fig.tight_layout()
#etc...
```



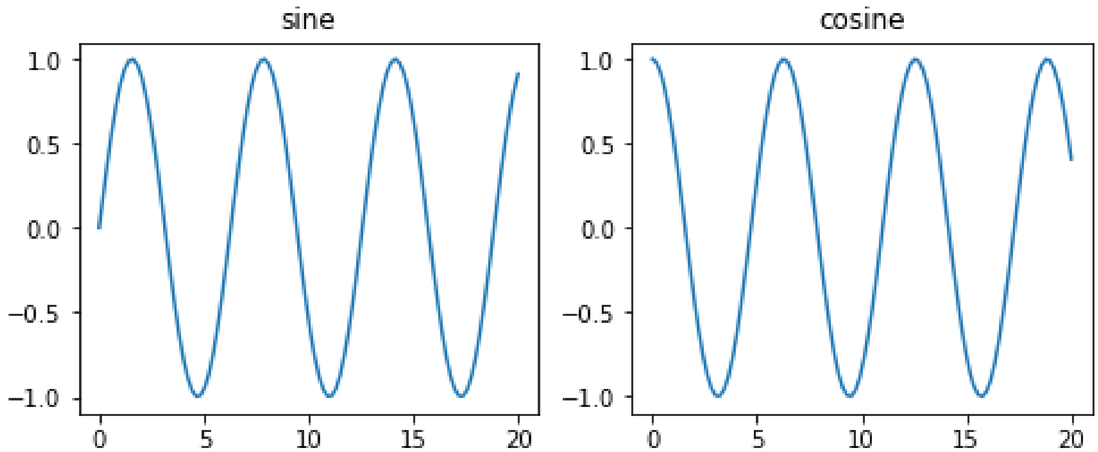
Order of the commands

In [25]:
```
fig1 = plt.figure(figsize=(8, 3))
ax1 = fig1.add_subplot(1, 2, 1)
ax1.plot(x, np.sin(x))
ax1.set_title('sine')

ax2 = fig1.add_subplot(1, 2, 2)
ax2.plot(x, np.cos(x))
ax2.set_title('cosine');
```



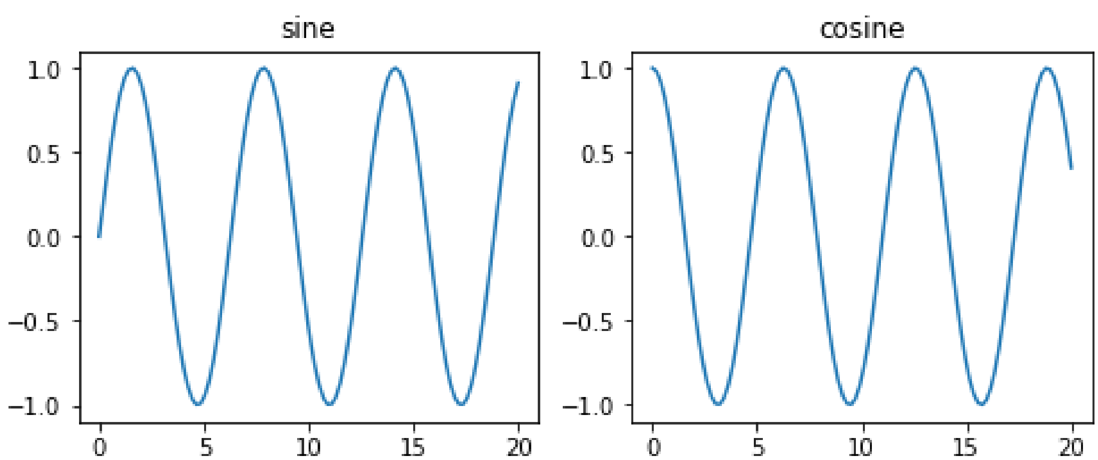
In [26]:
```
fig1 = plt.figure(figsize=(8, 3))
ax1 = fig1.add_subplot(1, 2, 1)
ax2 = fig1.add_subplot(1, 2, 2)

ax1.plot(x, np.sin(x))
ax2.plot(x, np.cos(x))

ax1.set_title('sine') # you can go back to change ax1 and ax2 after plotting
ax2.set_title('cosine') # They both are objects containing method to apply on them;
```

Out[26]:
```
<matplotlib.text.Text at 0x7f0a31b0beb8>
```



In [27]:
```
fig1, (ax1, ax2) = plt.subplots(1, 2, figsize=(8, 3))
# fig, axes = plt.subplots(1, 2, figsize=(8, 3))
# ax1 = axes[0]
# ax2 = axes[1]

ax1.plot(x, np.sin(x))
ax2.plot(x, np.cos(x))

ax1.set_title('sine') # you can go back to change ax1 and ax2 after plotting
ax2.set_title('cosine') # They both are objects containing method to apply on them;
```

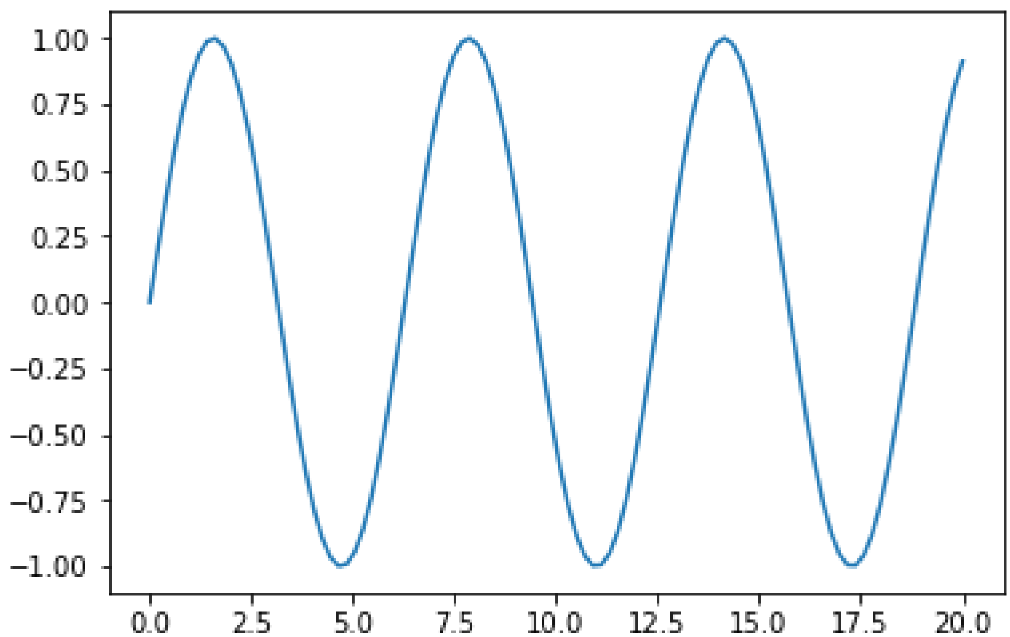
Out[27]: <matplotlib.text.Text at 0x7f0a301e36d8>



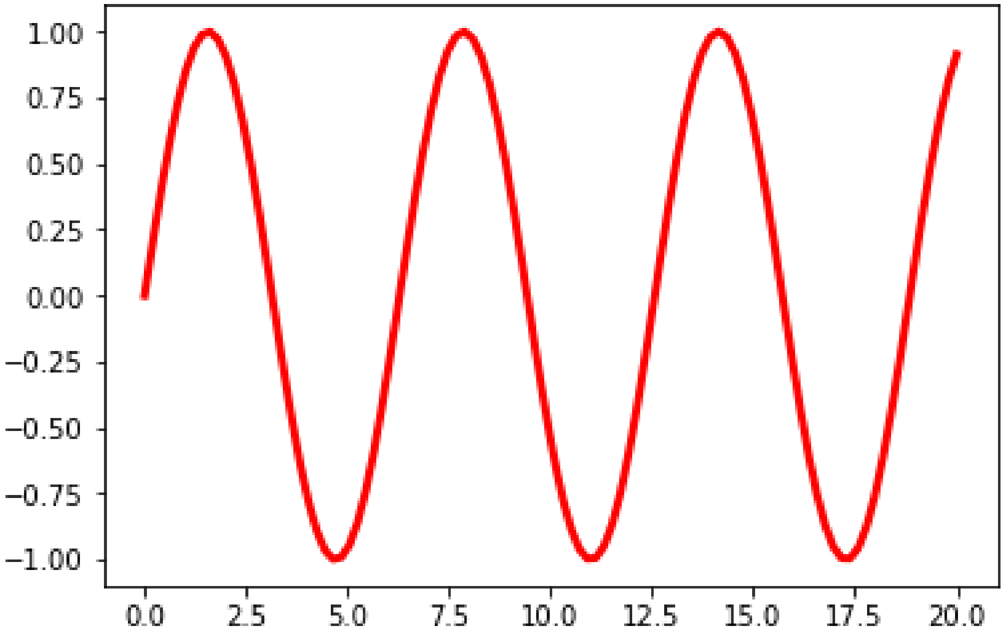
Everything is object

```
In [28]: fig, ax = plt.subplots()
         lines = ax.plot(x, np.sin(x))
         print(type(lines))
         print(len(lines))
```

```
<class 'list'>
1
```

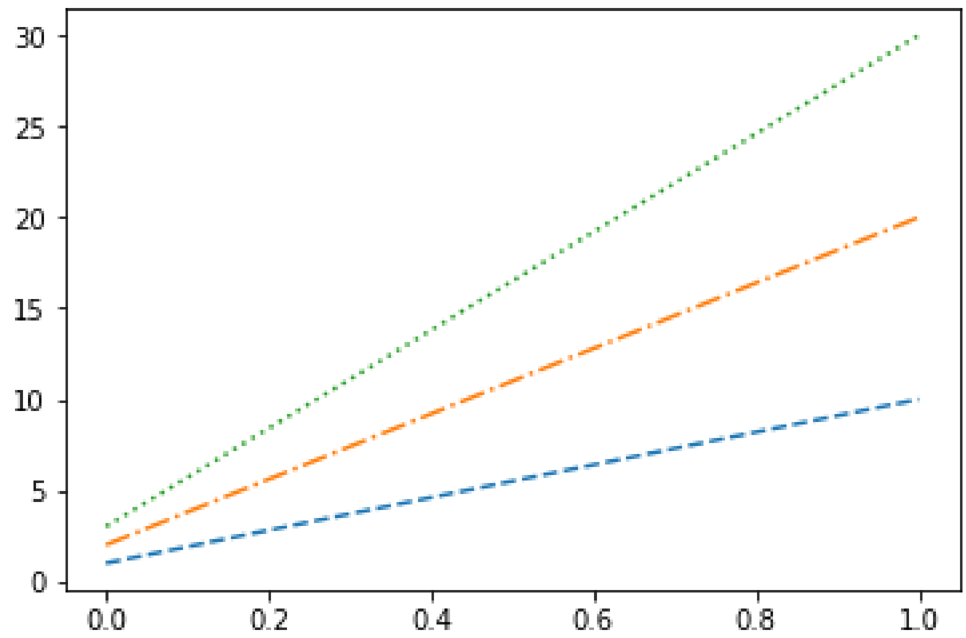



```
In [29]: fig, ax = plt.subplots()
         lines = ax.plot(x, np.sin(x))
         line = lines[0]
         #help(line) # HUGE quantity of information
         line.set_color('red')
         line.set_linewidth(3)
         fig.canvas.draw() # this is not necessary in notebook, but in scripts it is.
```

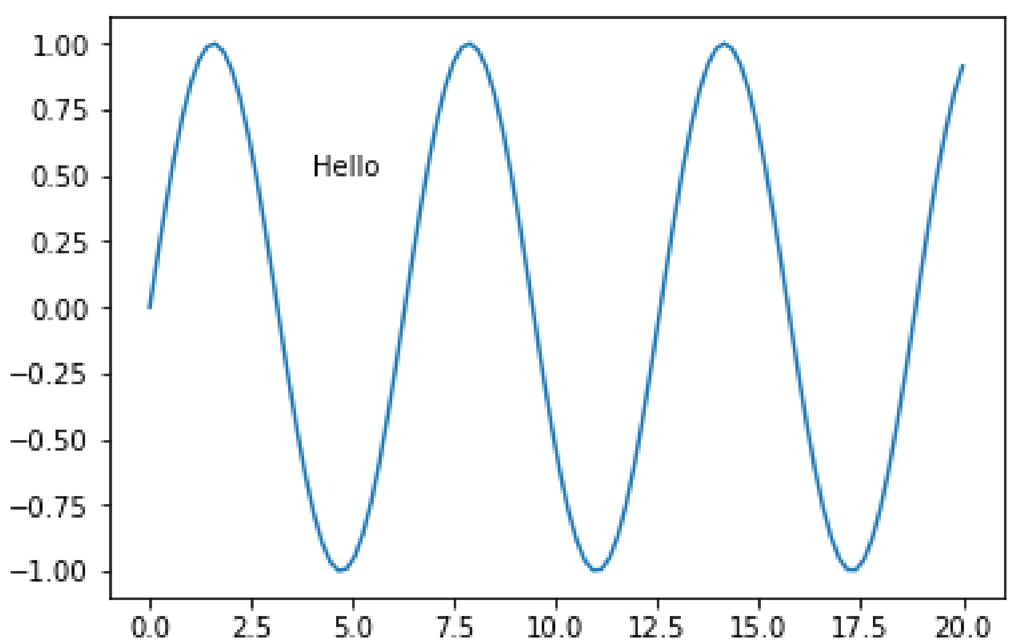



```
In [30]: fig, ax = plt.subplots()
         lines = ax.plot([[1,2,3],[10,20,30]])
         print(lines)

         lines[0].set_linestyle('--')
         lines[1].set_linestyle('-.')
         lines[2].set_linestyle(':')
```

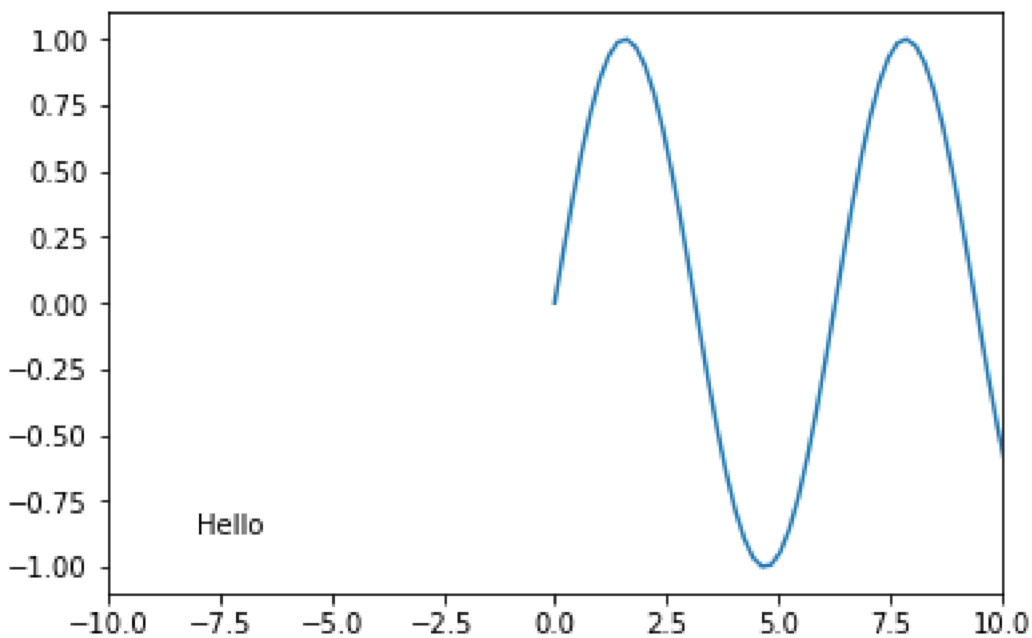
```
[<matplotlib.lines.Line2D object at 0x7f0a300946a0>, <matplotlib.lines.Line2D object at 0x7f0a2b
```



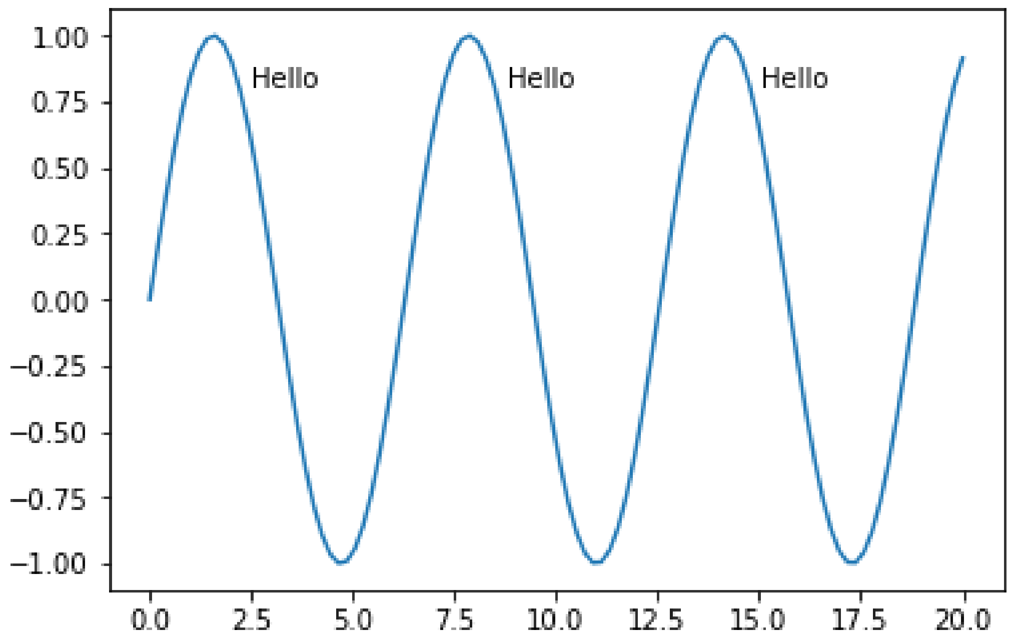
In [31]:
```
fig, ax = plt.subplots()
lines = ax.plot(x, np.sin(x))
ax.text(4, 0.5, "Hello");
```



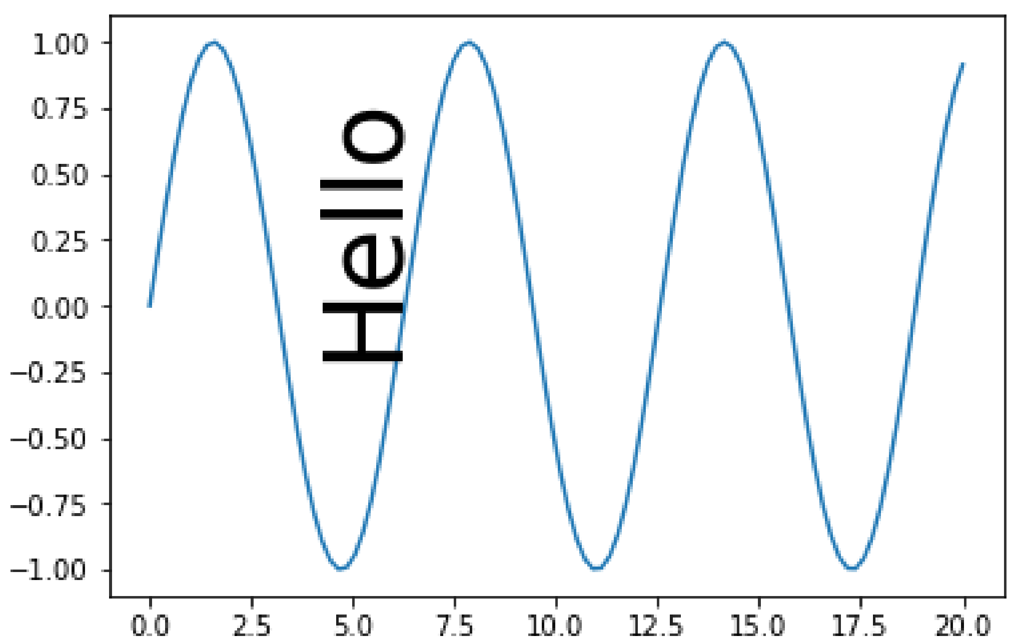
```
In [32]: fig, ax = plt.subplots()
         lines = ax.plot(x, np.sin(x))
         ax.set_xlim(-10,10)
         ax.text(0.1, 0.1, "Hello", transform=ax.transAxes);
```



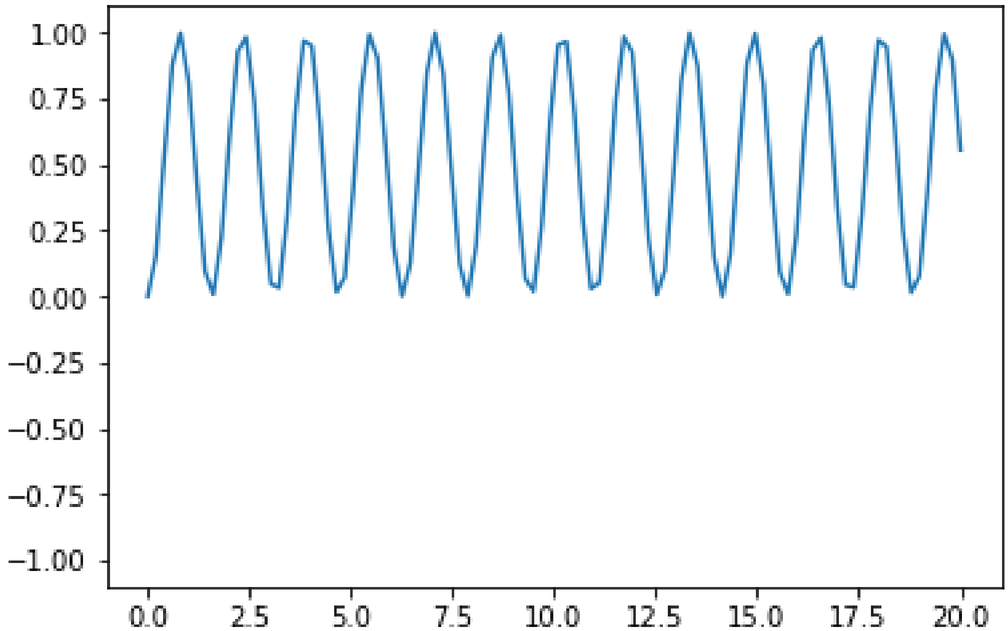

