Matplotlib使用教程

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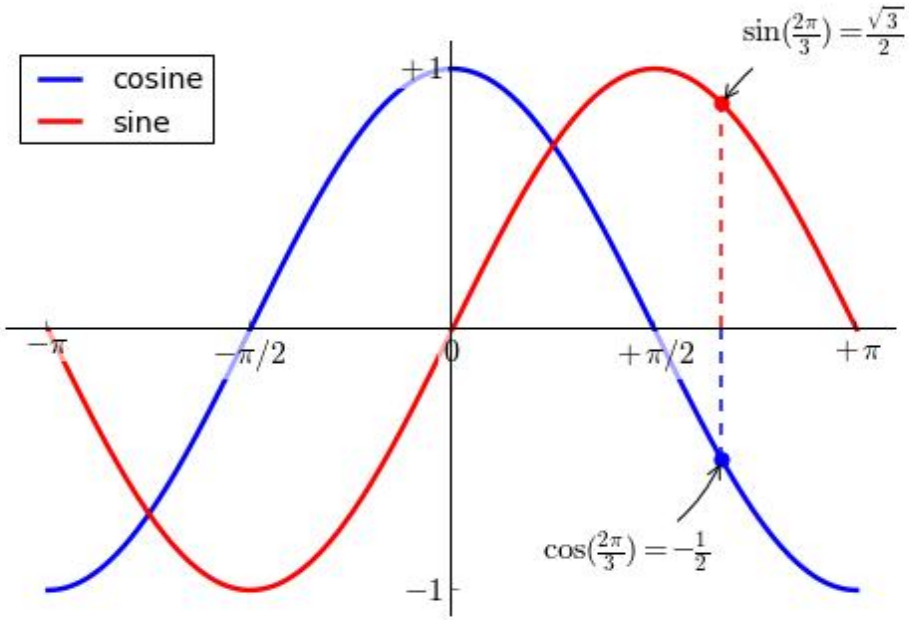
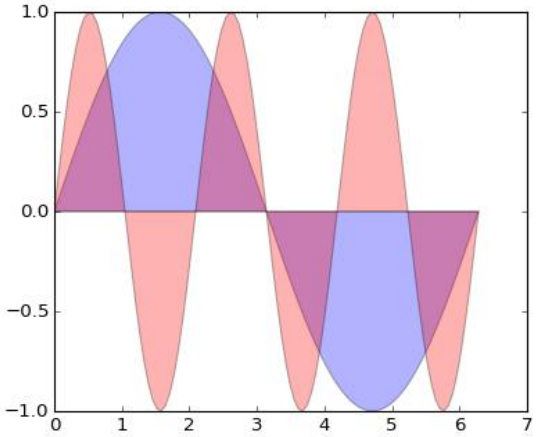
简单介绍

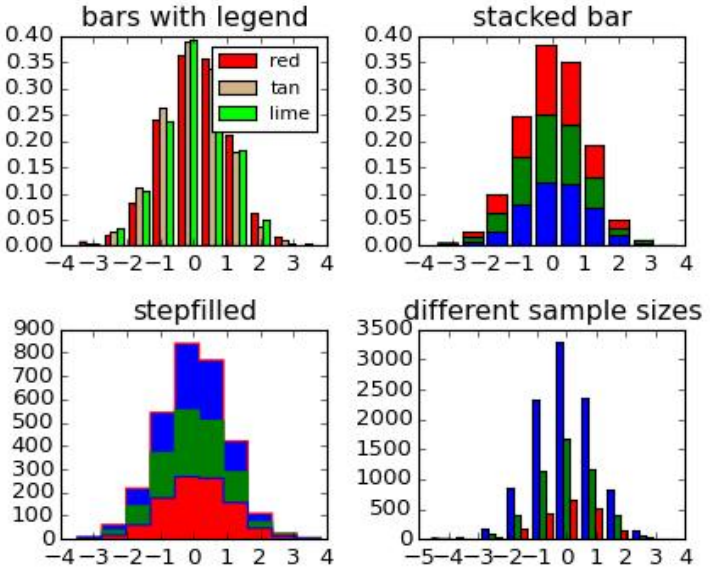
- Most popular plotting library for python
- Created by John Hunter (1968-2012)
- Has a lot in common with MatLab's plotting library, both functionally and syntactically.
- http://matplotlib.org/ 中的 Example 和 Gallery

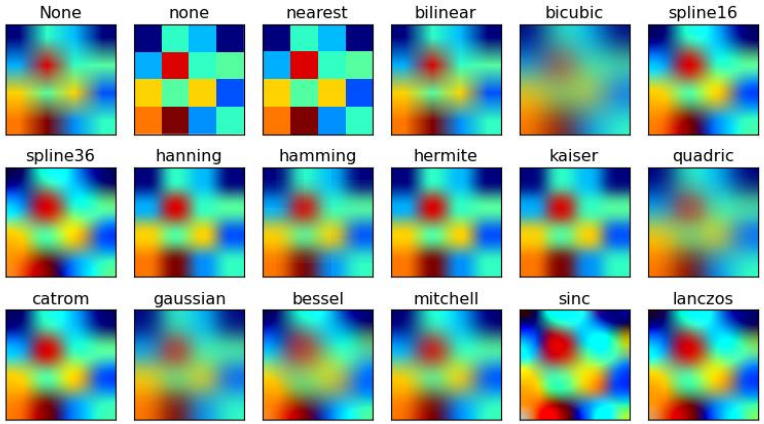
美观

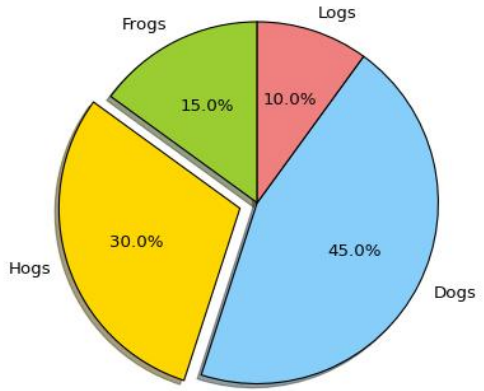

cosine
sine
$\sin(\frac{2\pi}{3}) = \frac{\sqrt{3}}{2}$
$+1$
-1
$-\pi$
$-\pi/2$
0
$+\pi/2$
$+\pi$
$\cos(\frac{2\pi}{3}) = -\frac{1}{2}$

花样多

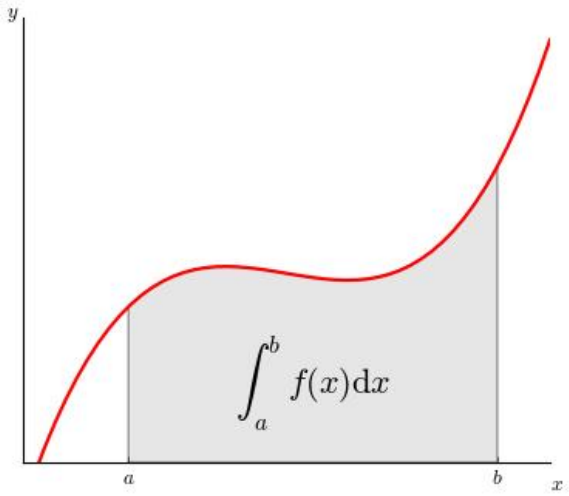

1.0
0.5
0.0
−0.5
−1.0
0
1
2
3
4
5
6
7

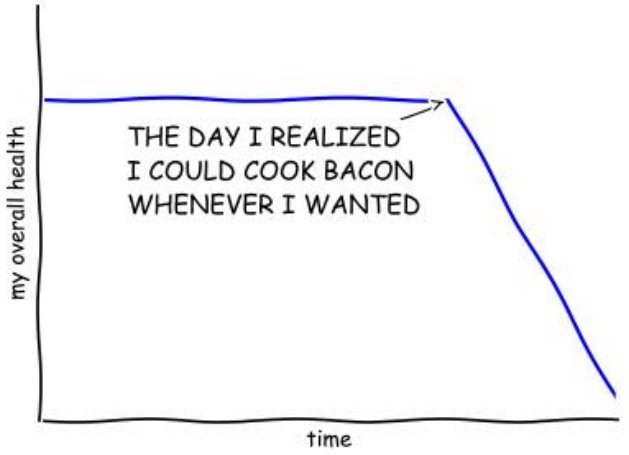

bars with legend
red
tan
lime
stacked bar
stepfilled
different sample sizes


None
none
nearest
bilinear
bicubic
spline16
spline36
hanning
hamming
hermite
kaiser
quadric
catrom
gaussian
bessel
mitchell
sinc
lanczos

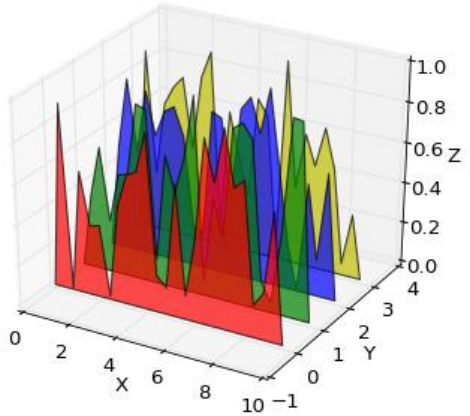

Frogs
Logs
15.0%
10.0%
30.0%
45.0%
Hogs
Dogs

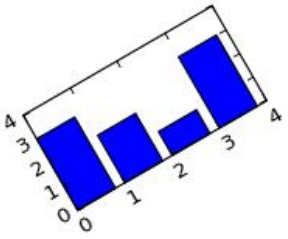
花样多

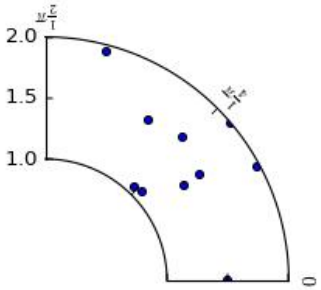


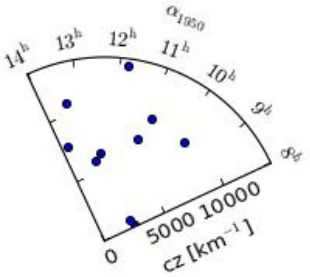


"Stove Ownership" from xkcd by Randall Monroe

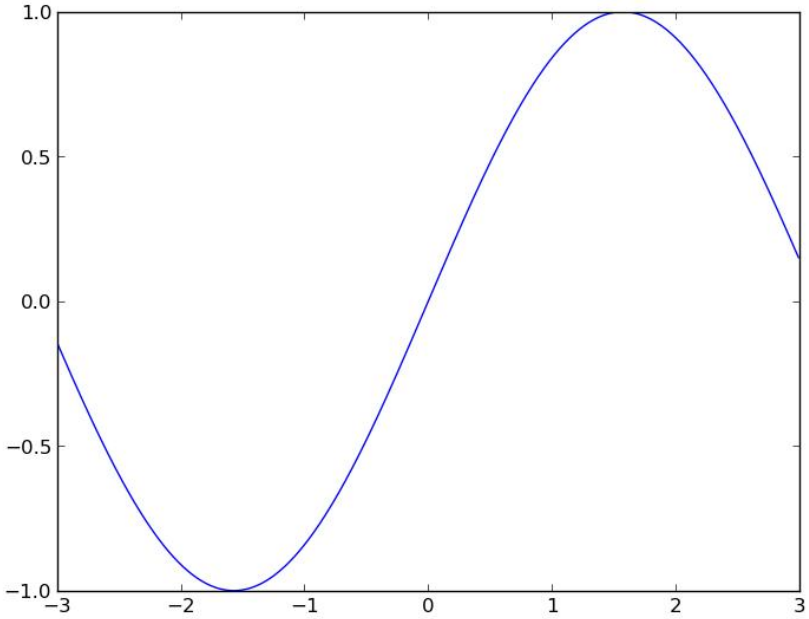






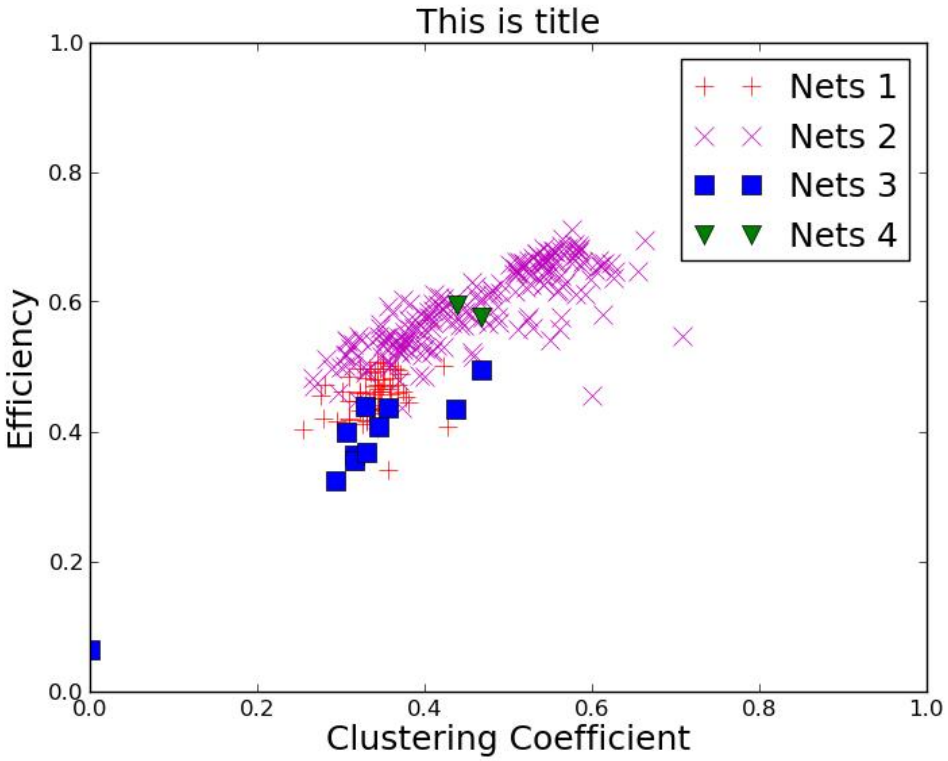


最简单的画图脚本




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

x=np.arange(-3,3,0.01)
plt.plot(x,sin(x))
plt.show()
```

从一个例子学起




```
#!/usr/bin/python

import numpy as np
import matplotlib.pyplot as plt

fs = 18
ms = 10

all_files = [ 'nets' + str(i) + '.txt' for i in np.arange(1,5) ]

plot_file = "dots.ex1.png"

data = [ np.loadtxt(all_files[i]) for i in range(0, len(all_files))]

subdata = data[0]
plt.plot(subdata[:,6], subdata[:,9], 'r+', markersize = ms, label = 'Nets 1')
subdata = data[1]
plt.plot(subdata[:,6], subdata[:,9], 'mx', markersize = ms, label = 'Nets
2')
subdata = data[2]
plt.plot(subdata[:,6], subdata[:,9], 'bs', markersize = ms, label = 'Nets
3')
subdata = data[3]
plt.plot(subdata[:,6], subdata[:,9], 'gv', markersize = ms, label = 'Nets
4')

plt.title('This is title', fontsize=fs)
plt.xlabel('Clustering Coefficient', fontsize=fs)
plt.ylabel('Efficiency', fontsize=fs)
plt.xlim((0,1))
plt.ylim((0,1))
for label in plt.gca().xaxis.get_ticklabels():
        label.set_fontsize(fs)
for label in plt.gca().yaxis.get_ticklabels():
        label.set_fontsize(fs)

plt.legend(loc=0, fontsize=fs)

plt.savefig(plot_file, bbox_inches='tight')
```

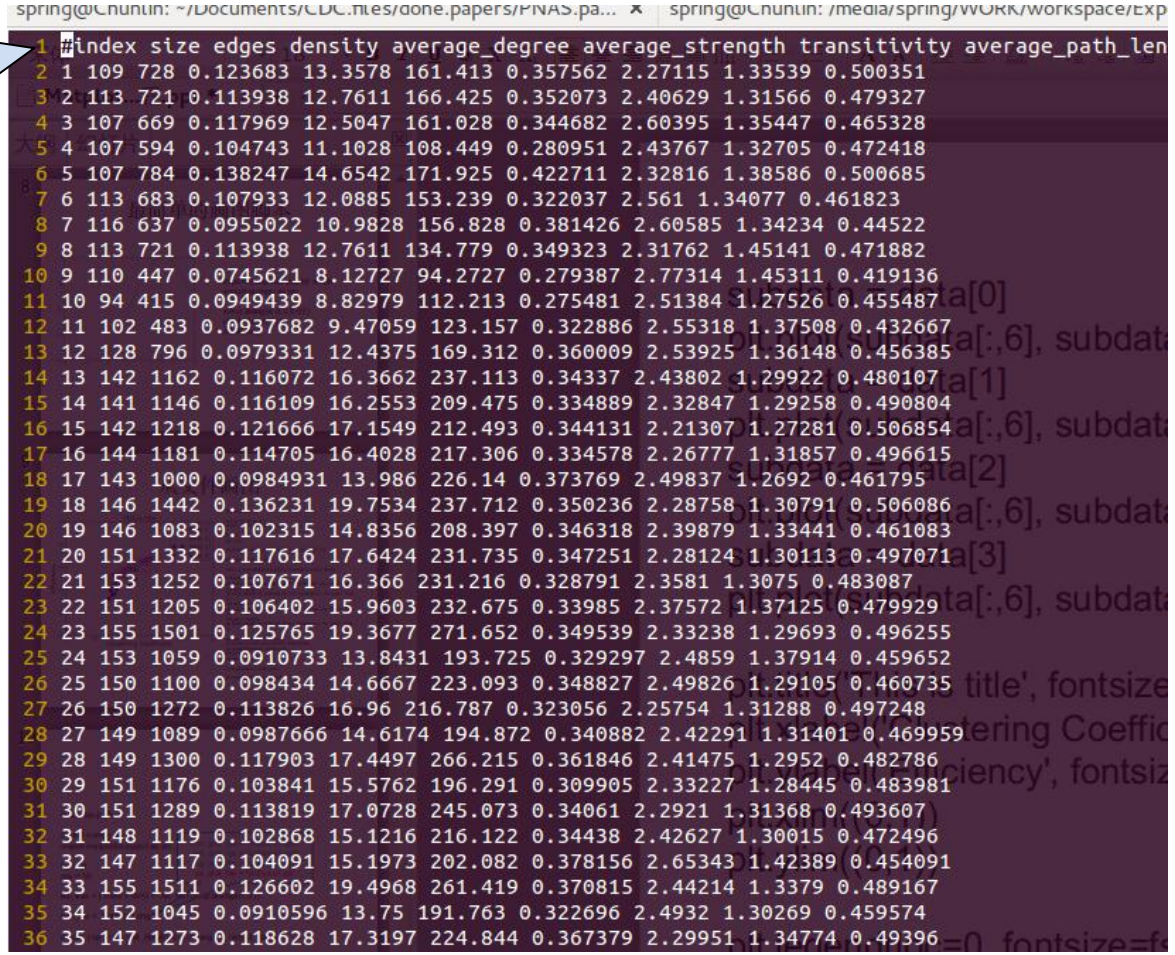
```
#!/usr/bin/python

import numpy as np
import matplotlib.pyplot as plt

fs = 18
ms = 10

all_files = [ 'nets' + str(i) + '.txt' for i in np.arange(1,5) ]

plot_file = "dots.ex1.png"

data = [ np.loadtxt(all_files[i]) for i in range(0, len(all_files))]
```

eps: plot_file = "dots.ex1.eps"
pdf: plot_file = "dots.ex1.pdf"
jpg: plot_file = "dots.ex1.jpg"
ps: plot_file = "dots.ex1.ps"

（待续）

文件的格式（与matplotlib无关）

除了#开头的行以外，
必须全部是数字



```
#index size edges density average_degree average_strength transitivity average_path_len
1 109 728 0.123683 13.3578 161.413 0.357562 2.27115 1.33539 0.500351
2 113 721 0.113938 12.7611 166.425 0.352073 2.40629 1.31566 0.479327
3 107 669 0.117969 12.5047 161.028 0.344682 2.60395 1.35447 0.465328
4 107 594 0.104743 11.1028 108.449 0.280951 2.43767 1.32705 0.472418
5 107 784 0.138247 14.6542 171.925 0.422711 2.32816 1.38586 0.500685
6 113 683 0.107933 12.0885 153.239 0.322037 2.561 1.34077 0.461823
7 116 637 0.0955022 10.9828 156.828 0.381426 2.60585 1.34234 0.44522
8 113 721 0.113938 12.7611 134.779 0.349323 2.31762 1.45141 0.471882
9 110 447 0.0745621 8.12727 94.2727 0.279387 2.77314 1.45311 0.419136
10 94 415 0.0949439 8.82979 112.213 0.275481 2.51384 1.27526 0.455487
11 102 483 0.0937682 9.47059 123.157 0.322886 2.55318 1.37508 0.432667
12 128 796 0.0979331 12.4375 169.312 0.360009 2.53925 1.36148 0.456385
13 142 1162 0.116072 16.3662 237.113 0.34337 2.43802 1.29922 0.480107
14 141 1146 0.116109 16.2553 209.475 0.334889 2.32847 1.29258 0.490804
15 142 1218 0.121666 17.1549 212.493 0.344131 2.21307 1.27281 0.506854
16 144 1181 0.114705 16.4028 217.306 0.334578 2.26777 1.31857 0.496615
17 143 1000 0.0984931 13.986 226.14 0.373769 2.49837 1.2692 0.461795
18 146 1442 0.136231 19.7534 237.712 0.350236 2.28758 1.30791 0.506086
19 146 1083 0.102315 14.8356 208.397 0.346318 2.39879 1.33441 0.461083
20 151 1332 0.117616 17.6424 231.735 0.347251 2.28124 1.30113 0.497071
21 153 1252 0.107671 16.366 231.216 0.328791 2.3581 1.3075 0.483087
22 151 1205 0.106402 15.9603 232.675 0.33985 2.37572 1.37125 0.479929
23 155 1501 0.125765 19.3677 271.652 0.349539 2.33238 1.29693 0.496255
24 153 1059 0.0910733 13.8431 193.725 0.329297 2.4859 1.37914 0.459652
25 150 1100 0.098434 14.6667 223.093 0.348827 2.49826 1.29105 0.460735
26 150 1272 0.113826 16.96 216.787 0.323056 2.25754 1.31288 0.497248
27 149 1089 0.0987666 14.6174 194.872 0.340882 2.42291 1.31401 0.469959
28 149 1300 0.117903 17.4497 266.215 0.361846 2.41475 1.2952 0.482786
29 151 1176 0.103841 15.5762 196.291 0.309905 2.33227 1.28445 0.483981
30 151 1289 0.113819 17.0728 245.073 0.34061 2.2921 1.31368 0.493607
31 148 1119 0.102868 15.1216 216.122 0.34438 2.42627 1.30015 0.472496
32 147 1117 0.104091 15.1973 202.082 0.378156 2.65343 1.42389 0.454091
33 155 1511 0.126602 19.4968 261.419 0.370815 2.44214 1.3379 0.489167
34 152 1045 0.0910596 13.75 191.763 0.322696 2.4932 1.30269 0.459574
35 147 1273 0.118628 17.3197 224.844 0.367379 2.29951 1.34774 0.49396
```

实际上是第7列