```
In [33]: fig, ax = plt.subplots()
         lines = ax.plot(x, np.sin(x))
         for x_text in 2.5+2*np.pi*(np.arange(3)):
             ax.text(x_text, 0.8, "Hello")
```



In [34]:
```
fig, ax = plt.subplots()
lines = ax.plot(x, np.sin(x))
txt = ax.text(4, 0.5, "Hello")
txt.set_rotation(90)
txt.set_size(40)
```



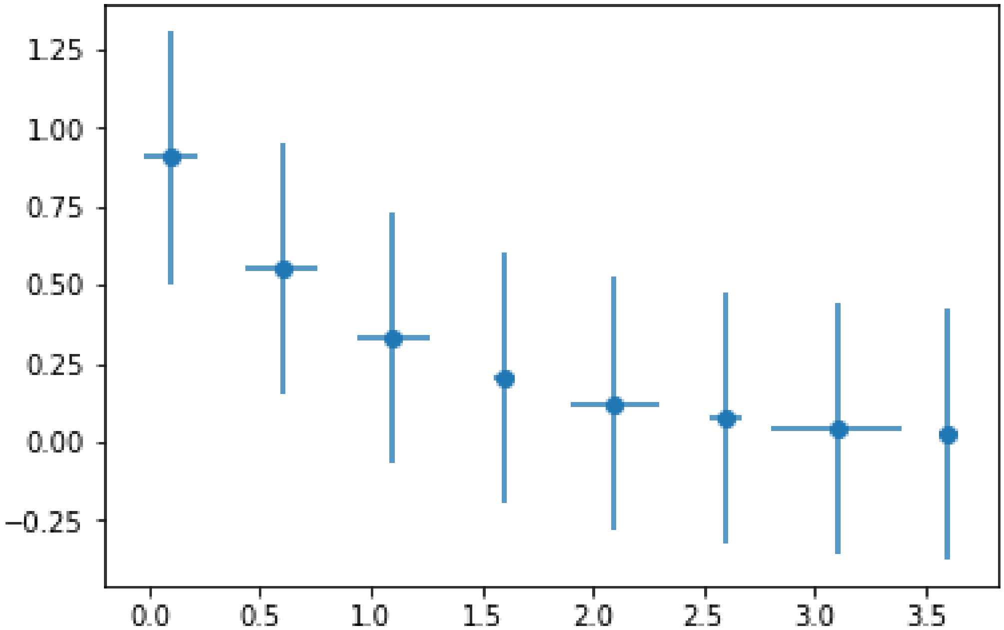
```
In [35]: fig, ax = plt.subplots()
         lines = ax.plot(x, np.sin(x)) # !!! data will change latter
         lines[0].set_ydata(np.sin(2 * x)**2) # Change the data themselve!!!
```



Error bars

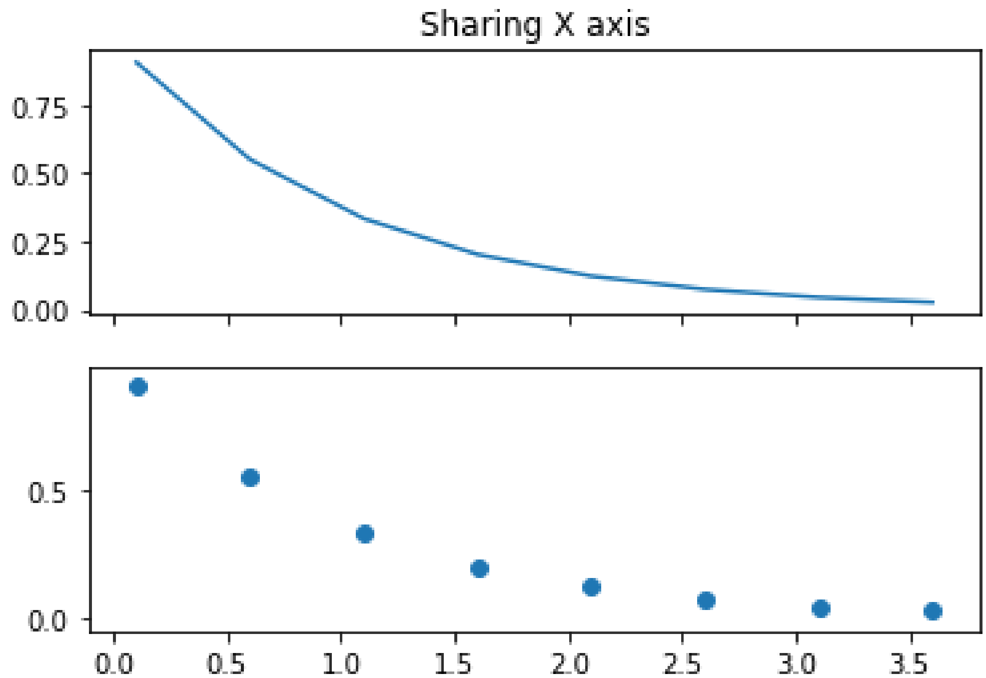
```
In [36]: x = np.arange(0.1, 4, 0.5)
         y = np.exp(-x)
         xerr = np.random.rand(len(x))*0.3
         fig, ax = plt.subplots()
         eb = ax.errorbar(x, y, xerr=xerr, yerr=0.4, fmt='o');
         print(type(eb))
```

```
<class 'matplotlib.container.ErrorbarContainer'>
```



Sharing axes

```
In [37]: %matplotlib tk
         fig, axes = plt.subplots(2, sharex=True)
         axes[0].plot(x, y)
         axes[0].set_title('Sharing X axis')
         axes[1].scatter(x, y);
```

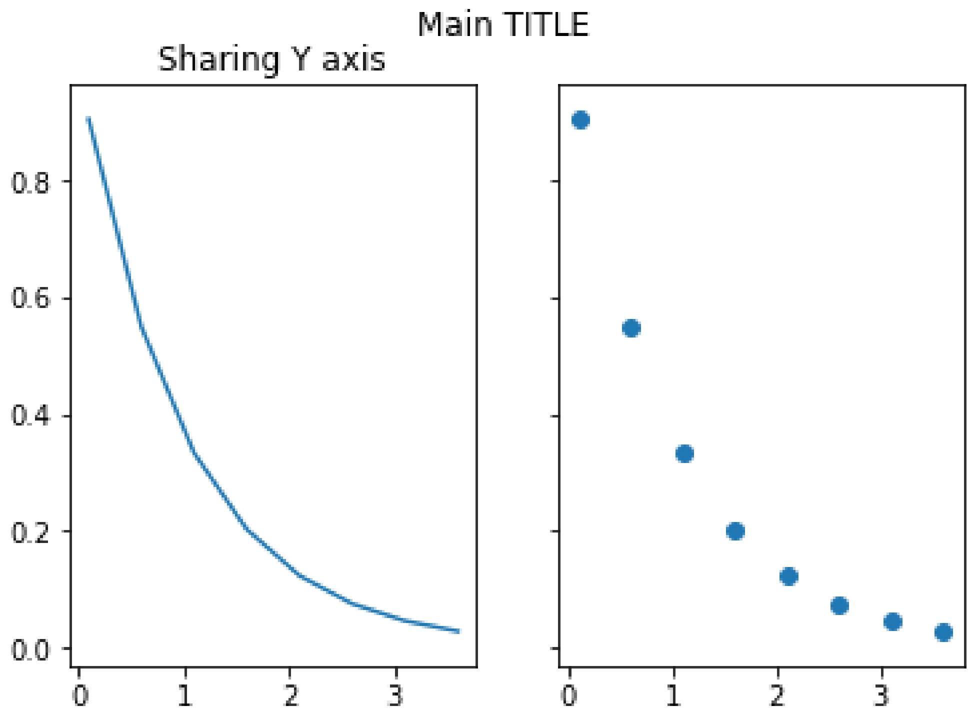



```
In [38]: import matplotlib
         print(matplotlib.__version__)
```

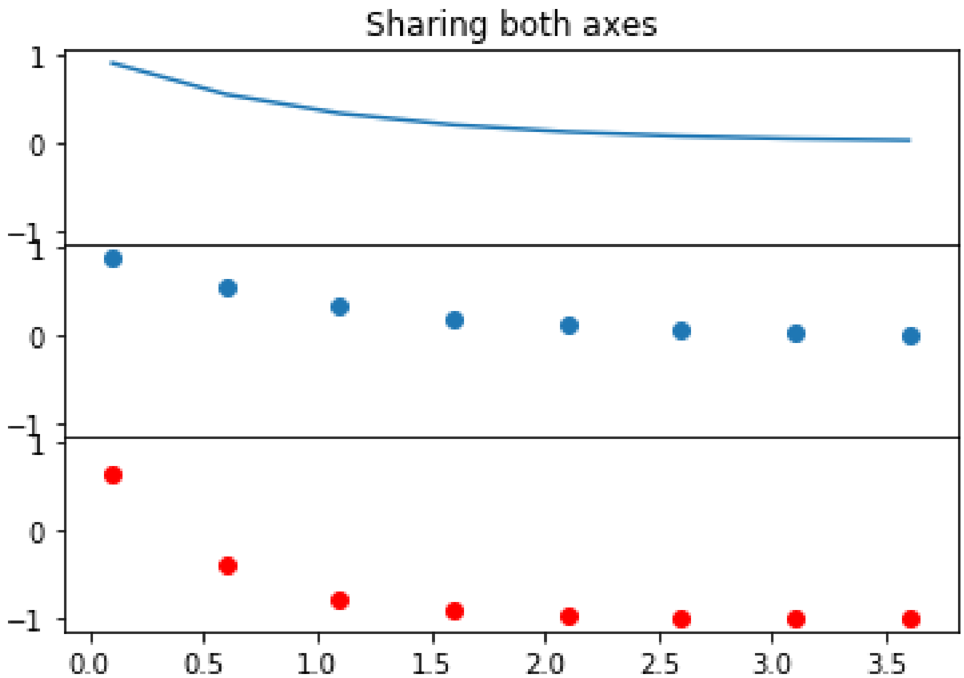
```
2.0.2
```

```
In [39]: f, (ax1, ax2) = plt.subplots(1, 2, sharey=True) # Unpacking the axes
         ax1.plot(x, y)
         f.suptitle('Main TITLE')
         ax1.set_title('Sharing Y axis')
         ax2.scatter(x, y)
```

```
Out[39]: <matplotlib.collections.PathCollection at 0x7f0a2bd6a160>
```

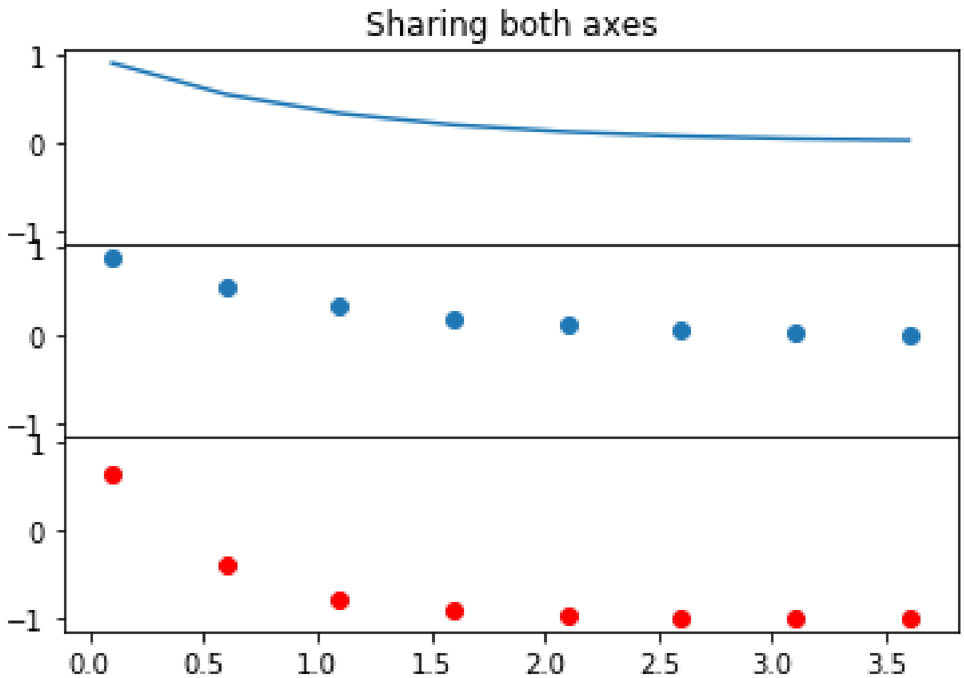



```
In [40]: fig, (ax1, ax2, ax3) = plt.subplots(3, sharex=True, sharey=True)
         ax1.plot(x, y)
         ax1.set_title('Sharing both axes')
         ax2.scatter(x, y)
         ax3.scatter(x, 2 * y ** 2 - 1, color='r')
         # Fine-tune figure; make subplots close to each other
         fig.subplots_adjust(hspace=0)
```