```
subdata = data[0]
plt.plot(subdata[:,6], subdata[:,9], 'r+', markersize = ms, label = 'Nets 1')
subdata = data[1]
plt.plot(subdata[:,6], subdata[:,9], 'mx', markersize = ms, label = 'Nets 2')
subdata = data[2]
plt.plot(subdata[:,6], subdata[:,9], 'bs', markersize = ms, label = 'Nets 3')
subdata = data[3]
plt.plot(subdata[:,6], subdata[:,9], 'gv', markersize = ms, label = 'Nets 4')

plt.title('This is title', fontsize=fs)
plt.xlabel('Clustering Coefficient', fontsize=fs)
plt.ylabel('Efficiency', fontsize=fs)
plt.xlim((0,1))
plt.ylim((0,1))
for label in plt.gca().xaxis.get_ticklabels():
        label.set_fontsize(fs)
for label in plt.gca().yaxis.get_ticklabels():
        label.set_fontsize(fs)

plt.legend(loc=0, fontsize=fs)

plt.savefig(plot_file, bbox_inches='tight')
```

plot 函数

- 画点或者线

```
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
```

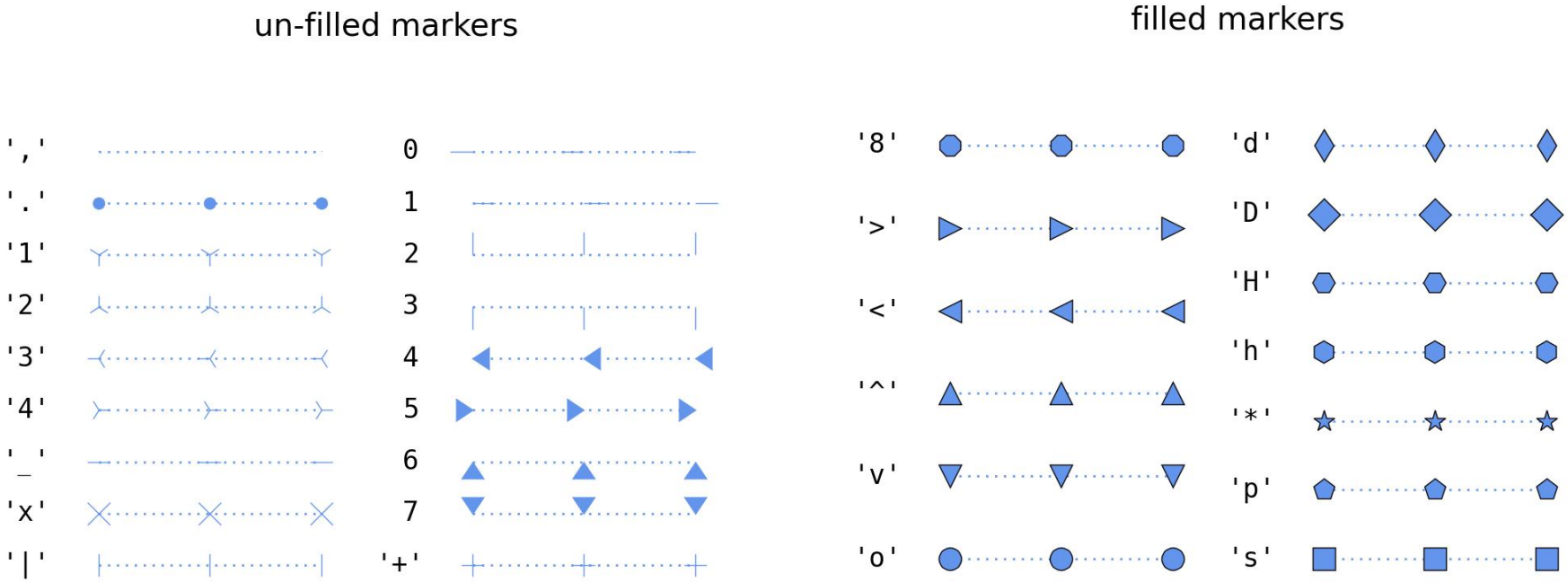
- 如果x或者y是二维矩阵，则相当于画列向量
- 可以在一个plot函数中画多个点或线

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

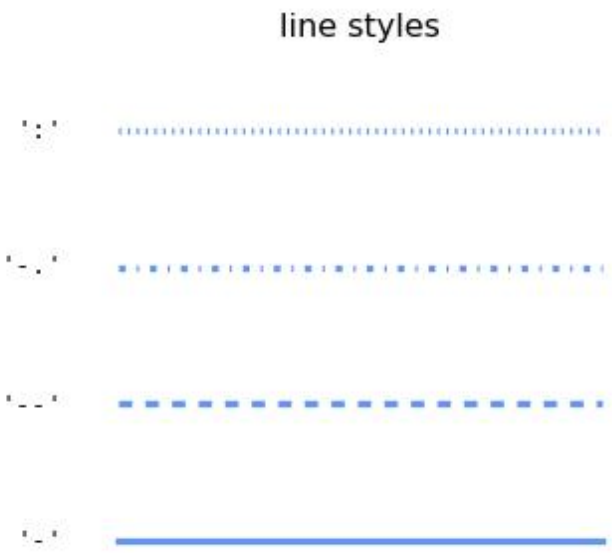
- 参数有fmt形式和kwargs形式

```
'g^-'    VS    color='g', marker='^', ls='-'
```

Markers

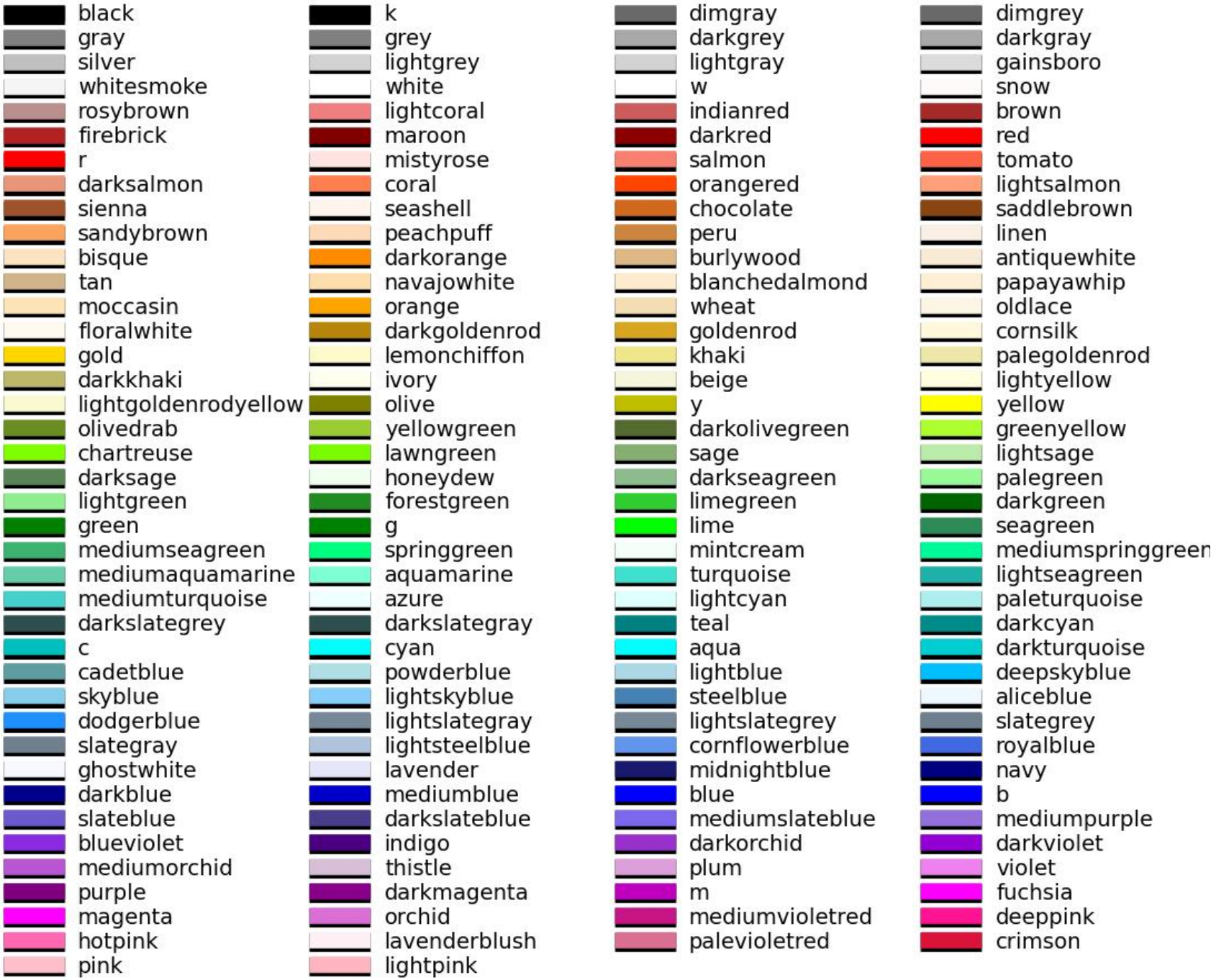

un-filled markers
filled markers
','
'.'
'1'
'2'
'3'
'4'
'_'
'x'
'|'
0
1
2
3
4
5
6
7
'+'
'8'
'>'
'<'
'^'
'v'
'o'
'd'
'D'
'H'
'h'
'*'
'p'
's'

Line styles



Colors

- 单词，如red
- 字母，如r
- 6个16进制数，如'#FF0000'或'#ff0000'
- 含有三(RGB)或四(RGBA)个元素(0~1)的元组，如(1, 0, 0)或(1,0,0,1)，只用于kwargs
- 灰度字符串，如'0.8'


black
gray
silver
whitesmoke
rosybrown
firebrick
r
darksalmon
sienna
sandybrown
bisque
tan
moccasin
floralwhite
gold
darkkhaki
lightgoldenrodyellow
olivedrab
chartreuse
darksage
lightgreen
green
mediumseagreen
mediumaquamarine
mediumturquoise
darkslategrey
c
cadetblue
skyblue
dodgerblue
slategray
ghostwhite
darkblue
slateblue
blueviolet
mediumorchid
purple
magenta
hotpink
pink
k
grey
lightgrey
white
lightcoral
maroon
mistyrose
coral
seashell
peachpuff
darkorange
navajowhite
orange
darkgoldenrod
lemonchiffon
ivory
olive
yellowgreen
lawngreen
honeydew
forestgreen
g
springgreen
aquamarine
azure
darkslategray
cyan
powderblue
lightskyblue
lightslategray
lightsteelblue
lavender
mediumblue
darkslateblue
indigo
thistle
darkmagenta
orchid
lavenderblush
lightpink
dimgray
darkgrey
lightgray
w
indianred
darkred
salmon
orangered
chocolate
peru
burlywood
blanchedalmond
wheat
goldenrod
khaki
beige
y
darkolivegreen
sage
darkseagreen
limegreen
lime
mintcream
turquoise
lightcyan
teal
aqua
lightblue
steelblue
lightslategrey
cornflowerblue
midnightblue
blue
mediumslateblue
darkorchid
plum
m
mediumvioletred
palevioletred
dimgrey
darkgray
gainsboro
snow
brown
red
tomato
lightsalmon
saddlebrown
linen
antiquewhite
papayawhip
oldlace
cornsilk
palegoldenrod
lightyellow
yellow
greenyellow
lightsage
palegreen
darkgreen
seagreen
mediumspringgreen
lightseagreen
paleturquoise
darkcyan
darkturquoise
deepskyblue
aliceblue
slategrey
royalblue
navy
b
mediumpurple
darkviolet
violet
fuchsia
deeppink
crimson

一个字母可表示的颜色

- r 红色
- g 绿色
- b 蓝色
- c cyan
- m 紫色
- y 土黄色
- k 黑色
- w 白色

plot函数的参数

- 可使用Line2D的所有参数
  - http://matplotlib.org/api/pyplot_api.html#matplotlib.pyplot.plot
  - class matplotlib.lines.Line2D(xdata, ydata, linewidth=None, linestyle=None, color=None, marker=None, markersize=None, markeredgewidth=None, markeredgecolor=None, markerfacecolor=None, markerfacecoloralt=u'none', fillstyle=u'full', antialiased=None, dash_capstyle=None, solid_capstyle=None, dash_joinstyle=None, solid_joinstyle=None, pickradius=5, drawstyle=None, markevery=None, **kwargs)

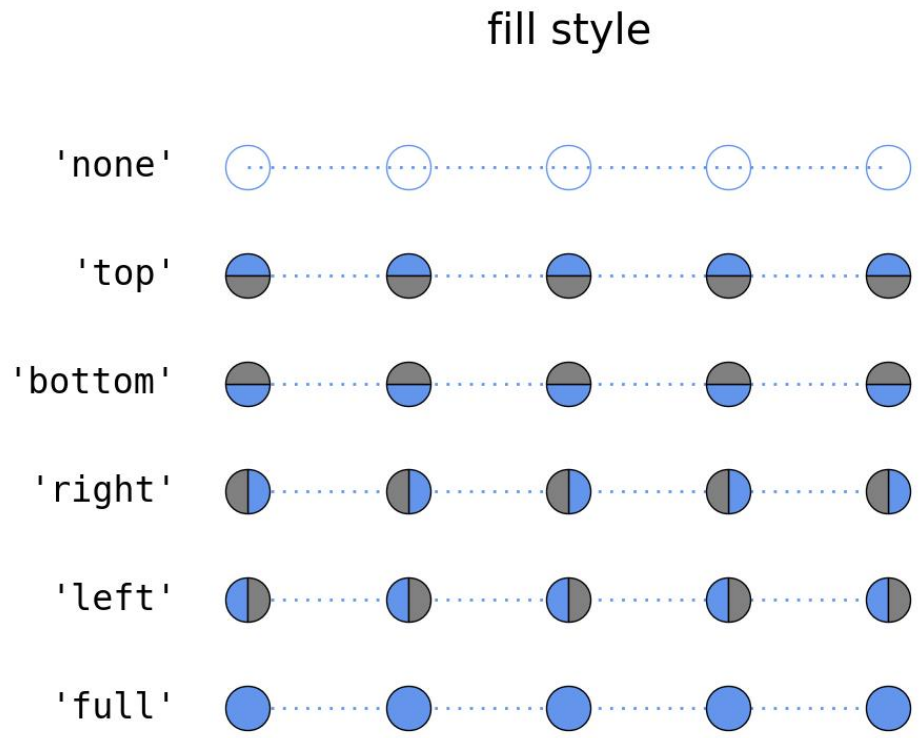
Line2D可以指定的参数

Property	Description
alpha	float (0.0 transparent through 1.0 opaque)
antialiased or aa	[True | False]
axes	an Axes instance
color or c	any matplotlib color
drawstyle	[‘default’ | ‘steps’ | ‘steps-pre’ | ‘steps-mid’ | ‘steps-post’]
fillstyle	[‘full’ | ‘left’ | ‘right’ | ‘bottom’ | ‘top’ | ‘none’]
label	string or anything printable with ‘%s’ conversion
linestyle or ls	['-' | '--' | '-.' | ':' | 'None' | ' ' | '']
linewidth or lw	float value in points

Line2D可以指定的参数

Property	Description
marker	A valid marker style
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 | length-2 tuple of float]
xdata	1D array
ydata	1D array
visible	[True | False]

fill style



markeredgecolor (mec)
markeredgewidth (mew)
markerfacecolor (mfc)
markerfacecoloralt (mfcalt)

1. 默认替代颜色为无色，不是灰色
2. 只设置color，相当于同时设置了mec和mfc

实际上是第7列

可改为 ms = ms

```
subdata = data[0]
plt.plot(subdata[:,6], subdata[:,9], 'r+', markersize = ms, label = 'Nets 1')
subdata = data[1]
plt.plot(subdata[:,6], subdata[:,9], 'mx', markersize = ms, label = 'Nets 2')
subdata = data[2]
plt.plot(subdata[:,6], subdata[:,9], 'bs', markersize = ms, label = 'Nets 3')
subdata = data[3]
plt.plot(subdata[:,6], subdata[:,9], 'gv', markersize = ms, label = 'Nets 4')

plt.title('This is title', fontsize=fs)
plt.xlabel('Clustering Coefficient', fontsize=fs)
plt.ylabel('Efficiency', fontsize=fs)
plt.xlim((0,1))
plt.ylim((0,1))
for label in plt.gca().xaxis.get_ticklabels():
        label.set_fontsize(fs)
for label in plt.gca().yaxis.get_ticklabels():
        label.set_fontsize(fs)

plt.legend(loc=0, fontsize=fs)

plt.savefig(plot_file, bbox_inches='tight')
```

title 函数

- matplotlib.pyplot.title(s, *args, **kwargs)
  - label: str
  - fontdict: dict
    - 默认为：{‘fontsize’: rcParams[‘axes.titlesize’], ‘fontweight’ : rcParams[‘axes.titleweight’], ‘verticalalignment’: ‘baseline’, ‘horizontalalignment’: loc}
  - loc : {‘center’, ‘left’, ‘right’}, str, optional

title 函数

- 可使用Text的所有参数
  - class matplotlib.text.Text(x=0, y=0, text=u'', color=None, verticalalignment=u'baseline', horizontalalignment=u'left', multialignment=None, fontproperties=None, rotation=None, linespacing=None, rotation_mode=None, **kwargs)

Text可以指定的参数

Property	Description
alpha	float (0.0 transparent through 1.0 opaque)
axes	an Axes instance
backgroundcolor	any matplotlib color
color or c	any matplotlib color
family or fontfamily or fontname or name	[FONTNAME | ‘serif’ | ‘sans-serif’ | ‘cursive’ | ‘fantasy’ | ‘monospace’]
fontproperties or font_properties	a matplotlib.font_manager.FontProperties instance
horizontalalignment or ha	[‘center’ | ‘right’ | ‘left’]
label	string or anything printable with ‘%s’ conversion
position	(x,y)

Text可以指定的参数

Property	Description
rotation	[angle in degrees | 'vertical' | 'horizontal']
size or fontsize	[size in points | 'xx-small' | 'x-small' | 'small' | 'medium' | 'large' | 'x-large' | 'xx-large']
stretch or fontstretch	[a numeric value in range 0-1000 | 'ultra-condensed' | 'extra-condensed' | 'condensed' | 'semi-condensed' | 'normal' | 'semi-expanded' | 'expanded' | 'extra-expanded' | 'ultra-expanded']
style or fontstyle	['normal' | 'italic' | 'oblique']
text	string or anything printable with '%s' conversion
verticalalignment or va or ma	['center' | 'top' | 'bottom' | 'baseline']
visible	[True | False]
weight or fontweight	[a numeric value in range 0-1000 | 'ultralight' | 'light' | 'normal' | 'regular' | 'book' | 'medium' | 'roman' | 'semibold' | 'demibold' | 'demi' | 'bold' | 'heavy' | 'extra bold' | 'black']
x	float
y	float

xlabel, ylabel

- 设置横坐标和纵坐标的名字
- 用法与 title一样

设置坐标轴

- 坐标范围设置
  - 设置x轴范围：xlim函数
  - 设置y轴范围：ylim函数

```
xmin, xmax = xlim()   # return the current xlim
xlim( (xmin, xmax) )  # set the xlim to xmin, xmax
xlim( xmin, xmax )    # set the xlim to xmin, xmax
xlim(xmax=3)          # adjust the max leaving min unchanged
xlim(xmin=1)          # adjust the min leaving max unchanged
```

设置线性坐标系与对数坐标系

- xscale/yscale(scale, **kwargs)
  - scale的3种取值：'linear' | 'log' | 'symlog'

Properties	Description	Available scale
basex/basey	The base of the logarithm	log, symlog
subsx/subsy	Where to place the subticks between each major tick. Should be a sequence of integers.	log, symlog
nonposx/nonposy	['mask' | 'clip']; non-positive values in x or y can be masked as invalid, or clipped to a very small positive number.	log
linthreshx/linthreshy	The range (-x, x) within which the plot is linear (to avoid having the plot go to infinity around zero).	symlog
linscalex/linscaley	This allows the linear range (-linthresh to linthresh) to be stretched relative to the logarithmic range. Its value is the number of decades to use for each half of the linear range.	symlog

在对数坐标系下画图

- matplotlib.pyplot.semilogx(*args, **kwargs)
- matplotlib.pyplot.semilogy(*args, **kwargs)
- matplotlib.pyplot.loglog(*args, **kwargs)
- 参数同plot (Line2D)
- 注意与前面xscale/yscale函数的区别
  - xscale/yscale 只设置坐标系，没有画图功能

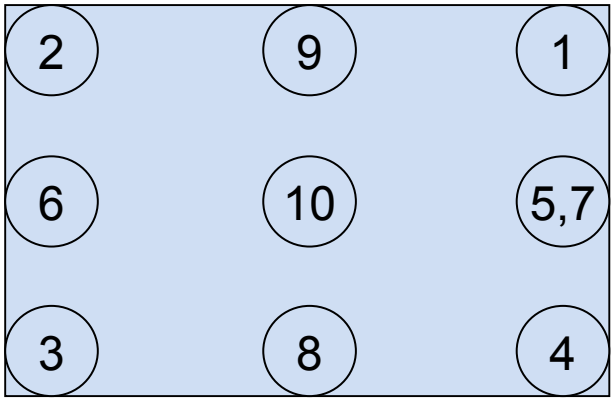
自定义坐标

- matplotlib.pyplot.xticks(*args, **kwargs)
- matplotlib.pyplot.yticks(*args, **kwargs)
  - 可使用Text的参数