```
In [41]: %matplotlib inline
```

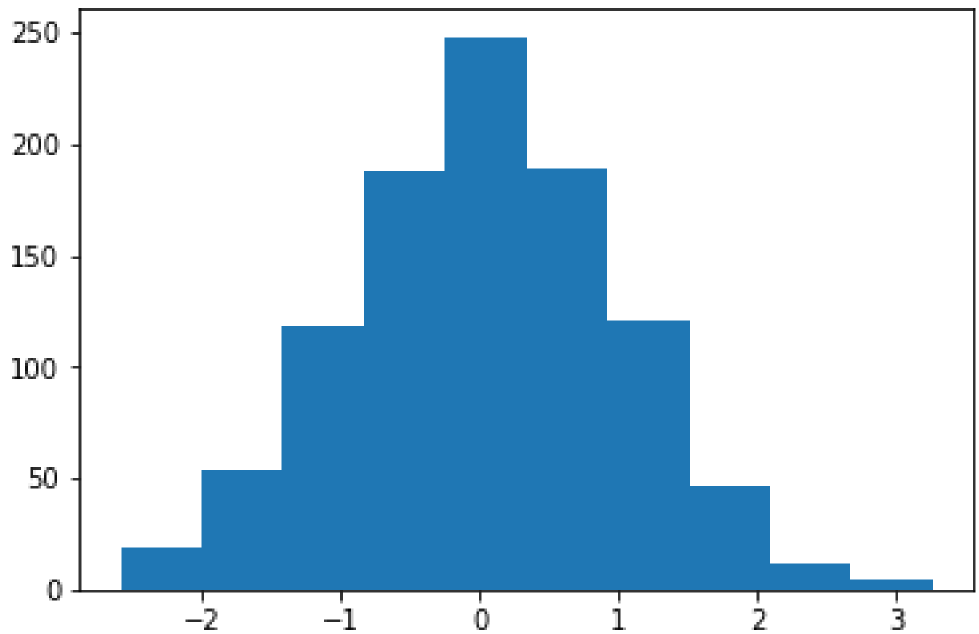
```
In [42]: fig, (ax1, ax2, ax3) = plt.subplots(3, sharex=True, sharey=True)
         ax1.plot(x, y)
         ax1.set_title('Sharing both axes')
         ax2.scatter(x, y)
         ax3.scatter(x, 2 * y ** 2 - 1, color='r')
         # Fine-tune figure; make subplots close to each other
         fig.subplots_adjust(hspace=0)
```



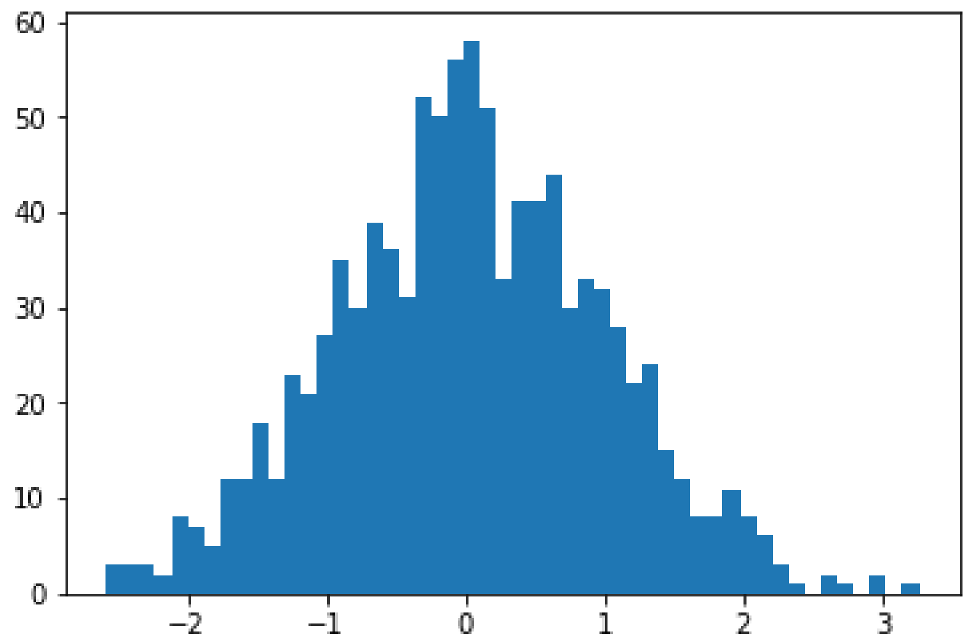
Histograms

```
In [43]: x = np.random.normal(size=1000)
         fig, ax = plt.subplots()
         H = ax.hist(x)
         print(H)
```

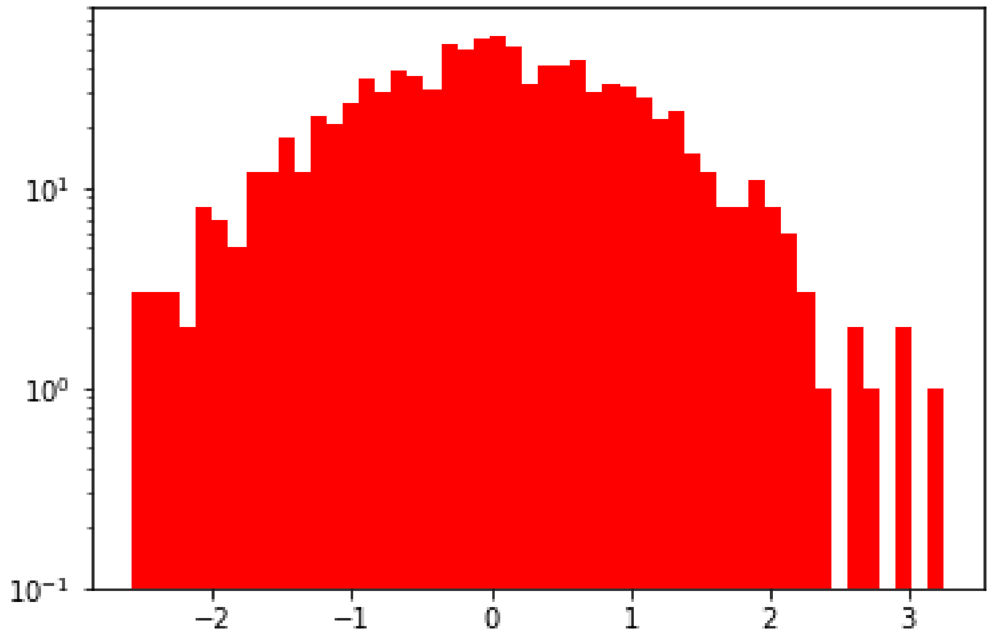
```
(array([  19.,   54.,  118.,  188.,  248.,  189.,  121.,   47.,   12.,    4.]), array([-2.584812
        0.33758421,  0.9220636 ,  1.50654299,  2.09102238,  2.67550176,
        3.25998115]), <a list of 10 Patch objects>)
```



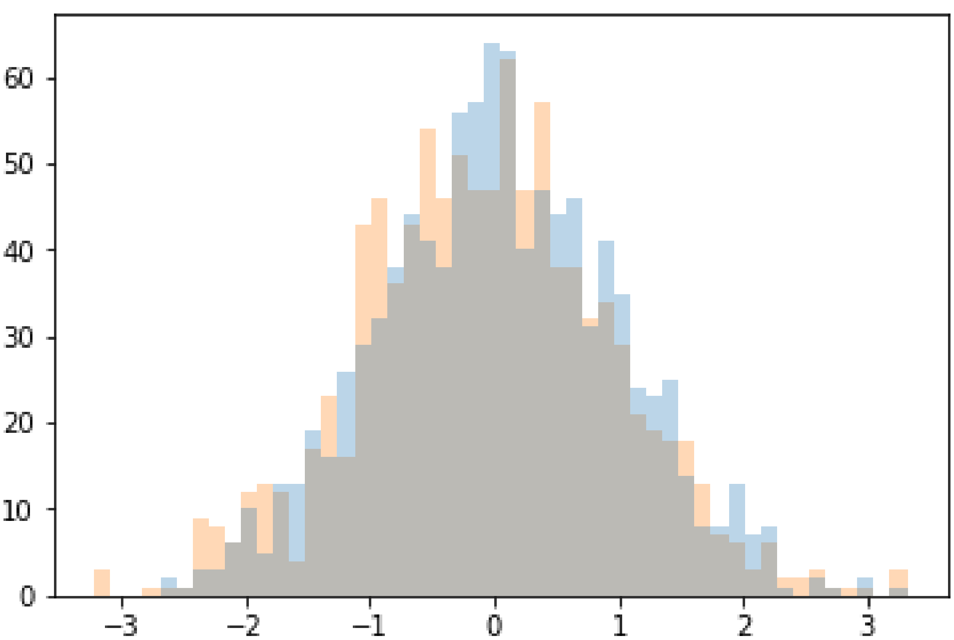
In [44]:
```
fig, ax = plt.subplots()
H = ax.hist(x, bins=50)
```



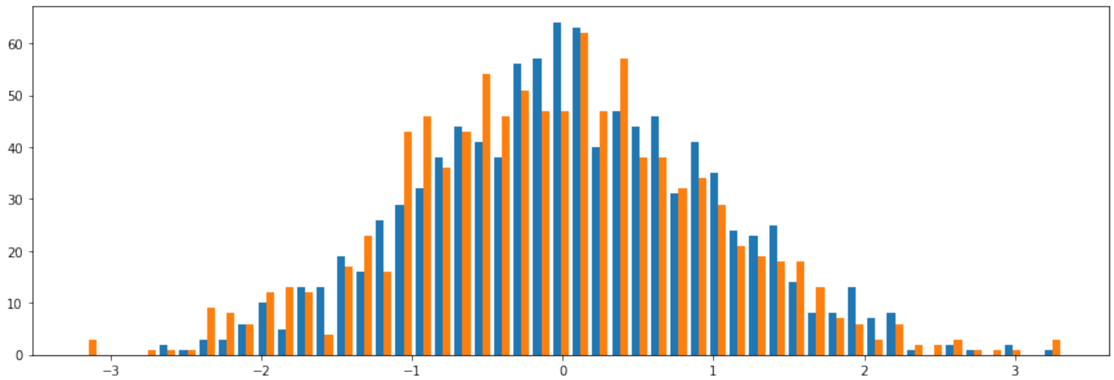
```
In [45]: fig, ax = plt.subplots()
         H = ax.hist(x, bins=50, histtype='stepfilled', log=True, color='r')
```



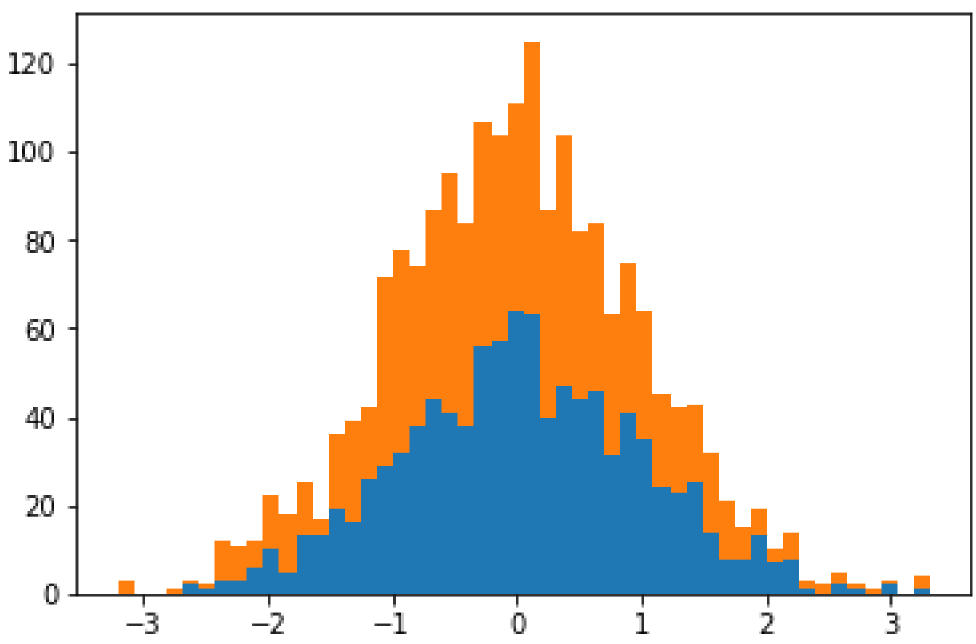

```
In [46]: x2 = np.random.normal(size=1000)
         fig, ax = plt.subplots()
         H = ax.hist((x, x2), bins=50, alpha=0.3, histtype='stepfilled')
```



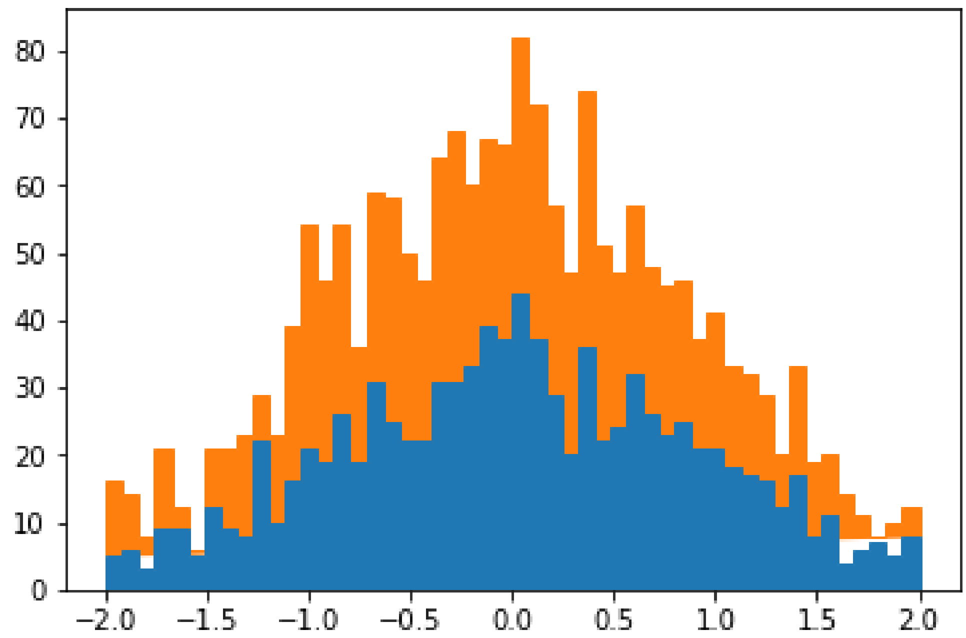
```
In [47]: fig, ax = plt.subplots(figsize=(15,5))
         H = ax.hist((x, x2), bins=50, histtype='bar')
```



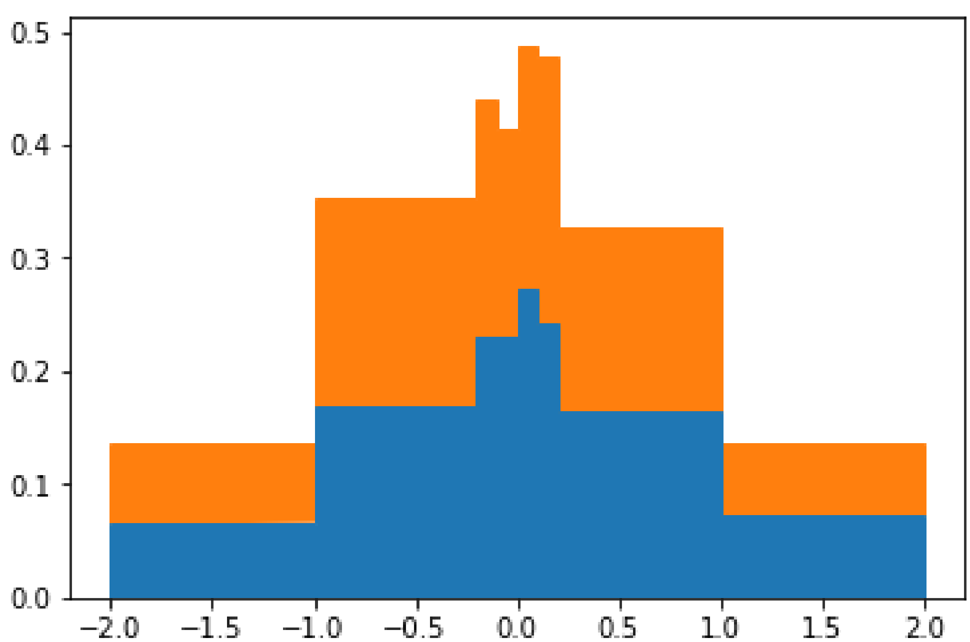
```
In [48]: fig, ax = plt.subplots()
         H = ax.hist((x, x2), bins=50, histtype='bar', stacked=True)
```



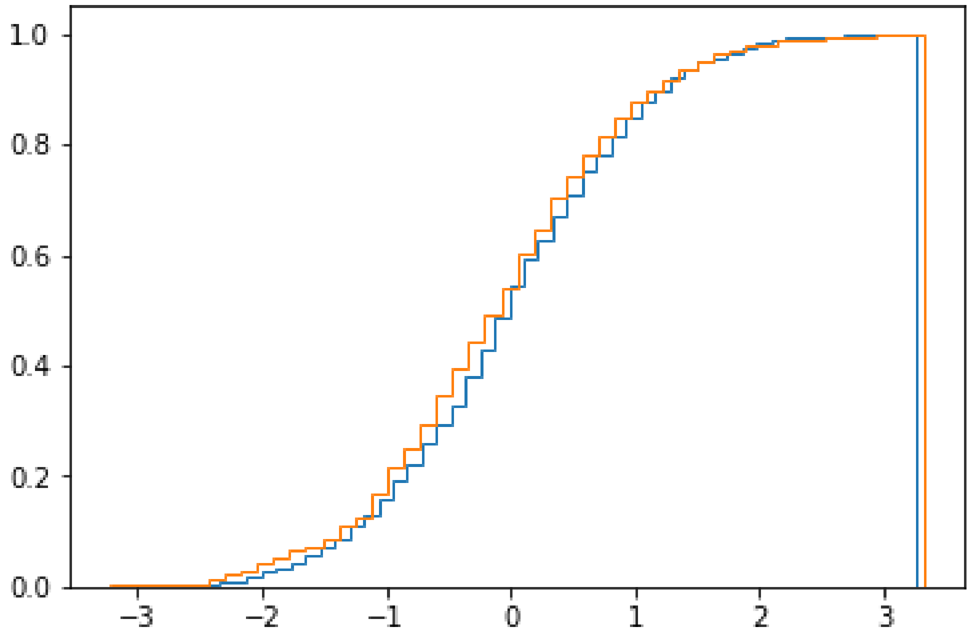
```
In [49]: fig, ax = plt.subplots()
         H = ax.hist((x, x2), bins=50, range=(-2, 2), histtype='step', stacked=True, fill=True)
```




```
In [50]: fig, ax = plt.subplots()
         H = ax.hist((x, x2), bins=(-2, -1, -0.2, -0.1, 0., 0.1, 0.2, 1, 2), range=(-2, 2),
                     histtype='step', stacked=True, fill=True, normed=True)
```



```
In [51]: fig, ax = plt.subplots()
         H = ax.hist(x, bins=50, histtype='step', cumulative=True, normed=True)
         H2 = ax.hist(x2, bins=50, histtype='step', cumulative=True, normed=True)
```



boxplots

```
In [52]: help(ax.boxplot)
```

```
Help on method boxplot in module matplotlib.axes._axes:

boxplot(x, notch=None, sym=None, vert=None, whis=None, positions=None, widths=None, patch_artist
    Make a box and whisker plot.