```
# return locs, labels where locs is an array of tick locations and
# labels is an array of tick labels.
locs, labels = plt.xticks()

# set the locations of the xticks
plt.xticks( np.arange(6) )

# set the locations and labels of the xticks
plt.xticks( np.arange(5), ('Tom', 'Dick', 'Harry', 'Sally', 'Sue') )

plt.xticks( np.arange(12), calendar.month_name[1:13], rotation=17 )

# 另外一种方法
plt.gca().set_xticks(np.arange(12))
plt.gca().set_xticklabels(calendar.month_name[1:13], rotation=17)
```

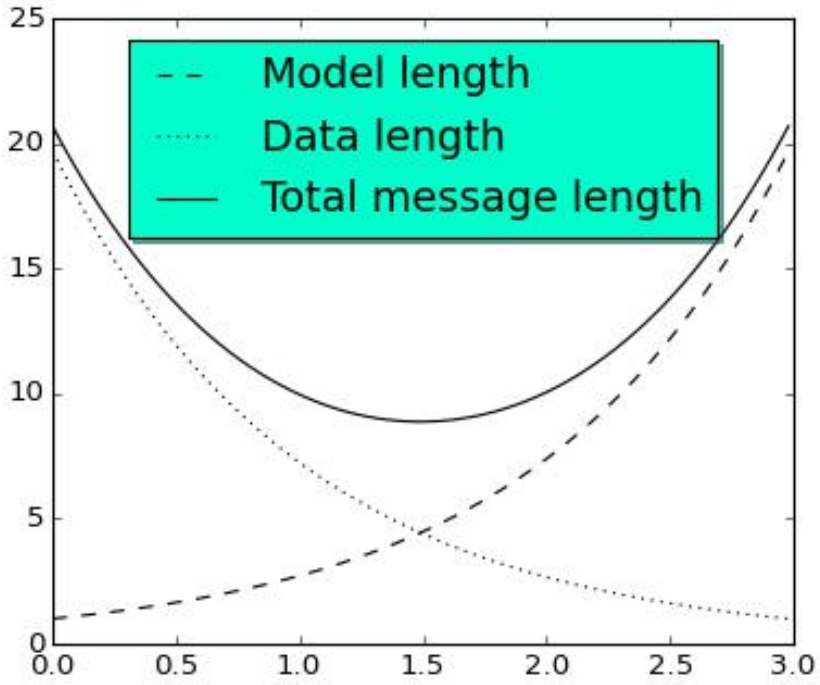
图例的用法

- matplotlib.pyplot.legend(*args, **kwargs)
  - loc: default 0
  - fontsize
  - numpoints
  - shadow
  - bbox_to_anchor
  - ...



Location String	Location Code
'best'	0
'upper right'	1
'upper left'	2
'lower left'	3
'lower right'	4
'right'	5
'center left'	6
'center right'	7
'lower center'	8
'upper center'	9
'center'	10

设置图例背景色和阴影




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

# Make some fake data.
a = b = np.arange(0,3, .02)
c = np.exp(a)
d = c[::-1]

# Create plots with pre-defined labels.
plt.plot(a, c, 'k--', label='Model length')
plt.plot(a, d, 'k:', label='Data length')
plt.plot(a, c+d, 'k', label='Total message length')

legend = plt.legend(loc='upper center',
shadow=True, fontsize='x-large')

# Put a nicer background color on the legend.
legend.get_frame().set_facecolor('#00FFCC')

plt.show()
```

保存图片

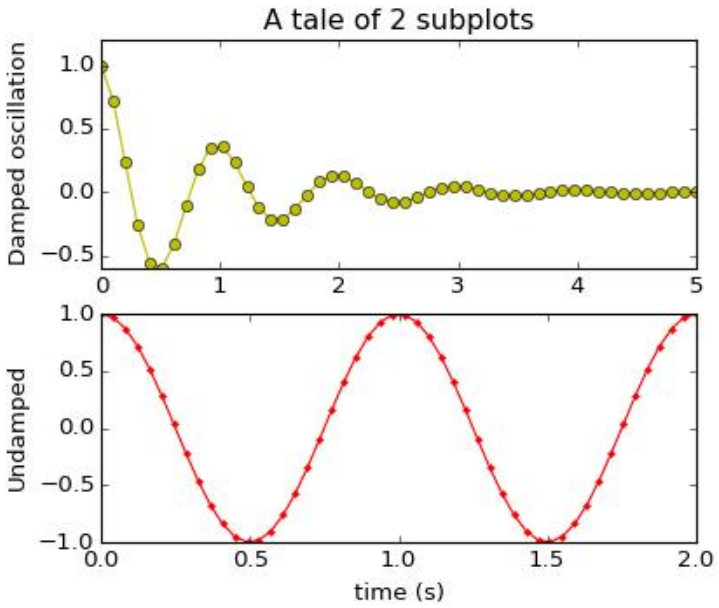
- matplotlib.pyplot.savefig(*args, **kwargs)
  - 文件名是必需参数
  - plt.savefig(plot_file, bbox_inches='tight')
    - bboxinches='tight'去掉不需要的白边
    - 输出ps格式文件时无法使用这个参数
  - 其他参数
- 如果只想在屏幕上显示出来
  - plt.show()

网格开关

- matplotlib.pyplot.grid(b=None, which=u'major', axis=u'both', **kwargs)
  - b: [True | False], 是否打网格, 默认反转b
  - which: ['major' | 'minor' | 'both']，在哪种坐标处打网格，默认为'major'
  - axis: ['both' | 'x' | 'y'], 横线和竖线|只竖线|只横线，默认为'both'
  - 还可使用Line2D中的参数
  - 最简单的使用：plt.grid()

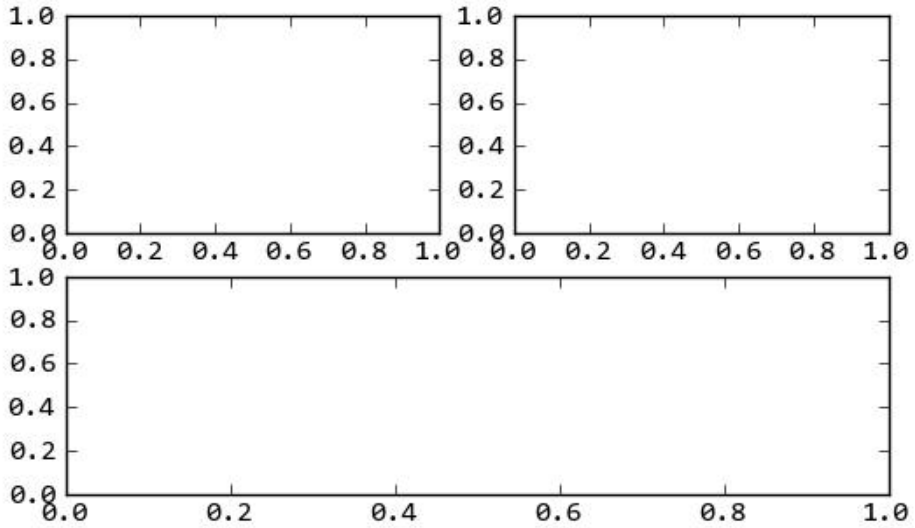
多图

- matplotlib.pyplot.subplot(*args, **kwargs)
  - subplot(nrows, ncols, plot_number)
  - 如果数字都小于10, 可以写成subplot(211)



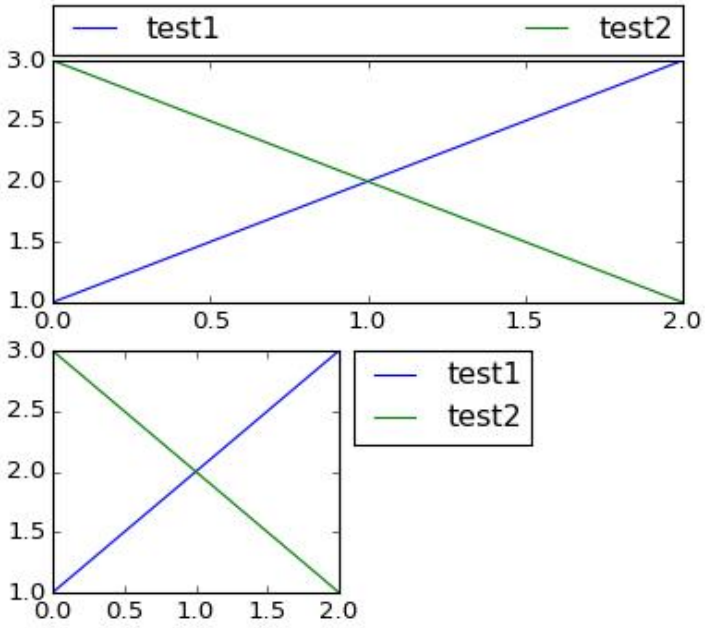

```
import numpy as np
import matplotlib.pyplot as plt

x1 = np.linspace(0.0, 5.0)
x2 = np.linspace(0.0, 2.0)
y1 = np.cos(2 * np.pi * x1) * np.exp(-x1)
y2 = np.cos(2 * np.pi * x2)

plt.subplot(2, 1, 1)
plt.plot(x1, y1, 'yo-')
plt.title('A tale of 2 subplots')
plt.ylabel('Damped oscillation')

plt.subplot(2, 1, 2)
plt.plot(x2, y2, 'r.-')
plt.xlabel('time (s)')
plt.ylabel('Undamped')

plt.show()
```

多图的一个例子




```
plt.subplot(221) # 第一行的左图
plt.subplot(222) # 第一行的右图
plt.subplot(212) # 第二整行
plt.show()
```

把图例放在图片以外的地方

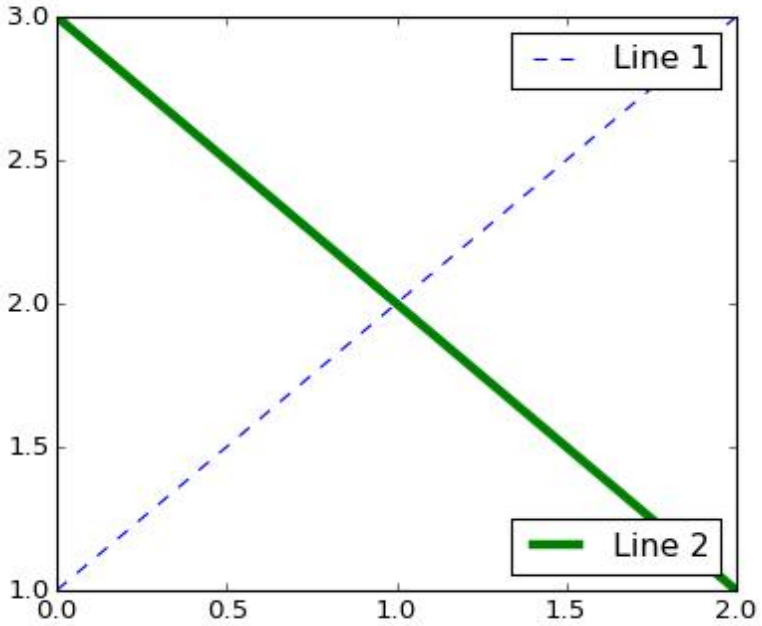


四元组：(loc的x相对坐标, loc的y相对坐标, 相对长度, 相对高度)
二元组：四元组的前两个

```
import matplotlib.pyplot as plt

plt.subplot(211)
plt.plot([1,2,3], label="test1")
plt.plot([3,2,1], label="test2")
# Place a legend above this legend, expanding
#itself to fully use the given bounding box.
plt.legend(bbox_to_anchor=(0., 1.02, 1., .102),
loc=3, ncol=2, mode="expand",
borderaxespad=0.)

plt.subplot(223)
plt.plot([1,2,3], label="test1")
plt.plot([3,2,1], label="test2")
# Place a legend to the right of this smaller
# figure.
plt.legend(bbox_to_anchor=(1.05, 1), loc=2,
borderaxespad=0.)

plt.show()
```

图例与坐标轴的距离为0

图例分开放置



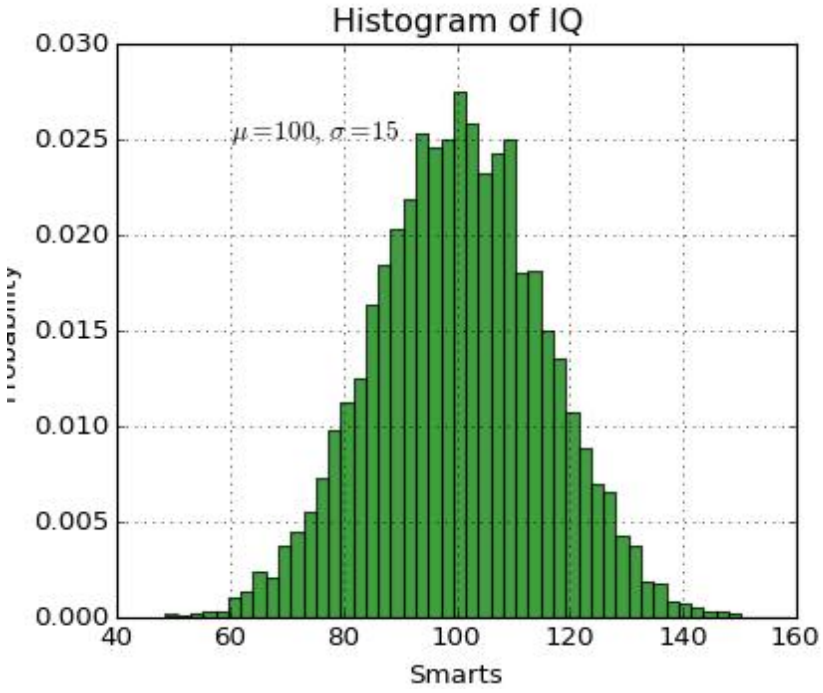
没有运行成功！

```
import matplotlib.pyplot as plt

line1, = plt.plot([1,2,3], label="Line 1",
linestyle='--')
line2, = plt.plot([3,2,1], label="Line 2",
linewidth=4)

# Create a legend for the first line.
first_legend = plt.legend(handles=[line1], loc=1)

# Add the legend manually to the current Axes.
ax = plt.gca().add_artist(first_legend)

# Create another legend for the second line.
plt.legend(handles=[line2], loc=4)

plt.show()
```

直方图

- 两种方法
  - hist
  - bar/hbar

hist




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

mu, sigma = 100, 15
x = mu + sigma * np.random.randn(10000)

# the histogram of the data
n, bins, patches = plt.hist(x, 50, normed=1,
facecolor='g', alpha=0.75)


plt.xlabel('Smarts')
plt.ylabel('Probability')
plt.title('Histogram of IQ')
plt.text(60, .025, r'$\mu=100,\ \sigma=15$')
plt.axis([40, 160, 0, 0.03])
plt.grid(True)
plt.show()
```

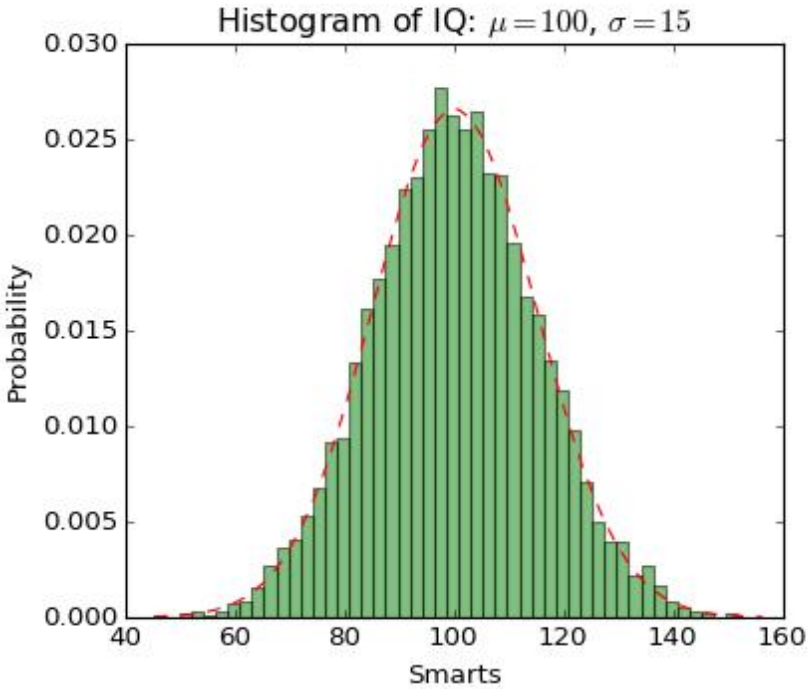
hist函数

- matplotlib.pyplot.hist(x, bins=10, range=None, normed=False, weights=None, cumulative=False, bottom=None, histtype=u'bar', align=u'mid', orientation=u'vertical', rwidth=None, log=False, color=None, label=None, stacked=False, hold=None, **kwargs)
  - x: 一个列表或者多个列表（表示不同数据集，长度可以不一致）
  - range: 元组
  - weights: x里每个元素对bin高度的贡献（默认为1）
  - bottom: 数字或者长度为bins的列表
  - histtype: ['bar' | 'barstacked' | 'step' | 'stepfilled']
  - align: ['left' | 'mid' | 'right']
  - orientation: ['horizontal' | 'vertical']
  - rwidth: bar相对bin的宽度
  - color: 一种颜色或者颜色列表（针对不同数据集）

text函数

- matplotlib.pyplot.text(x, y, s, fontdict=None, withdash=False, **kwargs)
  - Add text in string s to axis at location x, y, data coordinates
  - 注意这里的坐标是绝对坐标，与图例不同
  - 可使用Text的所有参数

直方图与相应折线图

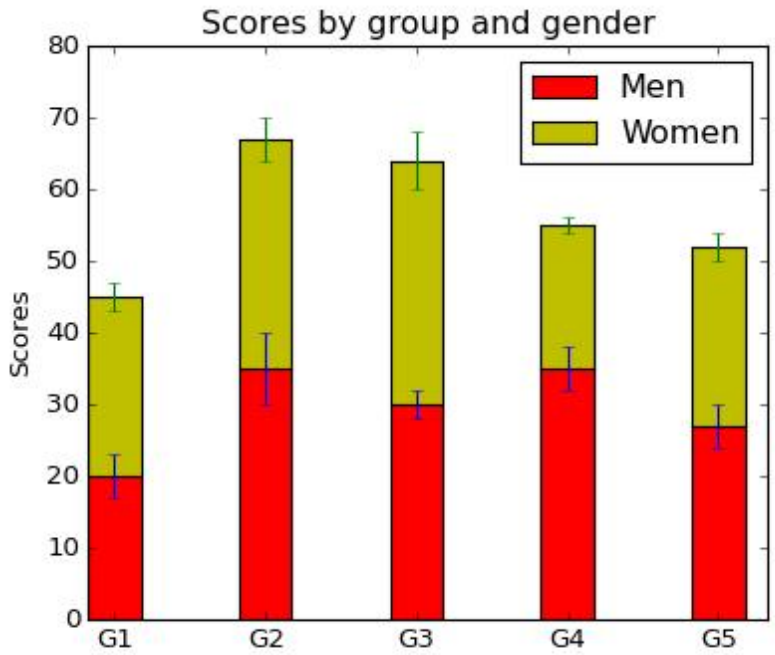



```
import numpy as np
import matplotlib.mlab as mlab
import matplotlib.pyplot as plt


# example data
mu = 100 # mean of distribution
sigma = 15 # standard deviation of distribution
x = mu + sigma * np.random.randn(10000)

num_bins = 50
# the histogram of the data
n, bins, patches = plt.hist(x, num_bins, normed=1,
facecolor='green', alpha=0.5)
# add a 'best fit' line
y = mlab.normpdf(bins, mu, sigma)
plt.plot(bins, y, 'r--')
plt.xlabel('Smarts')
plt.ylabel('Probability')
plt.title(r'Histogram of IQ: $\mu=100$, $\sigma=15$')

# Tweak spacing to prevent clipping of ylabel
plt.subplots_adjust(left=0.15)
plt.show()
```

bar/barh

- matplotlib.pyplot.bar(left, height, width=0.8, bottom=None, hold=None, **kwargs)
- matplotlib.pyplot.barh(bottom, width, height=0.8, left=None, hold=None, **kwargs)
  - 画left, left + width, bottom, bottom + height这四条线内的矩形
  - 其他参数（两个函数一样）：color, edgecolor, linewidth, xerr, yerr, ecolor (error bar的颜色), capsize (errorbar的大小), error_kw, align ('edge' or 'center'), orientation ('vertical' or 'horizontal'), log
- 适合在求出数据的概率分布后使用。

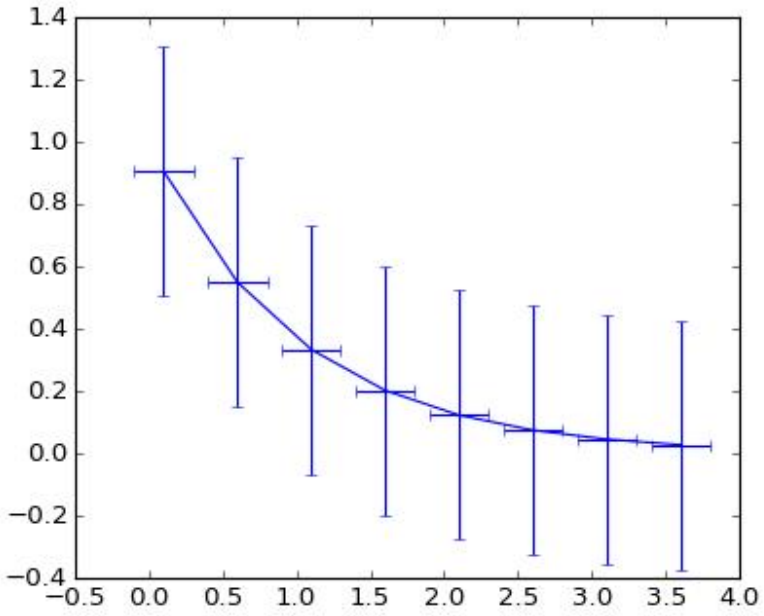
使用bar的一个例子