    Make a box and whisker plot for each column of ``x`` or each
    vector in sequence ``x``.  The box extends from the lower to
    upper quartile values of the data, with a line at the median.
    The whiskers extend from the box to show the range of the
    data.  Flier points are those past the end of the whiskers.

    Parameters
    ----------
    x : Array or a sequence of vectors.
        The input data.

    notch : bool, optional (False)
        If `True`, will produce a notched box plot. Otherwise, a
```

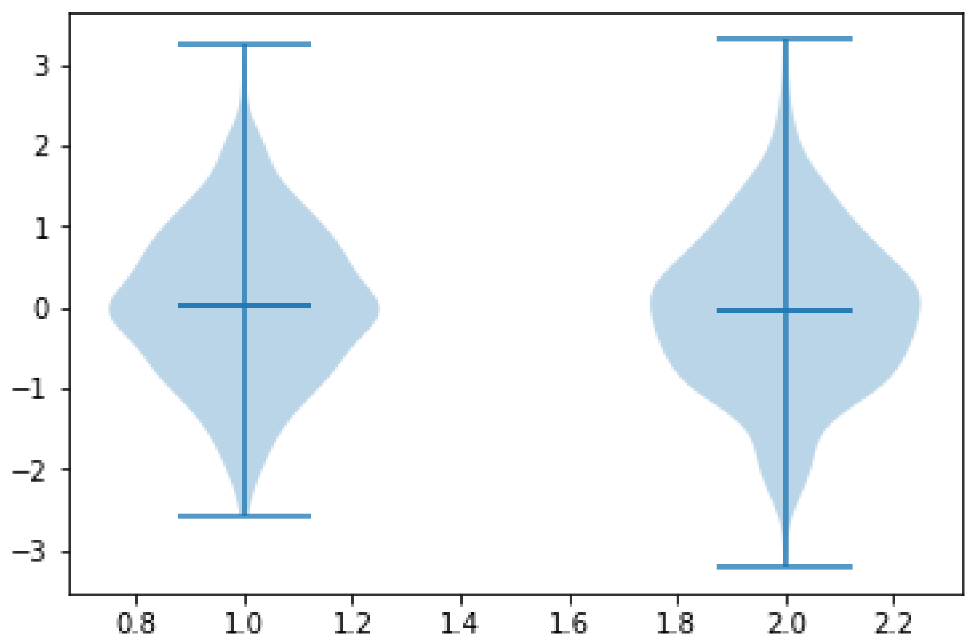
```
    rectangular boxplot is produced. The notches represent the
    confidence interval (CI) around the median. See the entry
    for the ``bootstrap`` parameter for information regarding
    how the locations of the notches are computed.

    .. note::

        In cases where the values of the CI are less than the
        lower quartile or greater than the upper quartile, the
        notches will extend beyond the box, giving it a
        distinctive "flipped" appearance. This is expected
        behavior and consistent with other statistical
        visualization packages.

sym : str, optional
    The default symbol for flier points. Enter an empty string
    ('') if you don't want to show fliers. If `None`, then the
    fliers default to 'b+'  If you want more control use the
    flierprops kwarg.

vert : bool, optional (True)
    If `True` (default), makes the boxes vertical. If `False`,
    everything is drawn horizontally.

whis : float, sequence, or string (default = 1.5)
    As a float, determines the reach of the whiskers to the beyond the
    first and third quartiles. In other words, where IQR is the
    interquartile range (`Q3-Q1`), the upper whisker will extend to
    last datum less than `Q3 + whis*IQR`). Similarly, the lower whisker
    will extend to the first datum greater than `Q1 - whis*IQR`.
    Beyond the whiskers, data
    are considered outliers and are plotted as individual
    points. Set this to an unreasonably high value to force the
    whiskers to show the min and max values. Alternatively, set
    this to an ascending sequence of percentile (e.g., [5, 95])
    to set the whiskers at specific percentiles of the data.
    Finally, ``whis`` can be the string ``'range'`` to force the
    whiskers to the min and max of the data.

bootstrap : int, optional
    Specifies whether to bootstrap the confidence intervals
    around the median for notched boxplots. If ``bootstrap`` is
    None, no bootstrapping is performed, and notches are
    calculated using a Gaussian-based asymptotic approximation
    (see McGill, R., Tukey, J.W., and Larsen, W.A., 1978, and
    Kendall and Stuart, 1967). Otherwise, bootstrap specifies
    the number of times to bootstrap the median to determine its
    95% confidence intervals. Values between 1000 and 10000 are
```

```
    recommended.

usermedians : array-like, optional
    An array or sequence whose first dimension (or length) is
    compatible with ``x``. This overrides the medians computed
    by matplotlib for each element of ``usermedians`` that is not
    `None`. When an element of ``usermedians`` is None, the median
    will be computed by matplotlib as normal.

conf_intervals : array-like, optional
    Array or sequence whose first dimension (or length) is
    compatible with ``x`` and whose second dimension is 2. When
    the an element of ``conf_intervals`` is not None, the
    notch locations computed by matplotlib are overridden
    (provided ``notch`` is `True`). When an element of
    ``conf_intervals`` is `None`, the notches are computed by the
    method specified by the other kwargs (e.g., ``bootstrap``).

positions : array-like, optional
    Sets the positions of the boxes. The ticks and limits are
    automatically set to match the positions. Defaults to
    `range(1, N+1)` where N is the number of boxes to be drawn.

widths : scalar or array-like
    Sets the width of each box either with a scalar or a
    sequence. The default is 0.5, or ``0.15*(distance between
    extreme positions)``, if that is smaller.

patch_artist : bool, optional (False)
    If `False` produces boxes with the Line2D artist. Otherwise,
    boxes and drawn with Patch artists.

labels : sequence, optional
    Labels for each dataset. Length must be compatible with
    dimensions  of ``x``.

manage_xticks : bool, optional (True)
    If the function should adjust the xlim and xtick locations.

autorange : bool, optional (False)
    When `True` and the data are distributed such that the  25th and
    75th percentiles are equal, ``whis`` is set to ``'range'`` such
    that the whisker ends are at the minimum and maximum of the
    data.

meanline : bool, optional (False)
    If `True` (and ``showmeans`` is `True`), will try to render
    the mean as a line spanning the full width of the box
```

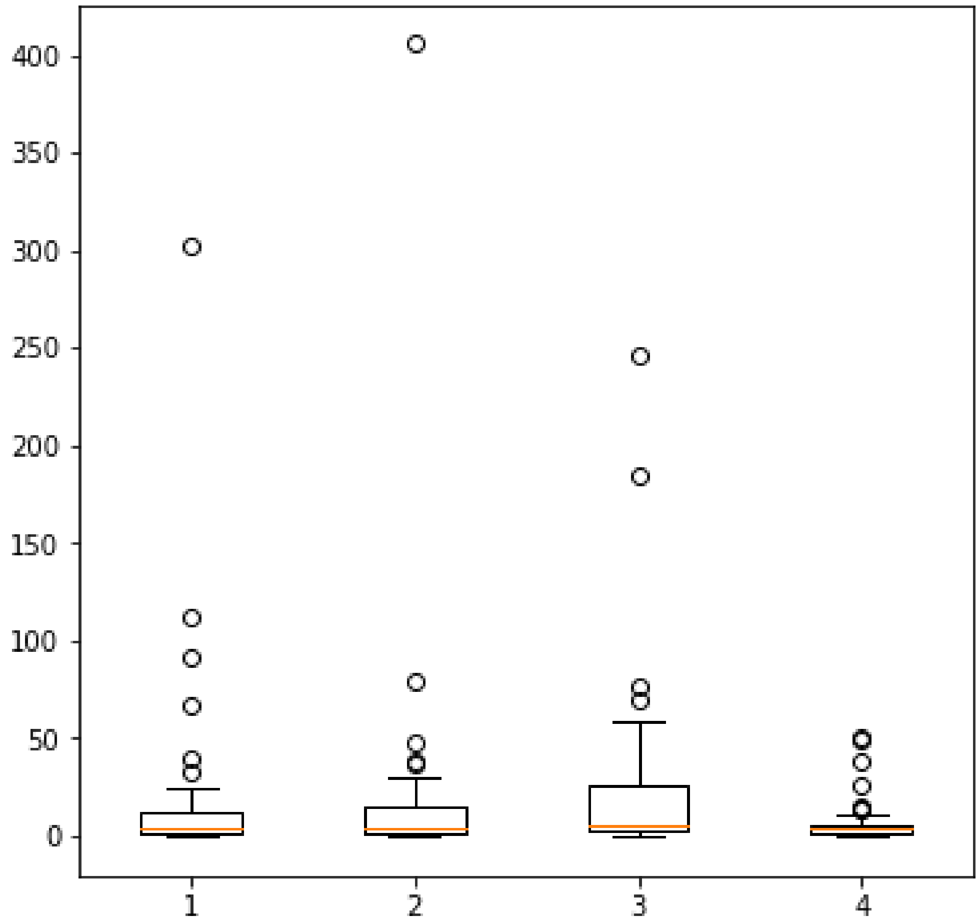
```
    according to ``meanprops`` (see below). Not recommended if
    ``shownotches`` is also True. Otherwise, means will be shown
    as points.

zorder : scalar, optional (None)
    Sets the zorder of the boxplot.

Other Parameters
----------------
showcaps : bool, optional (True)
    Show the caps on the ends of whiskers.
showbox : bool, optional (True)
    Show the central box.
showfliers : bool, optional (True)
    Show the outliers beyond the caps.
showmeans : bool, optional (False)
    Show the arithmetic means.
capprops : dict, optional (None)
    Specifies the style of the caps.
boxprops : dict, optional (None)
    Specifies the style of the box.
whiskerprops : dict, optional (None)
    Specifies the style of the whiskers.
flierprops : dict, optional (None)
    Specifies the style of the fliers.
medianprops : dict, optional (None)
    Specifies the style of the median.
meanprops : dict, optional (None)
    Specifies the style of the mean.

Returns
-------
result : dict
  A dictionary mapping each component of the boxplot to a list
  of the :class:`matplotlib.lines.Line2D` instances
  created. That dictionary has the following keys (assuming
  vertical boxplots):

  - ``boxes``: the main body of the boxplot showing the
    quartiles and the median's confidence intervals if
    enabled.

  - ``medians``: horizontal lines at the median of each box.

  - ``whiskers``: the vertical lines extending to the most
    extreme, non-outlier data points.

  - ``caps``: the horizontal lines at the ends of the
```

```
        whiskers.

      - ``fliers``: points representing data that extend beyond
        the whiskers (fliers).

      - ``means``: points or lines representing the means.

    Examples
    --------
    .. plot:: mpl_examples/statistics/boxplot_demo.py

    .. note::
        In addition to the above described arguments, this function can take a
        **data** keyword argument. If such a **data** argument is given, the
        following arguments are replaced by **data[<arg>]**:

        * All positional and all keyword arguments.
```

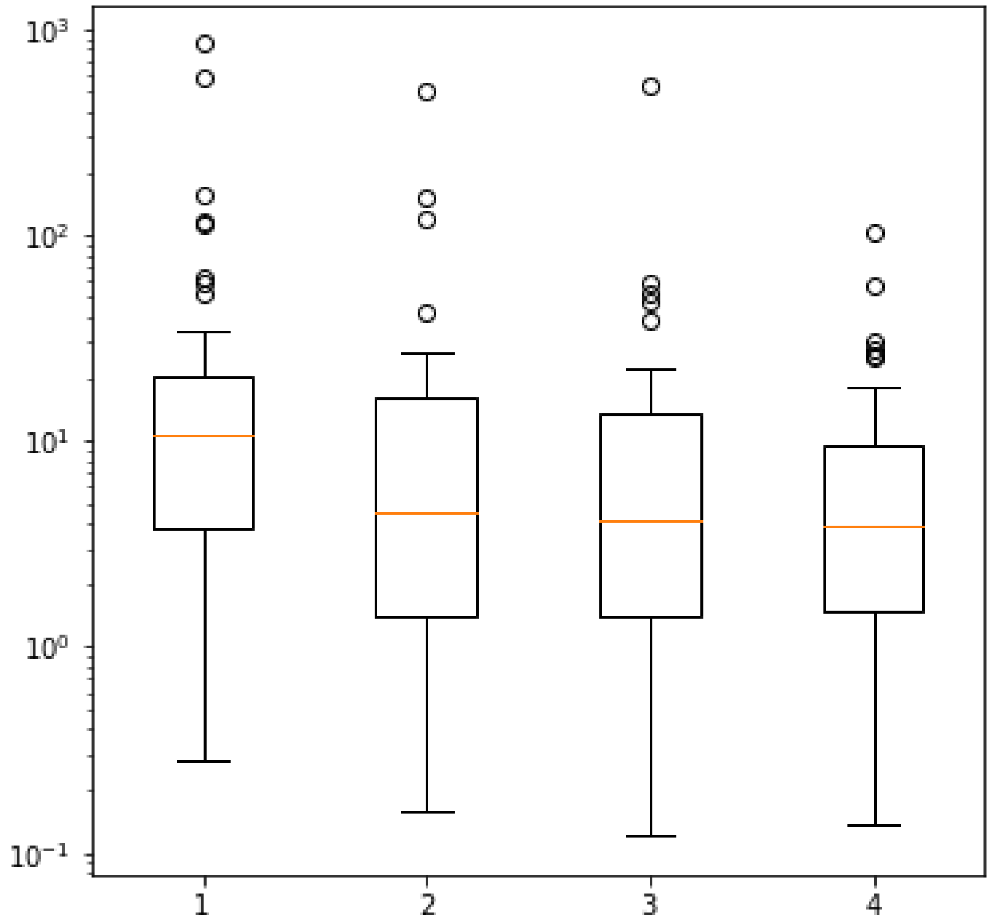
In [53]:
```python
fig, ax = plt.subplots()
bp = ax.violinplot((x, x2), showmeans=True,showmedians=True)
```



In [54]:
```python
data = np.random.lognormal(size=(37, 4), mean=1.5, sigma=1.75)

fig, ax = plt.subplots(figsize=(6,6))
bp = ax.boxplot(data) # Nothing to see !
```



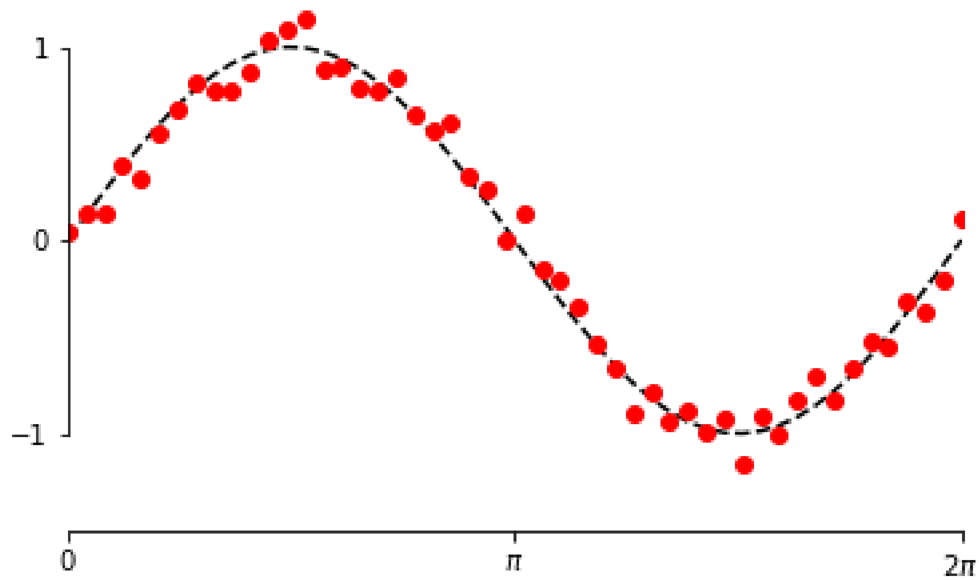

```
In [55]: data = np.random.lognormal(size=(37, 4), mean=1.5, sigma=1.75)

         fig, ax = plt.subplots(figsize=(6,6))
         bp = ax.boxplot(data)
         ax.set_yscale('log')
```



Ticks, axes and spines

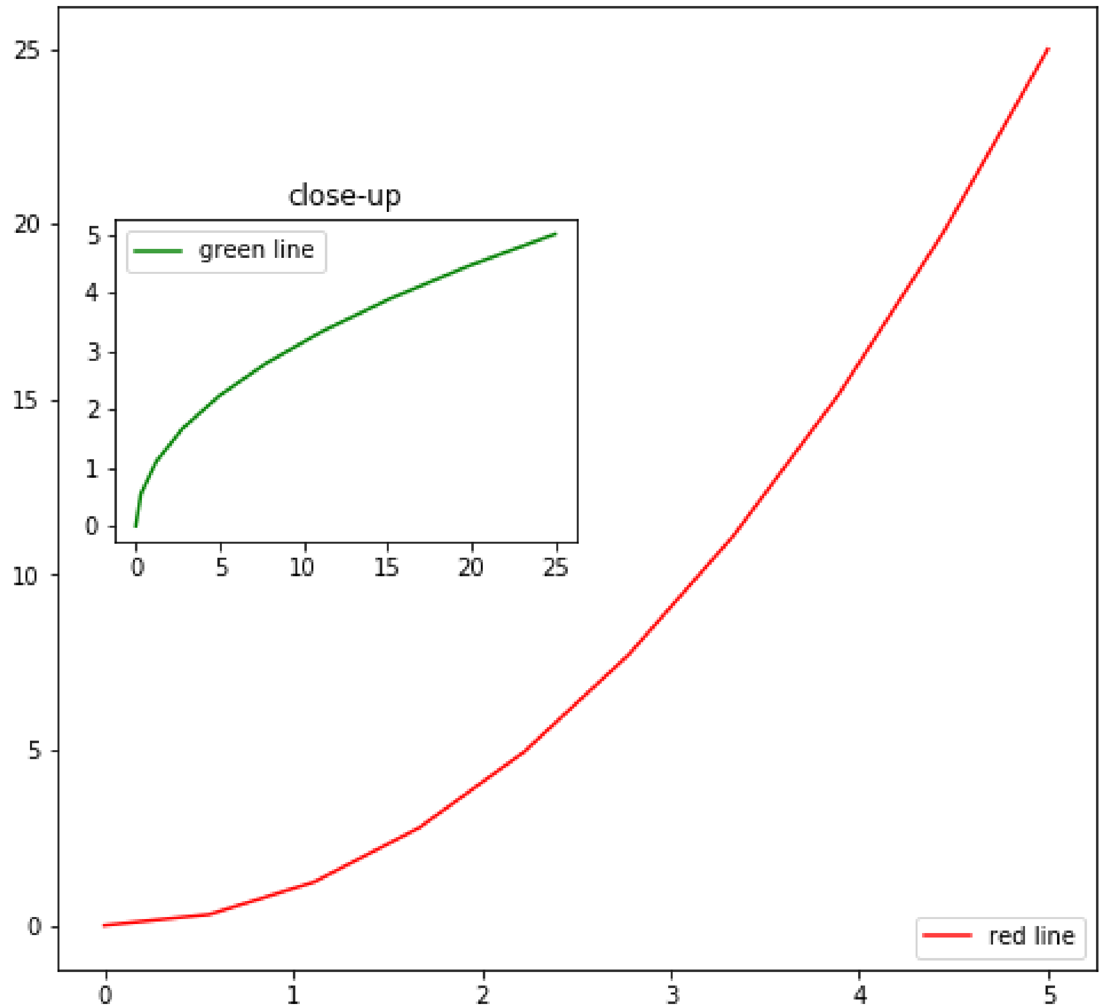
```
In [56]: x = np.linspace(0, 2*np.pi, 50)
         y = np.sin(x)
         y2 = y + 0.1 * np.random.normal(size=x.shape) # add noise to the data

         fig, ax = plt.subplots()
         ax.plot(x, y, 'k--')
         ax.plot(x, y2, 'ro')

         # set ticks and tick labels
         ax.set_xlim((0, 2*np.pi))
         ax.set_xticks([0, np.pi, 2*np.pi])
         ax.set_xticklabels(['0', '$\pi$','2$\pi$'])
         ax.set_ylim((-1.5, 1.5))
         ax.set_yticks([-1, 0, 1])
```

```
# Only draw spine between the y-ticks
ax.spines['left'].set_bounds(-1, 1)
# Hide the right and top spines
ax.spines['right'].set_visible(False)
ax.spines['top'].set_visible(False)
# Only show ticks on the left and bottom spines
ax.yaxis.set_ticks_position('left')
ax.xaxis.set_ticks_position('bottom')
```



A plot inside a plot

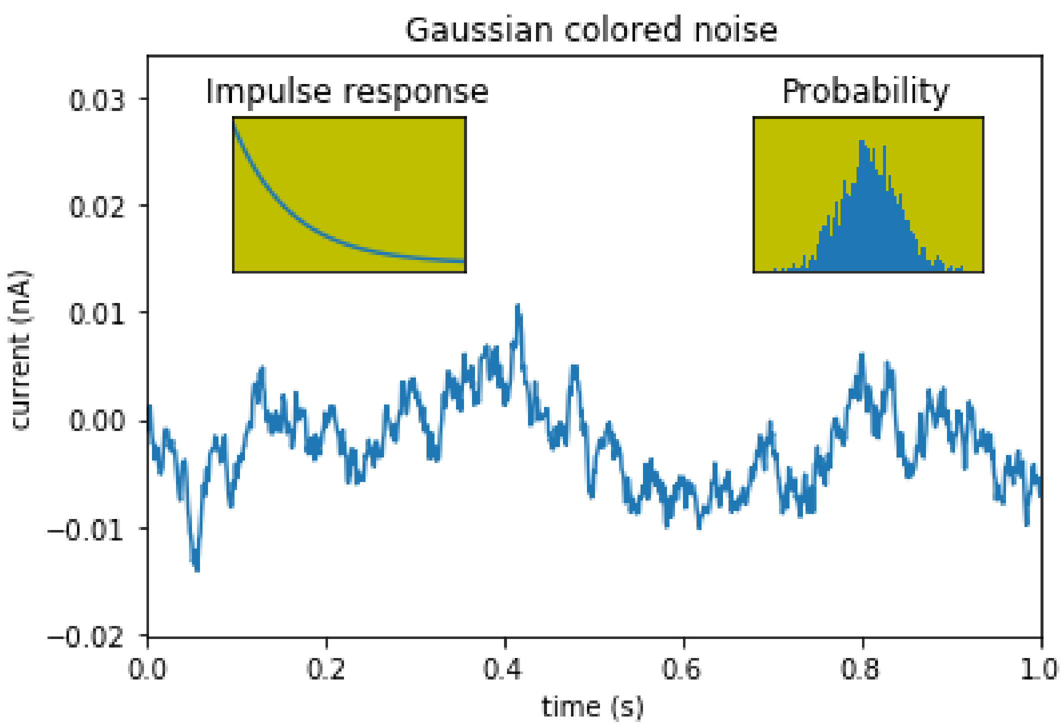
```
In [57]: x = np.linspace(0, 5, 10)
         y = x ** 2

         fig = plt.figure(figsize=(7,6.5))

         ax1 = fig.add_axes([0.1, 0.1, 0.9, 0.9]) # main axes
         ax2 = fig.add_axes([0.15, 0.5, 0.4, 0.3]) # inset axes

         # main figure
         ax1.plot(x, y, 'r', label='red line')
         ax1.legend(loc=4)
         # insert
         ax2.plot(y, x, 'g', label = 'green line')
         ax2.set_title('close-up')
         ax2.legend(loc='best');
```



In [58]:
```
# The classical way

# create some data to use for the plot
dt = 0.001
t = np.arange(0.0, 10.0, dt)
r = np.exp(-t[:1000]/0.05)  # impulse response
x = np.random.randn(len(t))
s = np.convolve(x,r)[:len(x)]*dt  # colored noise

# the main axes is subplot(111) by default
plt.plot(t, s)
plt.axis([0, 1, 1.1*np.amin(s), 2*np.amax(s) ])
plt.xlabel('time (s)')
plt.ylabel('current (nA)')
plt.title('Gaussian colored noise')
```

```
# this is an inset axes over the main axes
a = plt.axes([.65, .6, .2, .2], axisbg='y')
n, bins, patches = plt.hist(s, 400, normed=1)
plt.title('Probability')
plt.setp(a, xticks=[], yticks=[])

# this is another inset axes over the main axes
b = plt.axes([0.2, 0.6, .2, .2], axisbg='y')
plt.plot(t[:len(r)], r)
plt.title('Impulse response')
plt.setp(b, xlim=(0,.2), xticks=[], yticks=[]);
```

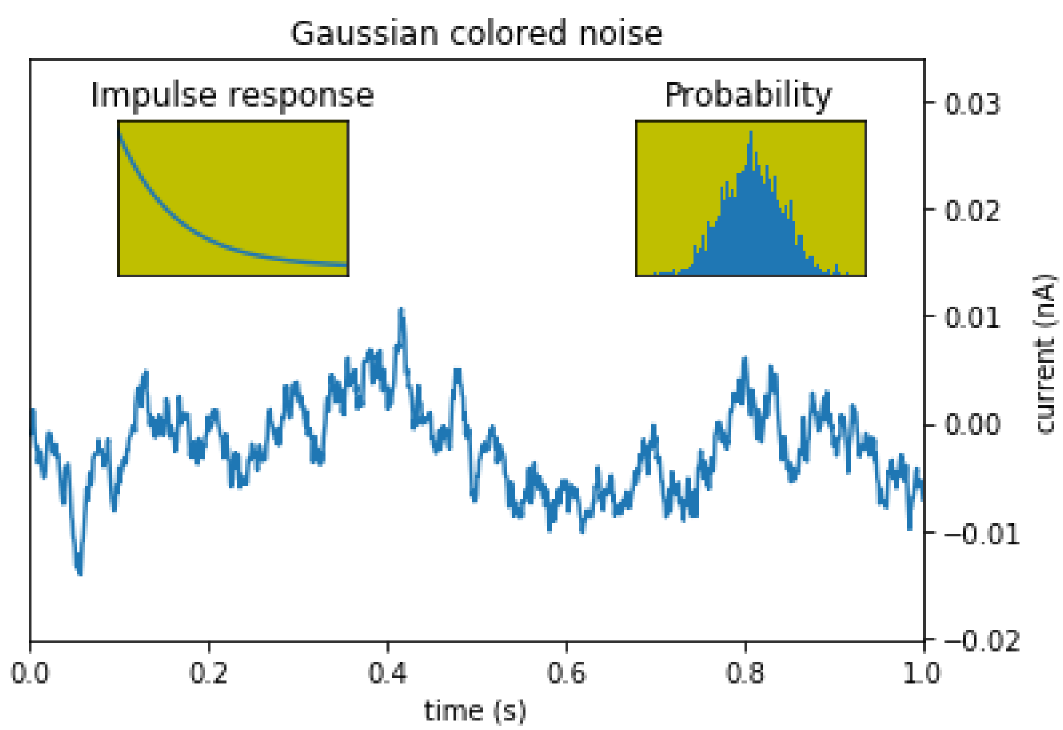
```
/home/veronica/anaconda3/lib/python3.6/site-packages/matplotlib/cbook.py:136: MatplotlibDeprecat
  warnings.warn(message, mplDeprecation, stacklevel=1)
```




```
In [59]: # The Object oriented way

         # the main axes is subplot(111) by default
         fig, ax = plt.subplots()
         ax.plot(t, s)
         ax.axis([0, 1, 1.1*np.amin(s), 2*np.amax(s) ])
         # The previous command is equivalent to:
```

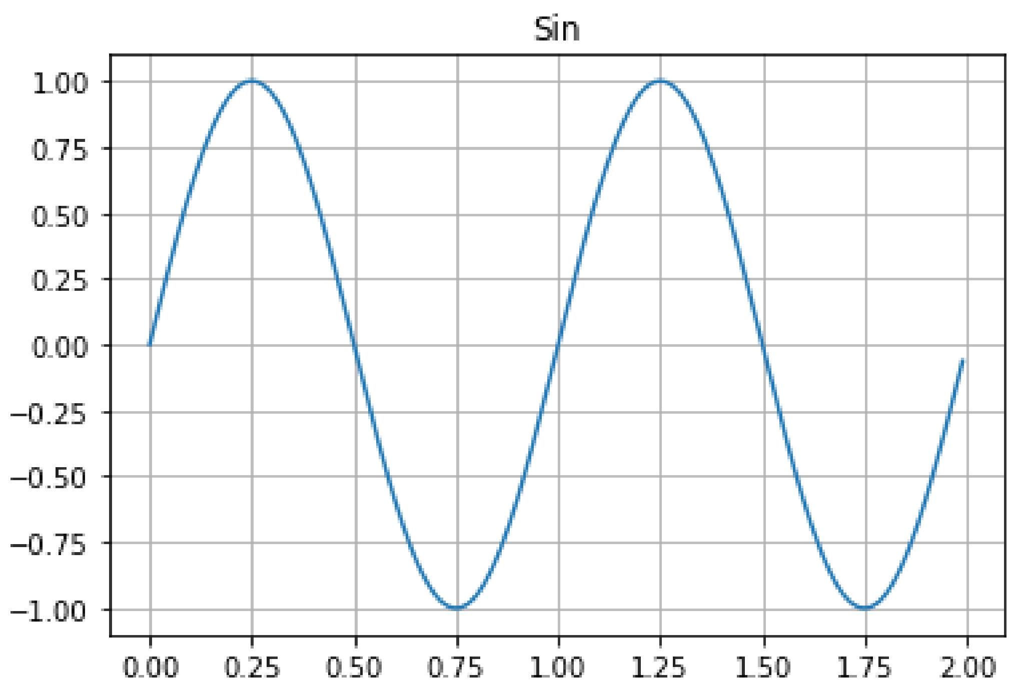
```
#ax.set_xlim((0., 1))
#ax.set_ylim((1.1*np.amin(s), 2*np.amax(s)))
ax.set_xlabel('time (s)')
ax.set_ylabel('current (nA)')
ax.set_title('Gaussian colored noise')
ax.yaxis.tick_right()
ax.yaxis.set_label_position("right")

# this is an inset axes over the main axes
ax2 = plt.axes([.65, .6, .2, .2], axisbg='y')
n, bins, patches = ax2.hist(s, 400, normed=1)
ax2.set_title('Probability')
ax2.xaxis.set_ticks([])
ax2.yaxis.set_ticks([])

# this is another inset axes over the main axes
ax3 = plt.axes([0.2, 0.6, .2, .2], axisbg='y')
ax3.plot(t[:len(r)], r)
ax3.set_title('Impulse response')
ax3.set_xlim((0., .2))
ax3.xaxis.set_ticks([])
ax3.yaxis.set_ticks([]);
```

```
/home/veronica/anaconda3/lib/python3.6/site-packages/matplotlib/cbook.py:136: MatplotlibDeprecat
  warnings.warn(message, mplDeprecation, stacklevel=1)
```



Play with all the objects of a plot

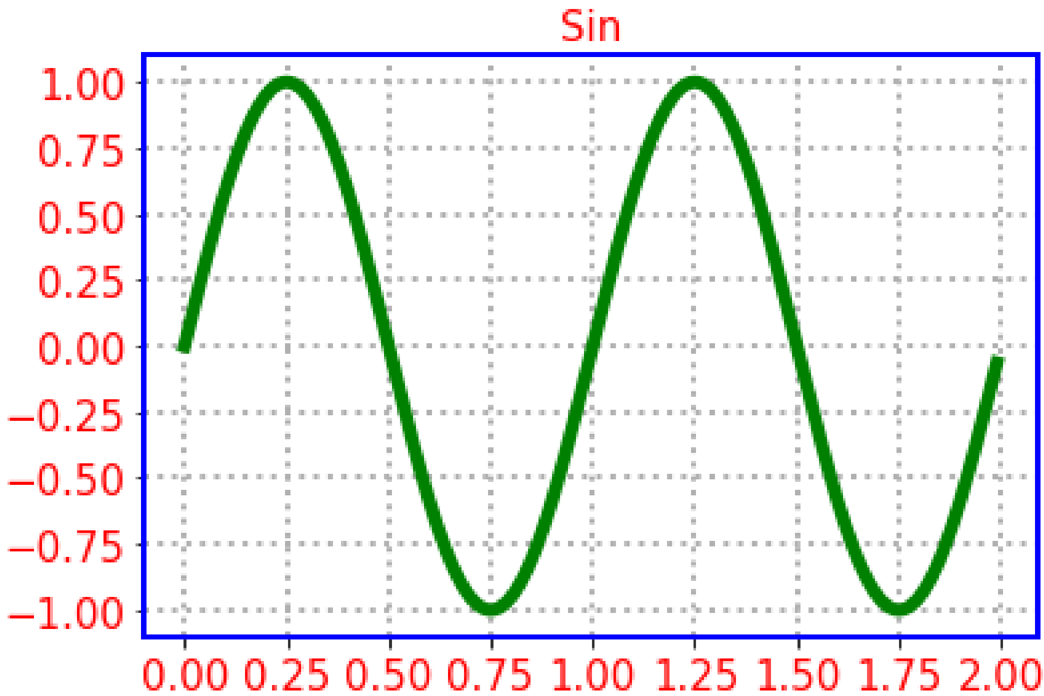
```
In [60]: # Define some data
         t = np.arange(0.0, 2.0, 0.01)
         s = np.sin(2*np.pi*t)
         fig, ax = plt.subplots()

         # Plot the data and keep the data-line into an object
         datalines = ax.plot(t, s)
         # Plot grids on the figure
         ax.grid(True)
         tit = ax.set_title('Sin')

         # Put all the lines and labels into lists of objects
         ticklines = iter(ax.spines.values())
         gridlines = ax.get_xgridlines()
         gridlines.extend( ax.get_ygridlines() )
         labels = ax.get_xticklabels()
         labels.extend( ax.get_yticklabels() )
         labels.append(tit)
```




```
In [61]: # Define some data
         t = np.arange(0.0, 2.0, 0.01)
```

```
s = np.sin(2*np.pi*t)
fig, ax = plt.subplots()

# Plot the data and keep the data-line into an object
datalines = ax.plot(t, s)
# Plot grids on the figure
ax.grid(True)
tit = ax.set_title('Sin')

# Put all the lines and labels into lists of objects
ticklines = iter(ax.spines.values())
gridlines = ax.get_xgridlines()
gridlines.extend( ax.get_ygridlines() )
labels = ax.get_xticklabels()
labels.extend( ax.get_yticklabels() )
labels.append(tit)# Loop on the lists of lines to change properties
print(labels)

for line in ticklines:
    line.set_linewidth(2)
    line.set_color('blue')

for line in datalines:
    line.set_linewidth(5)
    line.set_color('green')

for line in gridlines:
    line.set_linestyle(':')
    line.set_linewidth(2)