```
#!/usr/bin/env python
import numpy as np
import matplotlib.pyplot as plt

N = 5
menMeans   = (20, 35, 30, 35, 27)
womenMeans = (25, 32, 34, 20, 25)
menStd     = (2, 3, 4, 1, 2)
womenStd   = (3, 5, 2, 3, 3)
ind = np.arange(N)    # the x locations for the groups
width = 0.35       # the width of the bars: can also be
len(x) sequence

p1 = plt.bar(ind, menMeans,   width, color='r',
yerr=womenStd)
p2 = plt.bar(ind, womenMeans, width, color='y',
            bottom=menMeans, yerr=menStd)

plt.ylabel('Scores')
plt.title('Scores by group and gender')
plt.xticks(ind+width/2., ('G1', 'G2', 'G3', 'G4', 'G5') )
plt.yticks(np.arange(0,81,10))
plt.legend( (p1[0], p2[0]), ('Men', 'Women') )

plt.show()
```

errorbar的画法

- matplotlib.pyplot.errorbar(x, y, yerr=None, xerr=None, fmt=u'', ecolor=None, elinewidth=None, capsize=3, barsabove=False, lolims=False, uplims=False, xlolims=False, xuplims=False, errorevery=1, capthick=None, hold=None, **kwargs)
  - 可以使用plot函数的参数




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

# example data
x = np.arange(0.1, 4, 0.5)
y = np.exp(-x)

plt.errorbar(x, y, xerr=0.2, yerr=0.4)
plt.show()
```

支持中文

- 涉及到字体问题
- 请上网自行解决

用matplotlib画图的第二种方法

面向对象绘图

流程

- matplotlib API包含有三层，Artist层处理所有的高层结构，例如处理图表、文字和曲线等的绘制和布局。通常我们只和Artist打交道，而不需要关心底层的绘制细节。
- 直接使用Artists创建图表的标准流程如下
  - 创建Figure对象
  - 用Figure对象创建一个或者多个Axes或者Subplot对象
  - 调用Axies等对象的方法创建各种简单类型的Artists

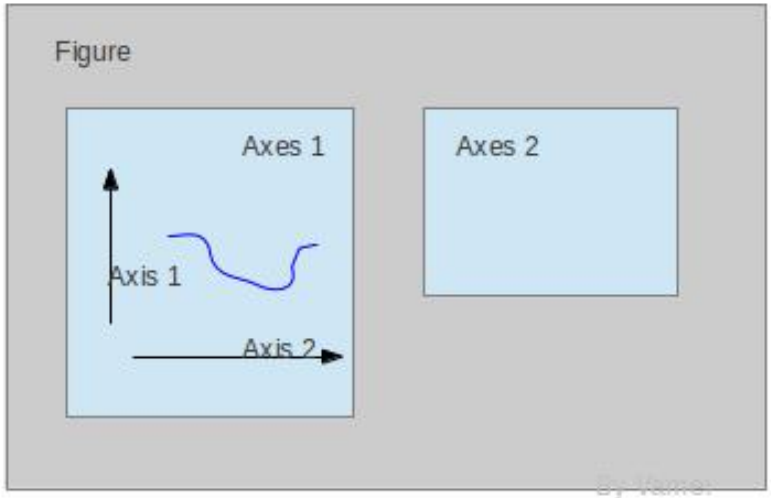
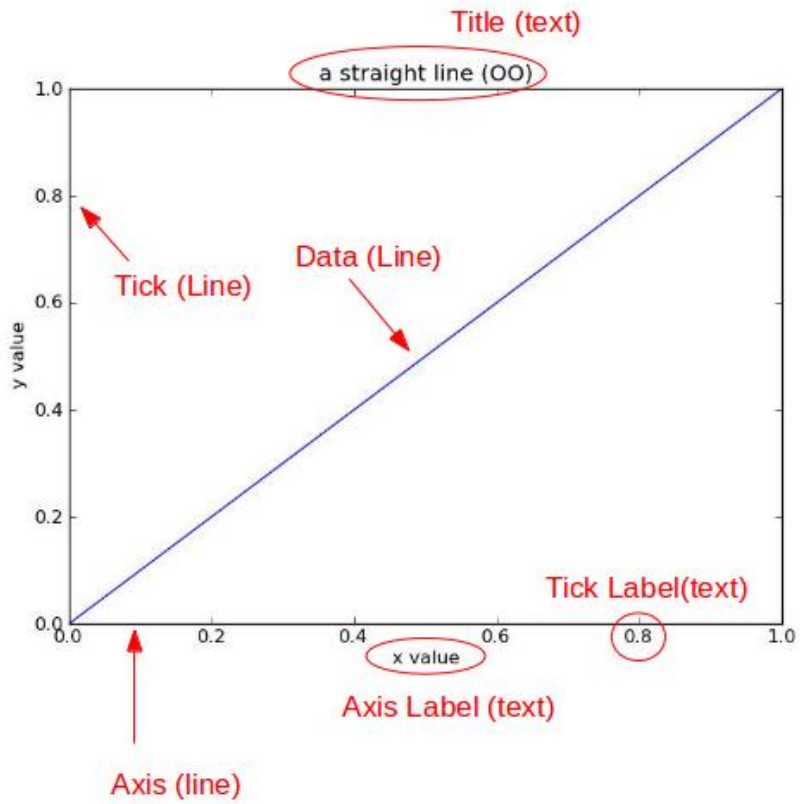


Figure
Axes 1
Axes 2
Axis 1
Axis 2


Title (text)
a straight line (OO)
Tick (Line)
Data (Line)
Tick Label(text)
y value
x value
Axis Label (text)
Axis (line)
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

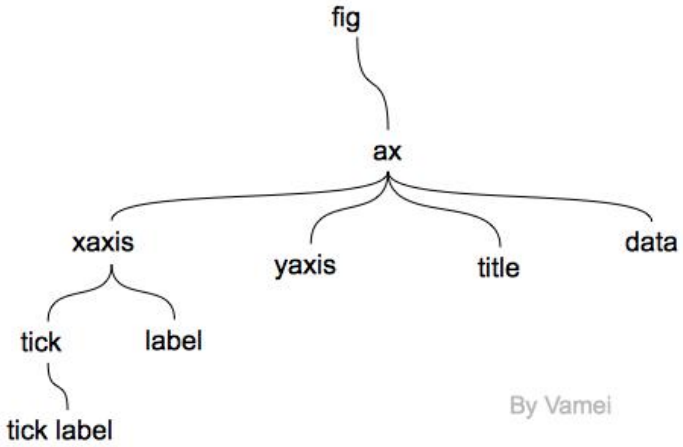
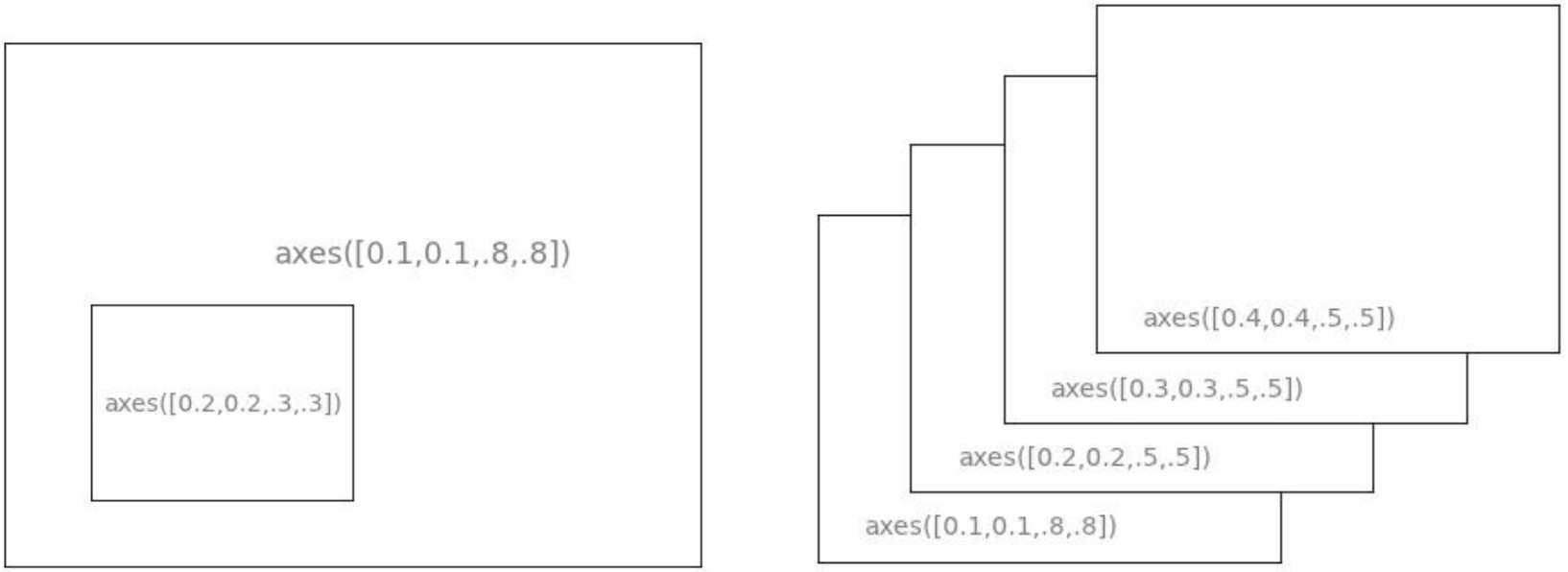
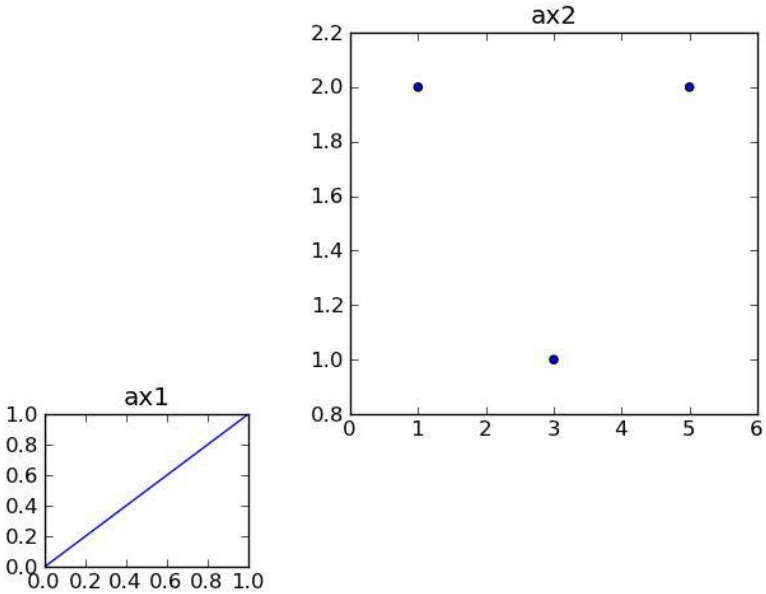


fig
ax
xaxis
yaxis
title
data
tick
label
tick label

subplots与axes的区别



第一个例子




```
import matplotlib.pyplot as plt

fig = plt.figure()

# first axes
ax1  = fig.add_axes([0.1, 0.1, 0.2, 0.2])
line,  = ax1.plot([0,1], [0,1])
ax1.set_title("ax1")

# second axes
ax2    = fig.add_axes([0.4, 0.3, 0.4, 0.5])
sca    = ax2.scatter([1,3,5],[2,1,2])
ax2.set_title("ax2")

plt.show()
```

figure类

- add_axes(*args, **kwargs)
  - rect = l,b,w,h
  - fig.add_axes(rect)
  - fig.add_axes(rect, frameon=False, axisbg='g')
  - fig.add_axes(rect, polar=True)
  - fig.add_axes(rect, projection='polar')
  - fig.add_axes(ax)
  - fig.add_axes(rect, label='axes1')

figure类

- add_subplots(*args, **kwargs)
  - fig.add_subplot(111)
  - fig.add_subplot(1,1,1)
  - fig.add_subplot(sub) # sub is an instance
- gca(**kwargs)
  - Get the current axes, creating one if necessary
- get_axes()

figure类

- legend(handles, labels, *args, **kwargs)