# loop on the labels to change properties
for label in labels:
    label.set_color('r')
    label.set_fontsize(15)
```

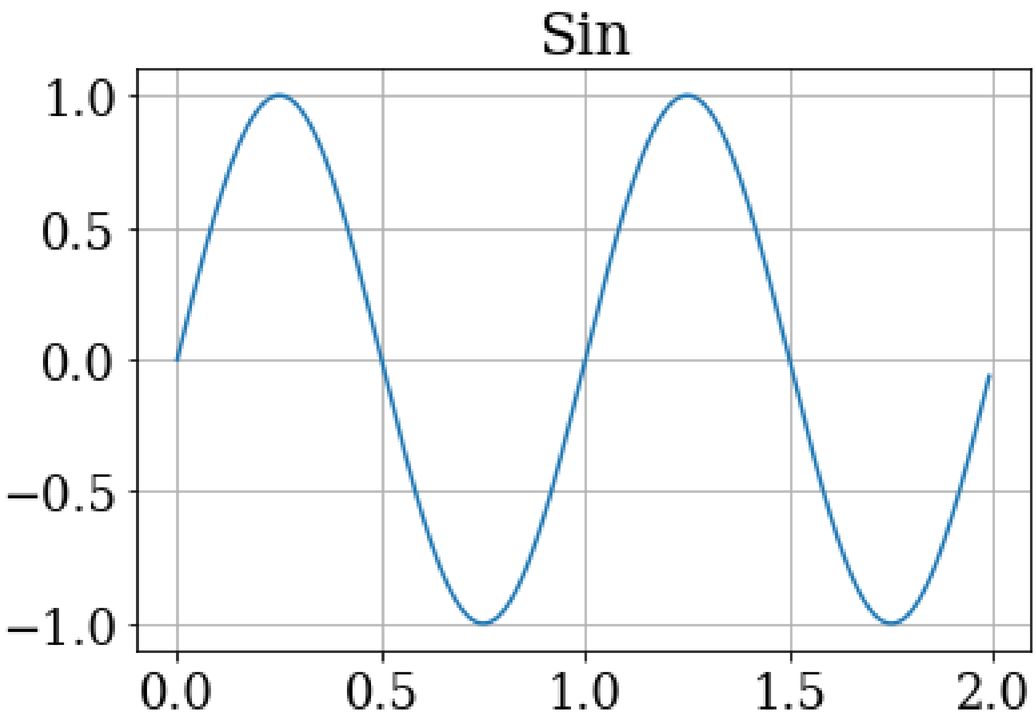
```
<a list of 23 Text xticklabel objects>
```



Changing font etc for all the plots:

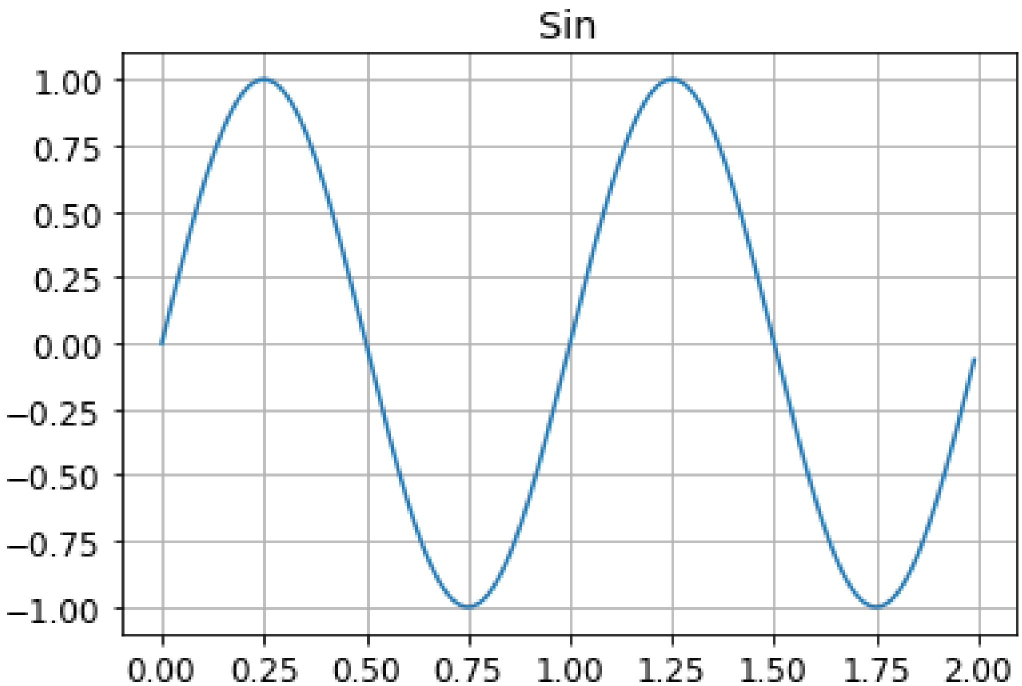
In [62]:
```
import matplotlib
matplotlib.rcParams.update({'font.size': 18, 'font.family': 'serif'})
```

In [63]:
```
# Define some data
t = np.arange(0.0, 2.0, 0.01)
s = np.sin(2*np.pi*t)
fig, ax = plt.subplots()

# Plot the data and keep the data-line into an object
datalines = ax.plot(t, s)
# Plot grids on the figure
ax.grid(True)
tit = ax.set_title('Sin')
```

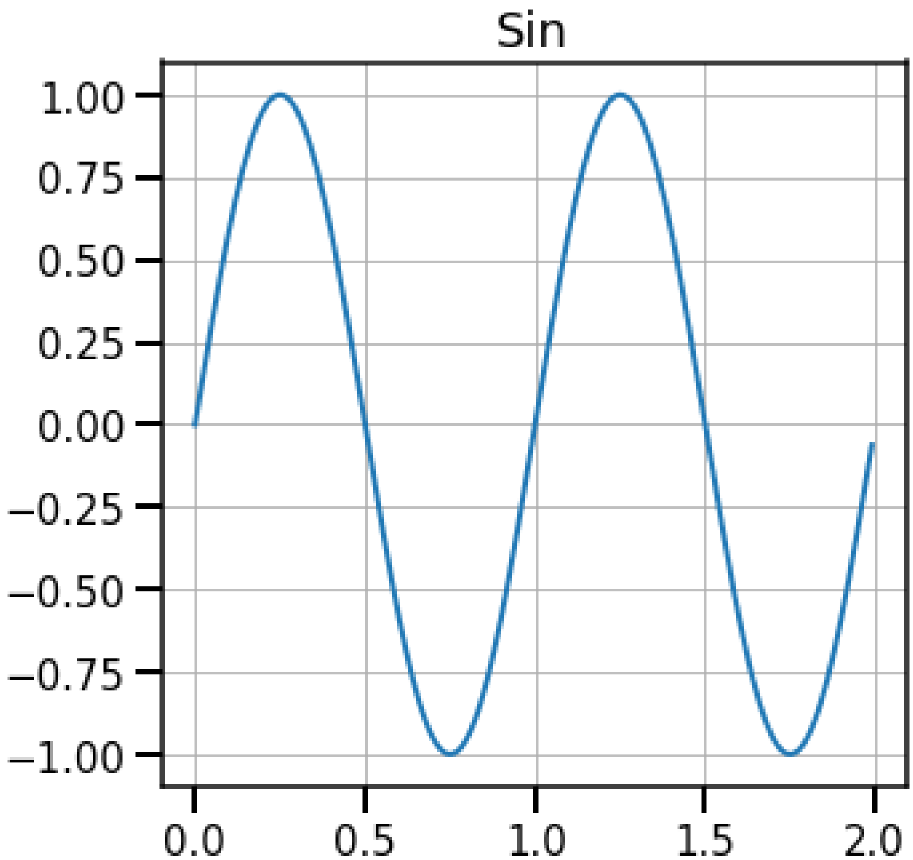



```
In [64]: # Back to default values
         matplotlib.rcParams.update({'font.size': 12, 'font.family': 'sans'})
```

```
In [65]: # Define some data
         t = np.arange(0.0, 2.0, 0.01)
         s = np.sin(2*np.pi*t)
         fig, ax = plt.subplots()

         # Plot the data and keep the data-line into an object
         datalines = ax.plot(t, s)
         # Plot grids on the figure
         ax.grid(True)
         tit = ax.set_title('Sin')
```

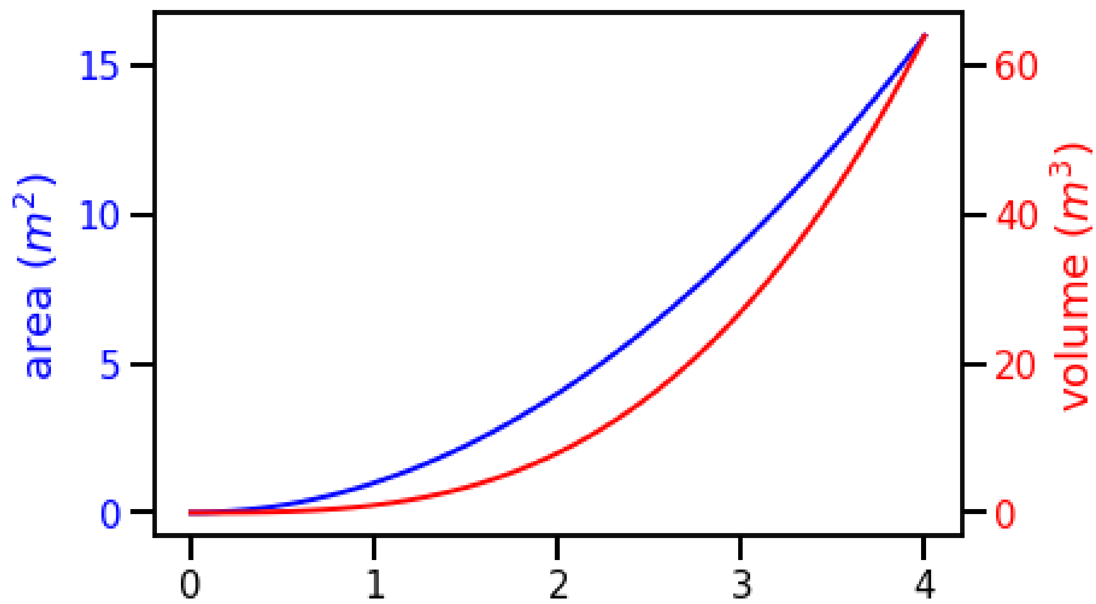



```
In [66]: matplotlib.rc('axes', linewidth=1.5)
         matplotlib.rc('lines', linewidth=2)
         matplotlib.rc('font', size=15)
         matplotlib.rc('xtick.major', width=2, size=10)
         matplotlib.rc('xtick.minor', width=2, size=5)
         matplotlib.rc('ytick.major', width=2, size=10)
         matplotlib.rc('ytick.minor', width=2, size=5)

         # Define some data
         t = np.arange(0.0, 2.0, 0.01)
         s = np.sin(2*np.pi*t)
         fig, ax = plt.subplots(figsize=(5,5))

         # Plot the data and keep the data-line into an object
         datalines = ax.plot(t, s)
         # Plot grids on the figure
         ax.grid(True)
         tit = ax.set_title('Sin')
```



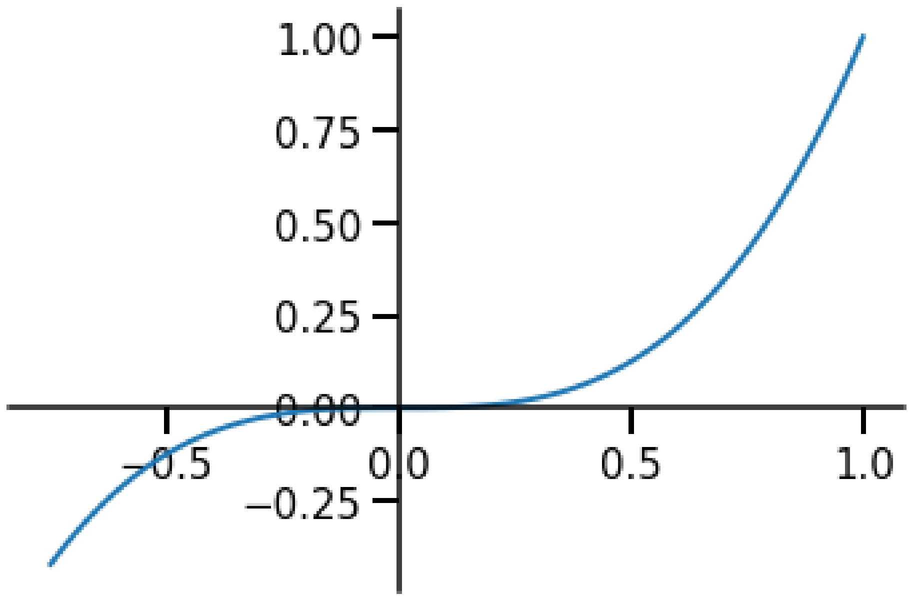
Twin axes

```
In [67]: x = np.linspace(0, 4, 100)
         fig, ax1 = plt.subplots()

         ax1.plot(x, x**2, lw=2, color="blue")
         ax1.set_ylabel(r"area $(m^2)$", fontsize=18, color="blue")
         for label in ax1.get_yticklabels():
             label.set_color("blue")

         ax2 = ax1.twinx()
         ax2.plot(x, x**3, lw=2, color="red")
         ax2.set_ylabel(r"volume $(m^3)$", fontsize=18, color="red")
         for label in ax2.get_yticklabels():
             label.set_color("red")
```



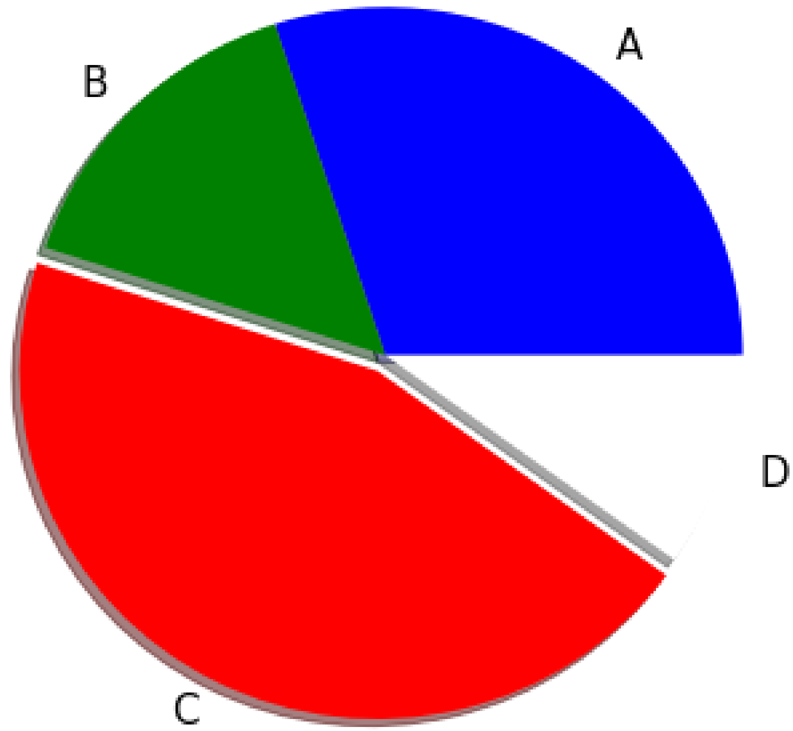
Axis crossing at 0

```
In [68]: fig, ax = plt.subplots()

         ax.spines['right'].set_color('none')
         ax.spines['top'].set_color('none')

         ax.xaxis.set_ticks_position('bottom')
         ax.spines['bottom'].set_position(('data',0)) # set position of x spine to x=0

         ax.yaxis.set_ticks_position('left')
         ax.spines['left'].set_position(('data',0))   # set position of y spine to y=0

         xx = np.linspace(-0.75, 1., 100)
         ax.plot(xx, xx**3);
```



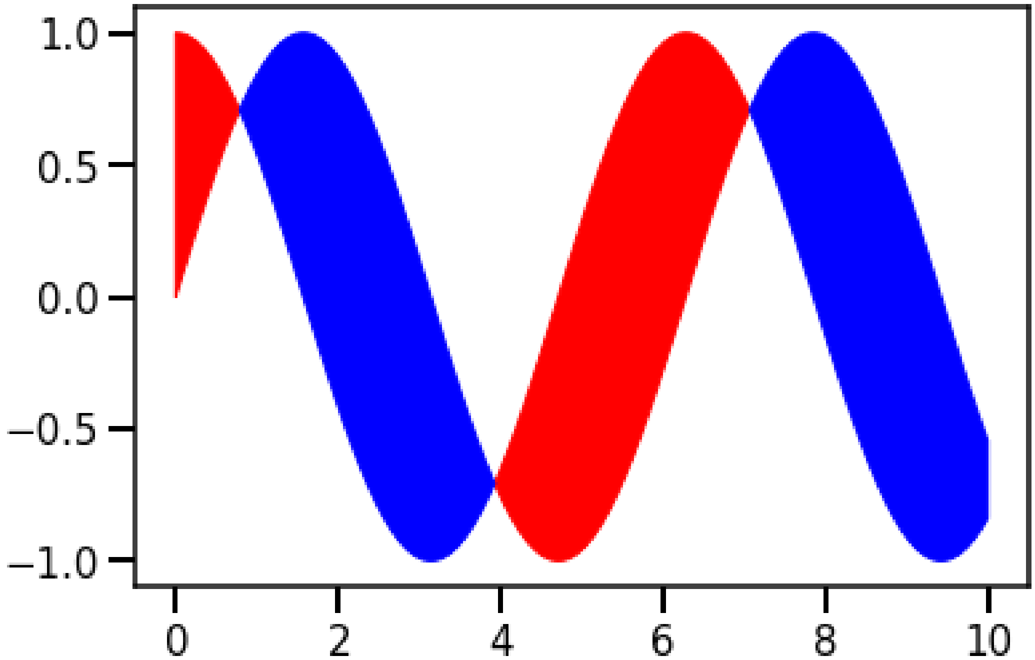
Pie plots

```
In [69]: fracs = [30, 15, 45, 10]
         colors = ['b', 'g', 'r', 'w']

         fig, ax = plt.subplots(figsize=(6, 6))  # make the plot square
         pie = ax.pie(fracs, colors=colors, explode=(0, 0, 0.05, 0), shadow=True,
                      labels=['A', 'B', 'C', 'D'])
```



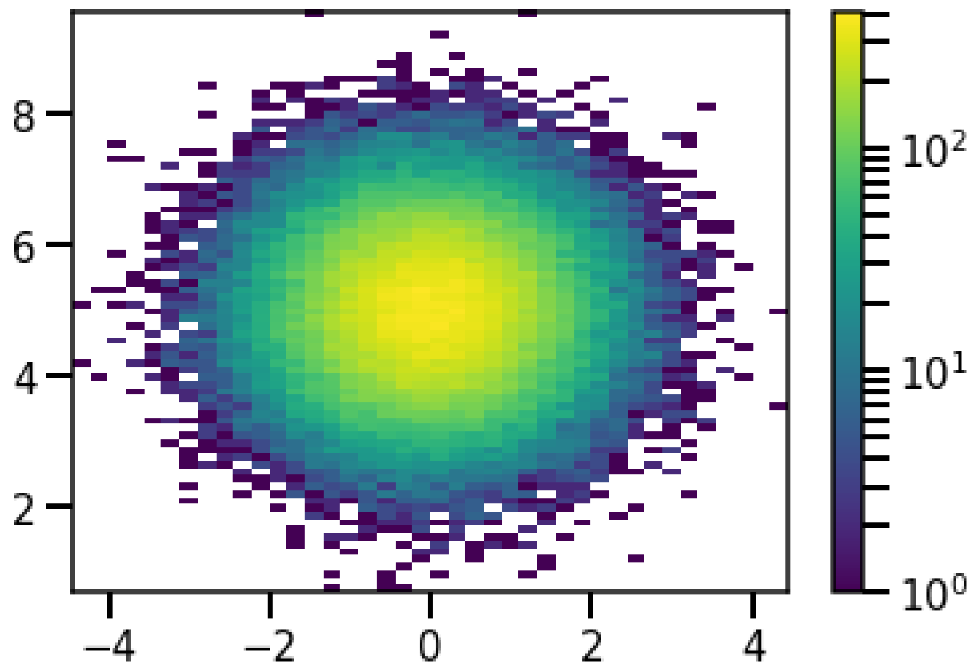
Filled regions

```
In [70]: x = np.linspace(0, 10, 1000)
         y1 = np.sin(x)
         y2 = np.cos(x)

         fig, ax = plt.subplots()
         ax.fill_between(x, y1, y2, where=(y1 < y2), color='red')
         ax.fill_between(x, y1, y2, where=(y1 > y2), color='blue');
```

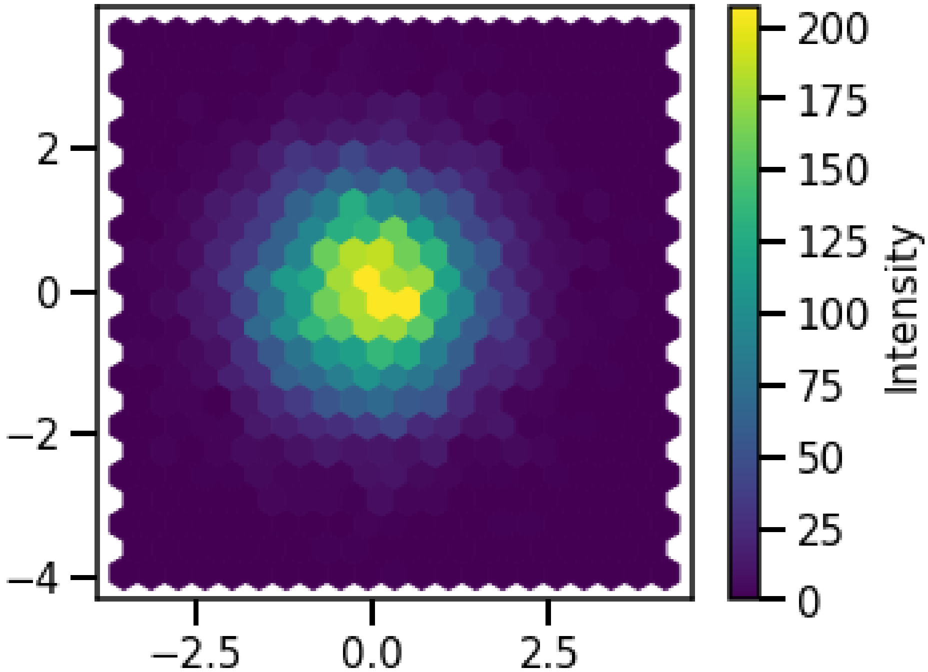


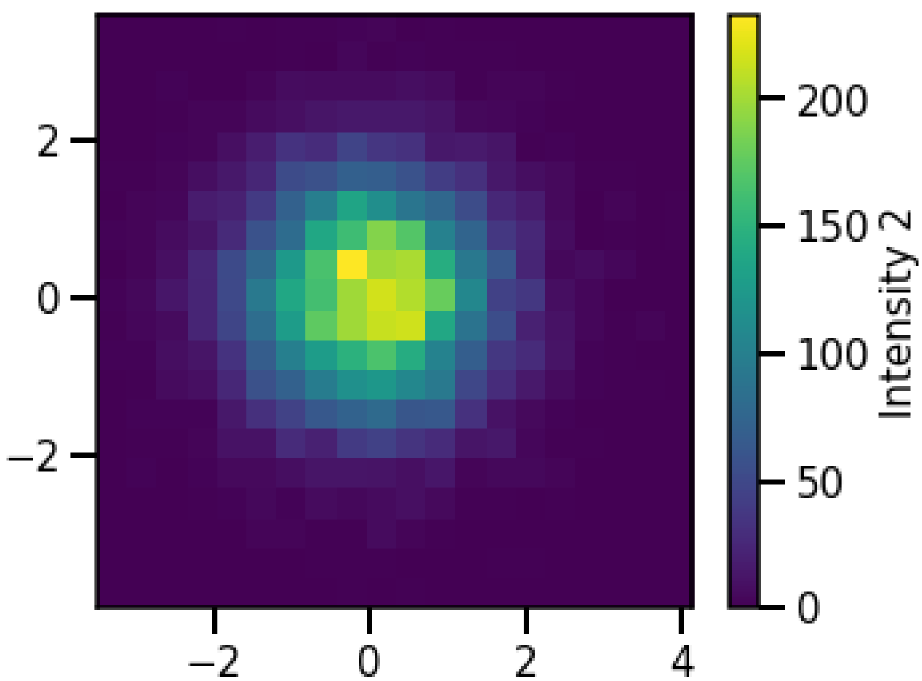
2D-histograms and hexagon plots

```
In [71]: from matplotlib.colors import LogNorm

         #normal distribution center at x=0 and y=5
         x = np.random.randn(100000)
         y = np.random.randn(100000)+5

         fig, ax = plt.subplots()
         counts, xedges, yedges, Image = ax.hist2d(x, y, bins=(40, 80), norm=LogNorm())
         cb = fig.colorbar(Image)
```




```
In [72]: x, y = np.random.normal(size=(2, 10000))

         fig, (ax1, ax2) = plt.subplots(2, figsize=(5, 9))

         im = ax1.hexbin(x, y, gridsize=20)
         cb = fig.colorbar(im, ax=ax1)
         cb.set_label('Intensity')

         H = ax2.hist2d(x, y, bins=20)
         cb = fig.colorbar(H[3], ax=ax2)
         cb.set_label('Intensity 2')
```

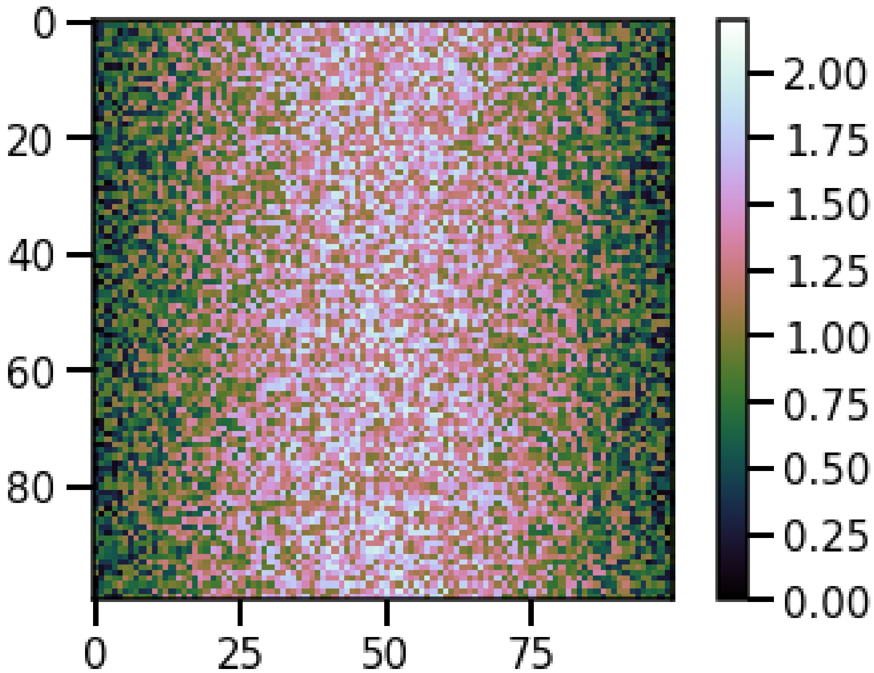




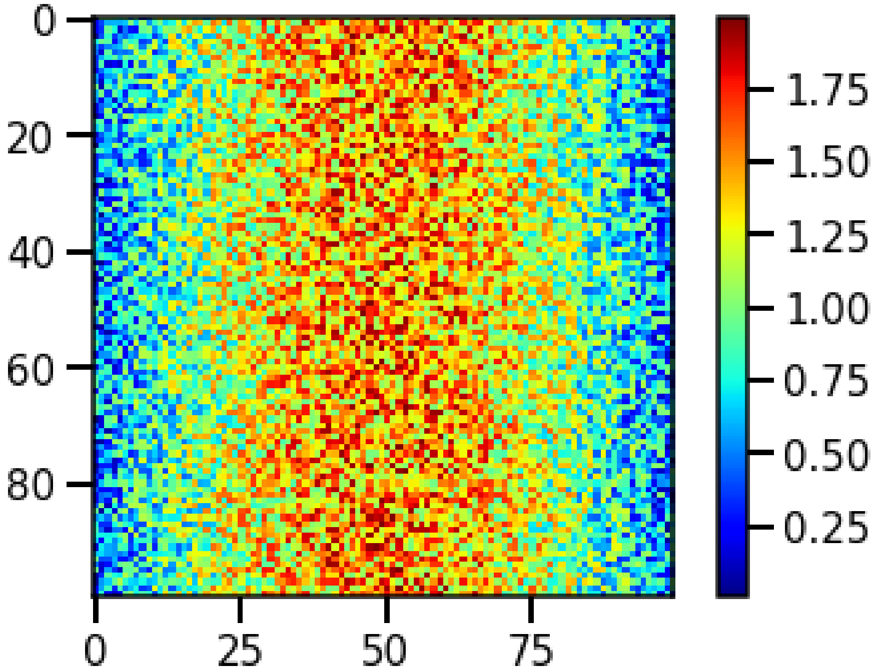
2D data sets and Images

```
In [73]: I = np.random.random((100, 100))
         I += np.sin(np.linspace(0, np.pi, 100))
```

```
fig, ax = plt.subplots()
im = ax.imshow(I, cmap=plt.cm.cubehelix, vmin=0, vmax=2.2) # draw the image
cb = fig.colorbar(im) # put the colorbar
```




```
In [74]: fig, ax = plt.subplots()
         im = ax.imshow(I, cmap=plt.cm.jet, interpolation='none') # draw the image, no interpola
         cb = fig.colorbar(im, ax=ax) # put the colorbar
```



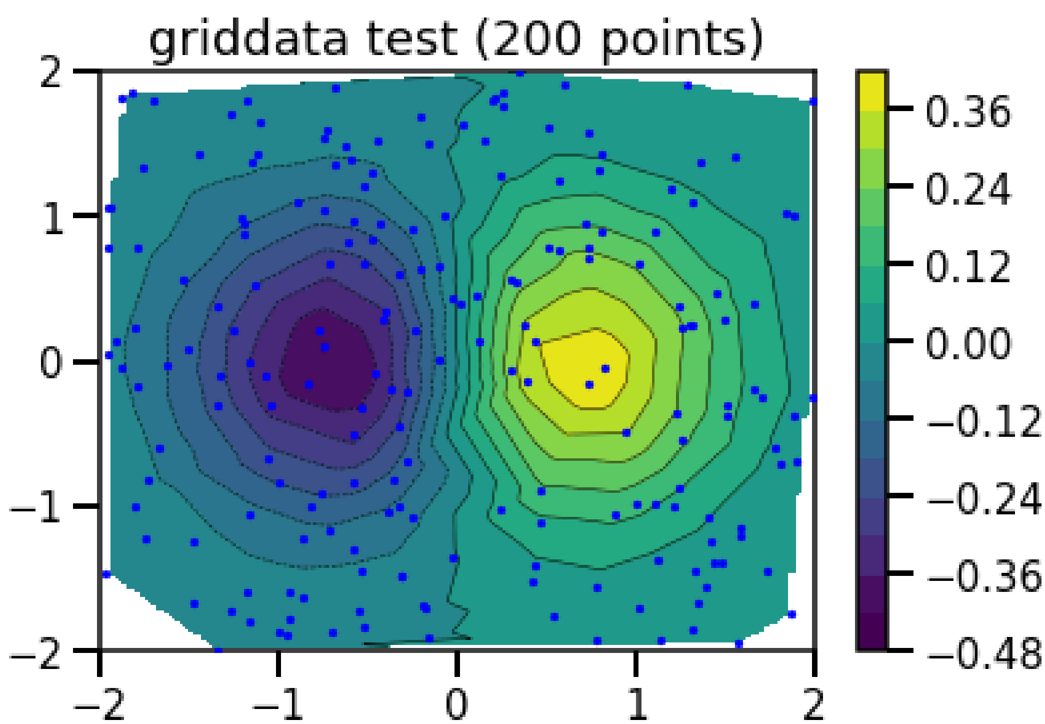

```
In [75]: help(plt.imshow)

Help on function imshow in module matplotlib.pyplot:

imshow(X, cmap=None, norm=None, aspect=None, interpolation=None, alpha=None, vmin=None, vmax=Non
    Display an image on the axes.

    Parameters
    ----------
    X : array_like, shape (n, m) or (n, m, 3) or (n, m, 4)
        Display the image in `X` to current axes.  `X` may be an
        array or a PIL image. If `X` is an array, it
        can have the following shapes and types:

        - MxN -- values to be mapped (float or int)
        - MxNx3 -- RGB (float or uint8)
        - MxNx4 -- RGBA (float or uint8)

        The value for each component of MxNx3 and MxNx4 float arrays
        should be in the range 0.0 to 1.0. MxN arrays are mapped
        to colors based on the `norm` (mapping scalar to scalar)
        and the `cmap` (mapping the normed scalar to a color).

    cmap : `~matplotlib.colors.Colormap`, optional, default: None
```

```
    If None, default to rc `image.cmap` value. `cmap` is ignored
    if `X` is 3-D, directly specifying RGB(A) values.

aspect : ['auto' | 'equal' | scalar], optional, default: None
    If 'auto', changes the image aspect ratio to match that of the
    axes.

    If 'equal', and `extent` is None, changes the axes aspect ratio to
    match that of the image. If `extent` is not `None`, the axes
    aspect ratio is changed to match that of the extent.

    If None, default to rc ``image.aspect`` value.

interpolation : string, optional, default: None
    Acceptable values are 'none', 'nearest', 'bilinear', 'bicubic',
    'spline16', 'spline36', 'hanning', 'hamming', 'hermite', 'kaiser',
    'quadric', 'catrom', 'gaussian', 'bessel', 'mitchell', 'sinc',
    'lanczos'

    If `interpolation` is None, default to rc `image.interpolation`.
    See also the `filternorm` and `filterrad` parameters.
    If `interpolation` is 'none', then no interpolation is performed
    on the Agg, ps and pdf backends. Other backends will fall back to
    'nearest'.

norm : `~matplotlib.colors.Normalize`, optional, default: None
    A `~matplotlib.colors.Normalize` instance is used to scale
    a 2-D float `X` input to the (0, 1) range for input to the
    `cmap`. If `norm` is None, use the default func:`normalize`.
    If `norm` is an instance of `~matplotlib.colors.NoNorm`,
    `X` must be an array of integers that index directly into
    the lookup table of the `cmap`.

vmin, vmax : scalar, optional, default: None
    `vmin` and `vmax` are used in conjunction with norm to normalize
    luminance data.  Note if you pass a `norm` instance, your
    settings for `vmin` and `vmax` will be ignored.

alpha : scalar, optional, default: None
    The alpha blending value, between 0 (transparent) and 1 (opaque)

origin : ['upper' | 'lower'], optional, default: None
    Place the [0,0] index of the array in the upper left or lower left
    corner of the axes. If None, default to rc `image.origin`.

extent : scalars (left, right, bottom, top), optional, default: None
    The location, in data-coordinates, of the lower-left and
    upper-right corners. If `None`, the image is positioned such that
```

```
    the pixel centers fall on zero-based (row, column) indices.

shape : scalars (columns, rows), optional, default: None
    For raw buffer images

filternorm : scalar, optional, default: 1
    A parameter for the antigrain image resize filter.  From the
    antigrain documentation, if `filternorm` = 1, the filter
    normalizes integer values and corrects the rounding errors. It
    doesn't do anything with the source floating point values, it
    corrects only integers according to the rule of 1.0 which means
    that any sum of pixel weights must be equal to 1.0.  So, the
    filter function must produce a graph of the proper shape.

filterrad : scalar, optional, default: 4.0
    The filter radius for filters that have a radius parameter, i.e.
    when interpolation is one of: 'sinc', 'lanczos' or 'blackman'

Returns
-------
image : `~matplotlib.image.AxesImage`

Other parameters
----------------
kwargs : `~matplotlib.artist.Artist` properties.

See also
--------
matshow : Plot a matrix or an array as an image.

Notes
-----
Unless *extent* is used, pixel centers will be located at integer
coordinates. In other words: the origin will coincide with the center
of pixel (0, 0).

Examples
--------

.. plot:: mpl_examples/pylab_examples/image_demo.py

.. note::
    In addition to the above described arguments, this function can take a
    **data** keyword argument. If such a **data** argument is given, the
    following arguments are replaced by **data[<arg>]**:

    * All positional and all keyword arguments.
```

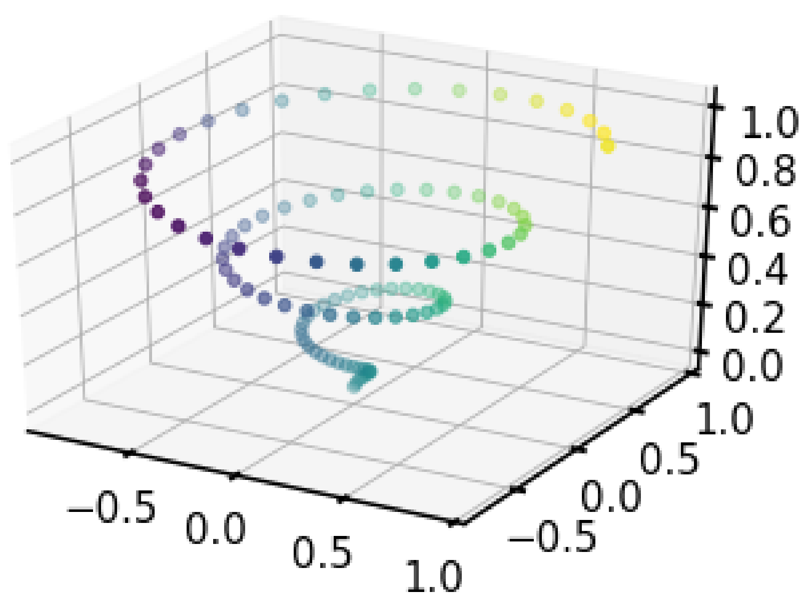
Contour

```
In [76]: from matplotlib.mlab import griddata
         fig, ax = plt.subplots()
         # make up data.
         #npts = int(raw_input('enter # of random points to plot:'))
         npts = 200
         x = np.random.uniform(-2, 2, npts)
         y = np.random.uniform(-2, 2, npts)
         z = x*np.exp(-x**2 - y**2)
         # define grid.
         xi = np.linspace(-2.1, 2.1, 100)
         yi = np.linspace(-2.1, 2.1, 200)
         # grid the data.
         zi = griddata(x, y, z, xi, yi, interp='linear')
         # contour the gridded data, plotting dots at the nonuniform data points.
         ax.contour(xi, yi, zi, 15, linewidths=0.5, colors='k')
         CF = ax.contourf(xi, yi, zi, 15,
                          vmax=abs(zi).max(), vmin=-abs(zi).max())
         cb = fig.colorbar(CF)  # draw colorbar
         # plot data points.
         ax.scatter(x, y, marker='o', c='b', s=5, zorder=10)
         ax.set_xlim(-2, 2)
         ax.set_ylim(-2, 2)
         ax.set_title('griddata test (%d points)' % npts);
```



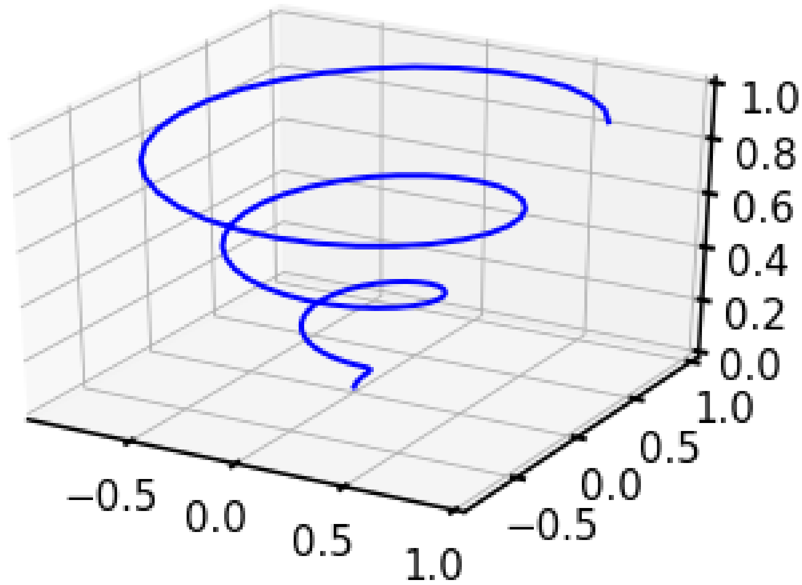
3D scatter plots

In [77]:
```
from mpl_toolkits.mplot3d import Axes3D
fig = plt.figure()
ax = plt.axes(projection='3d')

z = np.linspace(0, 1, 100)
x = z * np.sin(20 * z)
y = z * np.cos(20 * z)

c = x + y

ax.scatter(x, y, z, c=c);
#ax.set_zscale('log')
```

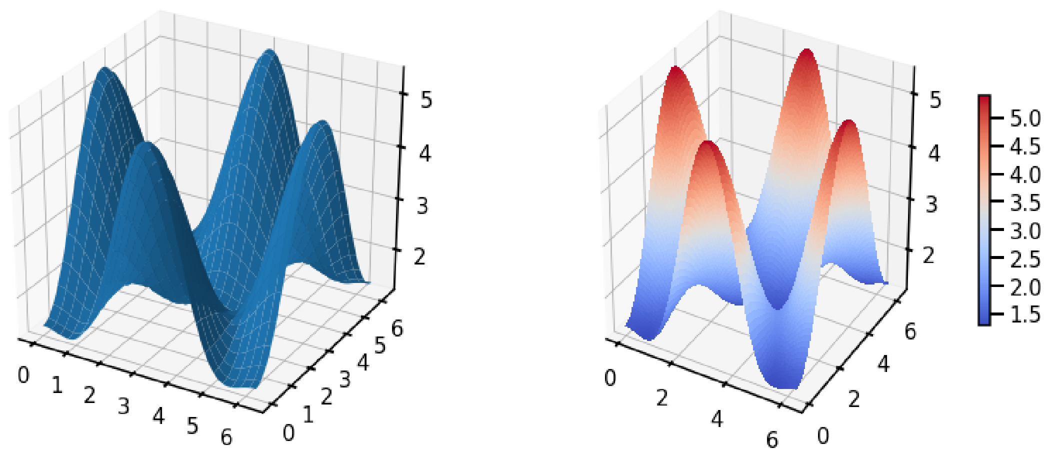


In [78]:
```
fig = plt.figure()
ax = plt.axes(projection='3d')

ax.plot(x, y, z, '-b')
```

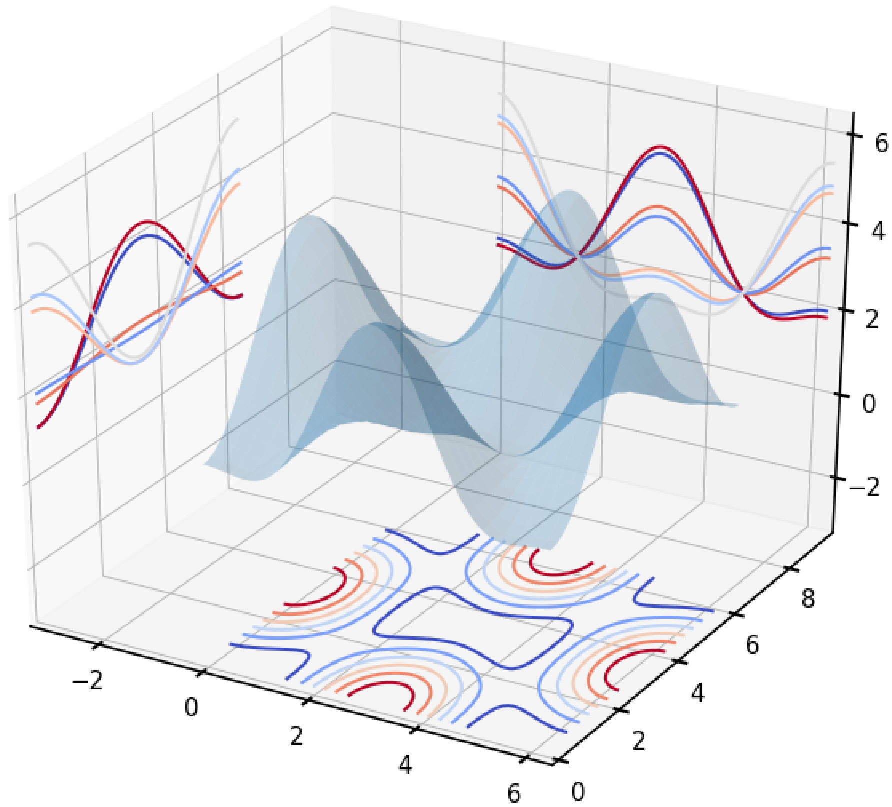
Out[78]: [<mpl_toolkits.mplot3d.art3d.Line3D at 0x7f0a32099eb8>]



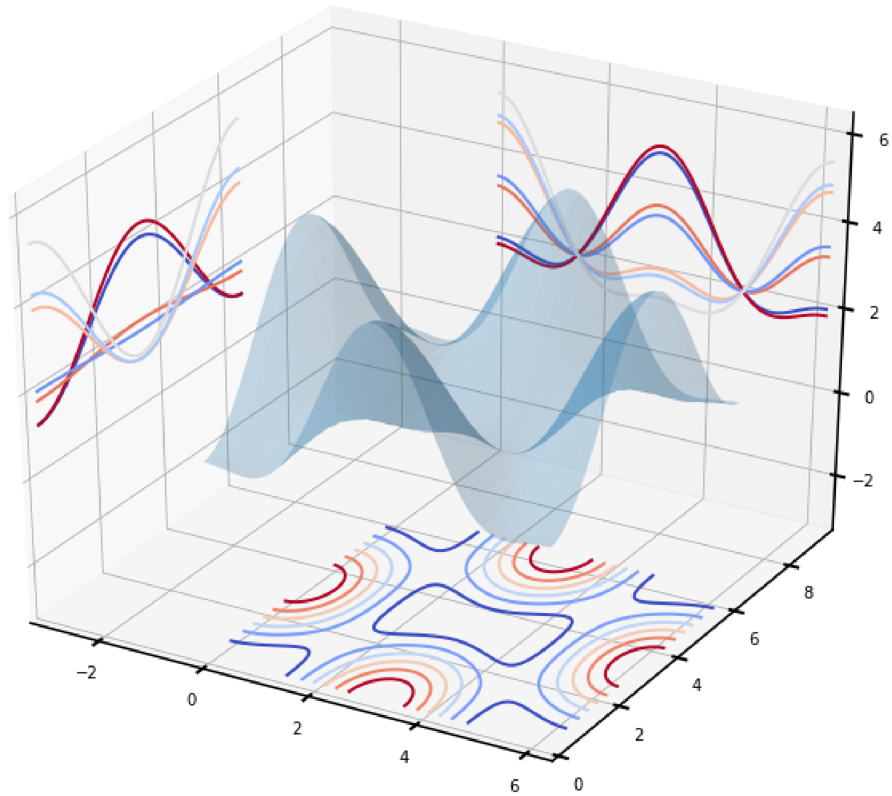
In [79]:
```
alpha = 0.7
phi_ext = 2 * np.pi * 0.5

def flux_qubit_potential(phi_m, phi_p):
    return 2 + alpha - 2 * np.cos(phi_p)*np.cos(phi_m) - alpha * np.cos(phi_ext - 2*phi

phi_m = np.linspace(0, 2*np.pi, 100)
phi_p = np.linspace(0, 2*np.pi, 100)
X,Y = np.meshgrid(phi_p, phi_m)
Z = flux_qubit_potential(X, Y).T
fig = plt.figure(figsize=(14,6))

# `ax` is a 3D-aware axis instance, because of the projection='3d' keyword argument to
ax = fig.add_subplot(1, 2, 1, projection='3d')

p = ax.plot_surface(X, Y, Z, rstride=4, cstride=4, linewidth=0)

# surface_plot with color grading and color bar
ax = fig.add_subplot(1, 2, 2, projection='3d')
p = ax.plot_surface(X, Y, Z, rstride=1, cstride=1, cmap=plt.cm.coolwarm, linewidth=0,
                    antialiased=False)
cb = fig.colorbar(p, shrink=0.5)
```




```
In [80]: pi = np.pi
         fig = plt.figure(figsize=(12,10))

         ax = fig.add_subplot(1,1,1, projection='3d')

         ax.plot_surface(X, Y, Z, rstride=4, cstride=4, alpha=0.25)
         cset = ax.contour(X, Y, Z, zdir='z', offset=-pi, cmap=plt.cm.coolwarm)
         cset = ax.contour(X, Y, Z, zdir='x', offset=-pi, cmap=plt.cm.coolwarm)
         cset = ax.contour(X, Y, Z, zdir='y', offset=3*pi, cmap=plt.cm.coolwarm)

         ax.set_xlim3d(-pi, 2*pi);
         ax.set_ylim3d(0, 3*pi);
         ax.set_zlim3d(-pi, 2*pi);
```

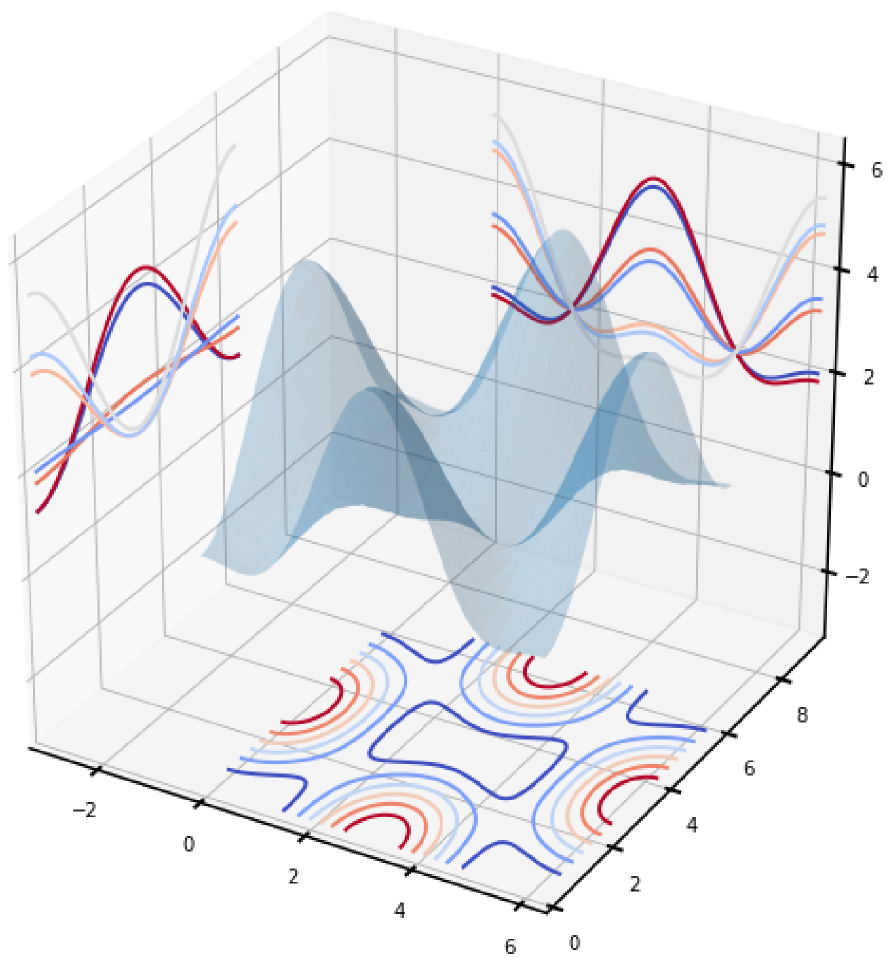


In [81]:
```
# Interactive rotating the plot
%matplotlib tk
fig = plt.figure(figsize=(12,10))

ax = fig.add_subplot(1,1,1, projection='3d')

ax.plot_surface(X, Y, Z, rstride=4, cstride=4, alpha=0.25)
cset = ax.contour(X, Y, Z, zdir='z', offset=-pi, cmap=plt.cm.coolwarm)
cset = ax.contour(X, Y, Z, zdir='x', offset=-pi, cmap=plt.cm.coolwarm)
cset = ax.contour(X, Y, Z, zdir='y', offset=3*pi, cmap=plt.cm.coolwarm)

ax.set_xlim3d(-pi, 2*pi);
ax.set_ylim3d(0, 3*pi);
ax.set_zlim3d(-pi, 2*pi);
```



Saving plots

```
In [82]: %matplotlib inline
         fig = plt.figure()

         ax = fig.add_subplot(1,1,1, projection='3d')

         ax.plot_surface(X, Y, Z, rstride=4, cstride=4, alpha=0.25)
         cset = ax.contour(X, Y, Z, zdir='z', offset=-pi, cmap=plt.cm.coolwarm)
         cset = ax.contour(X, Y, Z, zdir='x', offset=-pi, cmap=plt.cm.coolwarm)
         cset = ax.contour(X, Y, Z, zdir='y', offset=3*pi, cmap=plt.cm.coolwarm)

         ax.set_xlim3d(-pi, 2*pi);
         ax.set_ylim3d(0, 3*pi);
         ax.set_zlim3d(-pi, 2*pi);
         fig.set_size_inches(10,10)
         fig.savefig('Fig1.pdf')
```




```
In [83]: ls *pdf
```

```
BPT1.pdf                    intro_numpy.pdf     OOP.pdf
Calling Fortran.pdf         intro_Python_2.pdf  Optimization.pdf
Fig1.pdf                    intro_Python_3.pdf  test1.pdf
Interact with files.pdf     intro_Python.pdf    Useful_libraries.pdf
Intro_1.pdf                 intro_Scipy.pdf     Using_astropy.pdf
intro_Matplotlib.pdf        MySQL.pdf           Using_PyMySQL.pdf
```

Other tutorials: http://matplotlib.org/mpl_toolkits/mplot3d/tutorial.html

Access and clear the current figure and axe

```
In [84]: fig, ax = plt.subplots()
         print(plt.gca() is ax) # You can get the  current axes with gca
         print(plt.gcf() is fig) # The same for the current axes.
         # But it's preferable to store them in a variable when creating
         plt.clf() # clear the current figure
         plt.cla() # clear the current axes
         fig.clf() # clear a given figure
         ax.cla() # clear a given axes
```

```
True
True
```

```
<matplotlib.figure.Figure at 0x7f0a2b0af710>
```

What's happen when not in a Notebook? plt.show() and plt.ion() commands We are here in a Notebook, but most of the time, you will execute programs from a script or using the command line in a terminal.

When using plot, scatter or any other plotting tool, the figure will not appear when typing the command, you need to send the *plt.show()* command to pop-up it (or them if you did more than one figure). And you will loose the interactivity with the command line! You will recover it once the figure windows are closed.

The way to change this behaviour is to call the *plt.ion()* command (interactive On). And to deactivate this you can use *plt.ioff()* command (interactive Off).

If you are working within an ipython session created with the --pylab option, it is done by default.