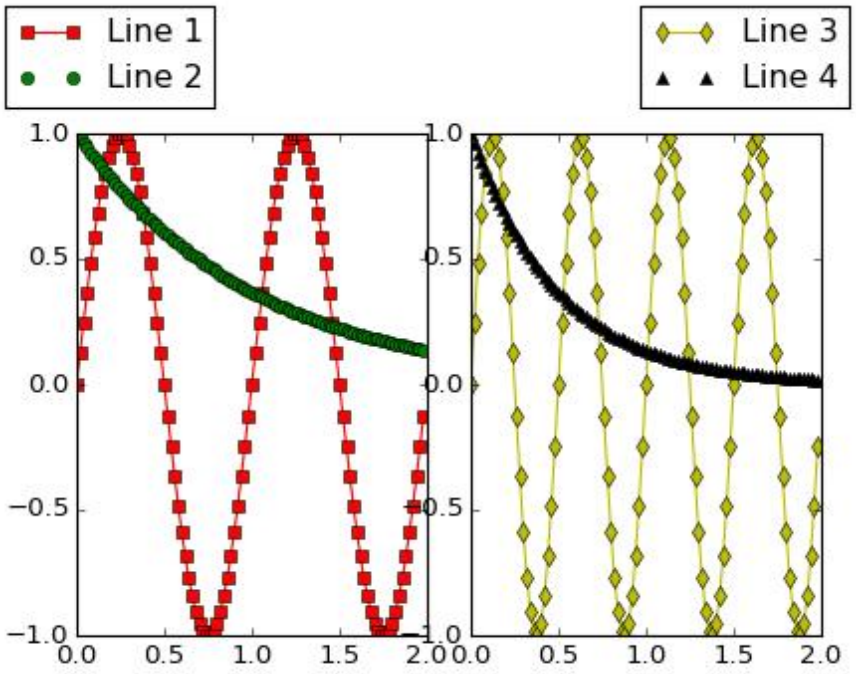
  legend((line1, line2, line3), ('label1', 'label2', 'label3'), 'upper right')
- savefig(*args, **kwargs)
- sca(a)
  - Set the current axes to be a and return a
- show(warn=True)
- suptitle(t, **kwargs)
  - Add a centered title to the figure.
- text(x, y, s, *args, **kwargs)

figure类

Others

- get/set_edgecolor()
- get/set_facecolor()
- get/set_figwidth()
- get/set_figheight()
- ....

figure类




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

fig = plt.figure()
ax1 = fig.add_axes([0.1, 0.1, 0.4, 0.7])
ax2 = fig.add_axes([0.55, 0.1, 0.4, 0.7])

x = np.arange(0.0, 2.0, 0.02)
y1 = np.sin(2*np.pi*x)
y2 = np.exp(-x)
l1, l2 = ax1.plot(x, y1, 'rs-', x, y2, 'go')

y3 = np.sin(4*np.pi*x)
y4 = np.exp(-2*x)
l3, l4 = ax2.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.show()
```

axes类

- add_artist(a)
- add_line(line)
- axis(*v, **kwargs)
- bar(left, height, width=0.8, bottom=None, **kwargs)
- barh(bottom, width, height=0.8, left=None, **kwargs)
- pyplot, figure, axes很多函数是一样的，axes在很多函数名称上加了set_或get_。

axis类（函数不全）

- cla(): clear
- get_gridlines()
- get_label()
- get/set_label_text()
- get_major/minor_ticks(numticks=None)
- get_major/minorticklabels()
- get_major/minorticklines()
- get/set_ticklabels(minor=False, which=None)
- get_ticklines(minor=False)
- grid(b=None, which=u'major', **kwargs)
- set_ticks(ticks, minor=False)

axis的一些应用

- 选择是否显示刻度值
  - x轴上，1为下，2为上
  - y轴上，1为左，2为右

```
for tick in ax.xaxis.get_major_ticks():
    tick.label1On = True
    tick.label2On = False
for tick in ax.yaxis.get_major_ticks():
    tick.label1On = False
    tick.label2On = False
```

axis的一些应用

- 选择如何显示刻度

```
ax.xaxis.set_ticks_position('none')
ax.yaxis.set_ticks_position('right')
```

axis的一些应用

- 完全自定义坐标轴刻度及刻度值

```
ax.set_xticks([-250, -200, -150, -100, -50, 0, 50, 100, 150, 200])
ax.set_xticklabels([‘-250′, ”, ‘-150′, ”, ‘-50′, ”, ’50’, ”, ‘150’, ”])
ax.set_yticks([-40, -20, 0, 20, 40, 60, 80])
ax.set_yticklabels([”, ”, ”, ”, ”, ”, ”])
```

axis的一些应用

- 分别设置x轴和y轴上刻度值的字体大小

```
for tick in ax.xaxis.get_major_ticks():
    tick.label1.set_fontsize(18)
for tick in ax.yaxis.get_major_ticks():
    tick.label1.set_fontsize(18)
```

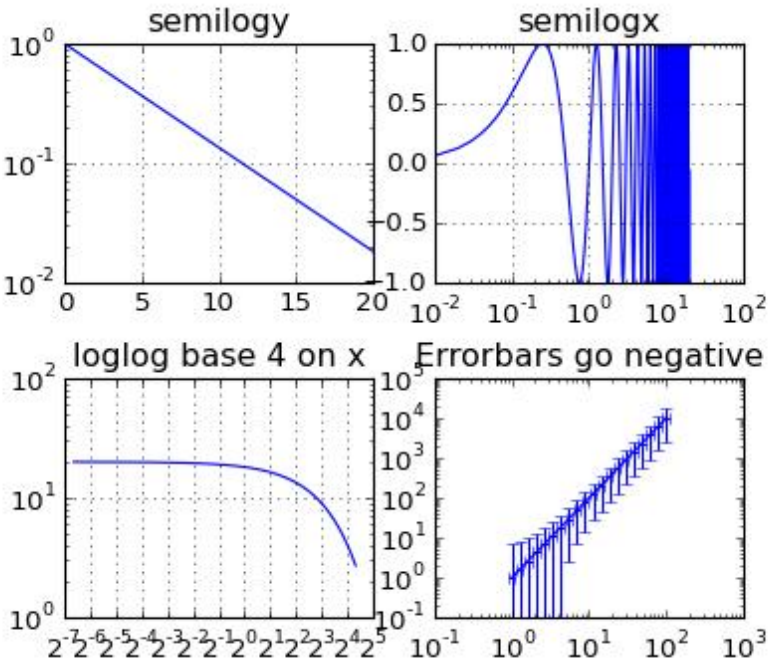
- 对比

```
for label in plt.gca().xaxis.get_ticklabels():
        label.set_fontsize(18)
for label in plt.gca().yaxis.get_ticklabels():
        label.set_fontsize(18)
```

- 这样也可以设置刻度值字体大小

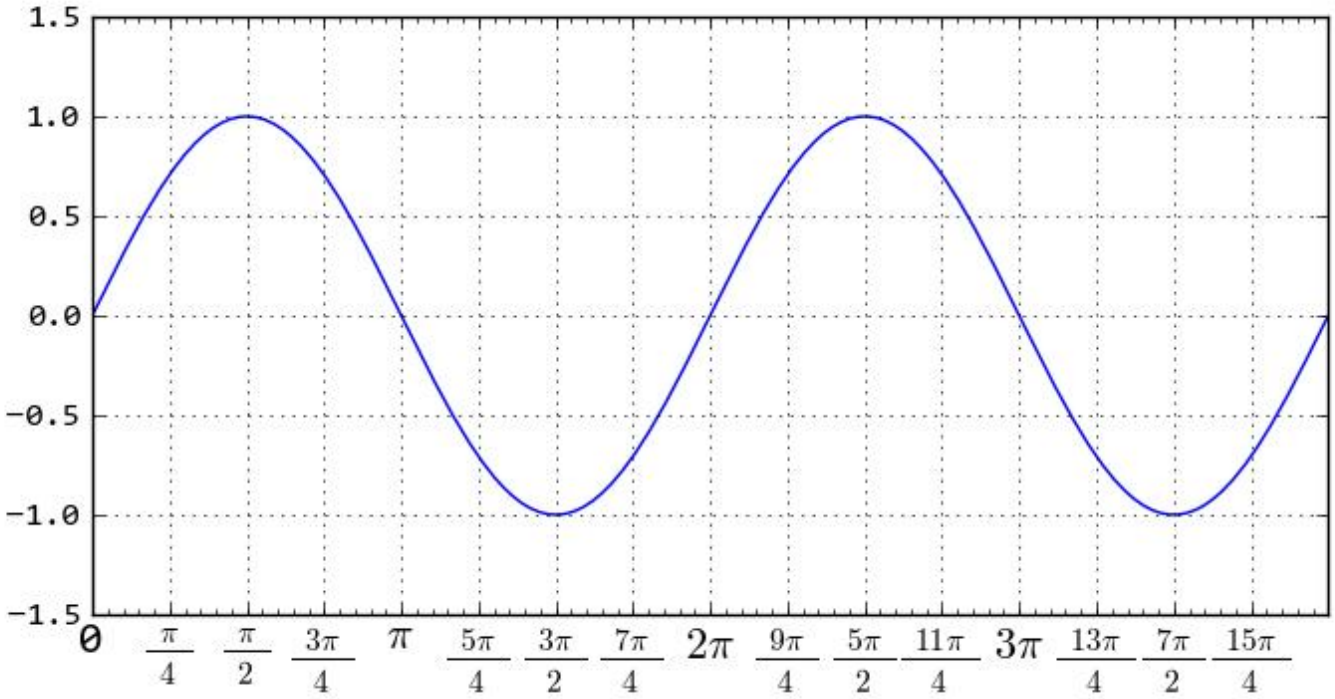
```
matplotlib.rc('xtick', labelsize=20)
matplotlib.rc('ytick', labelsize=20)
```

一个例子



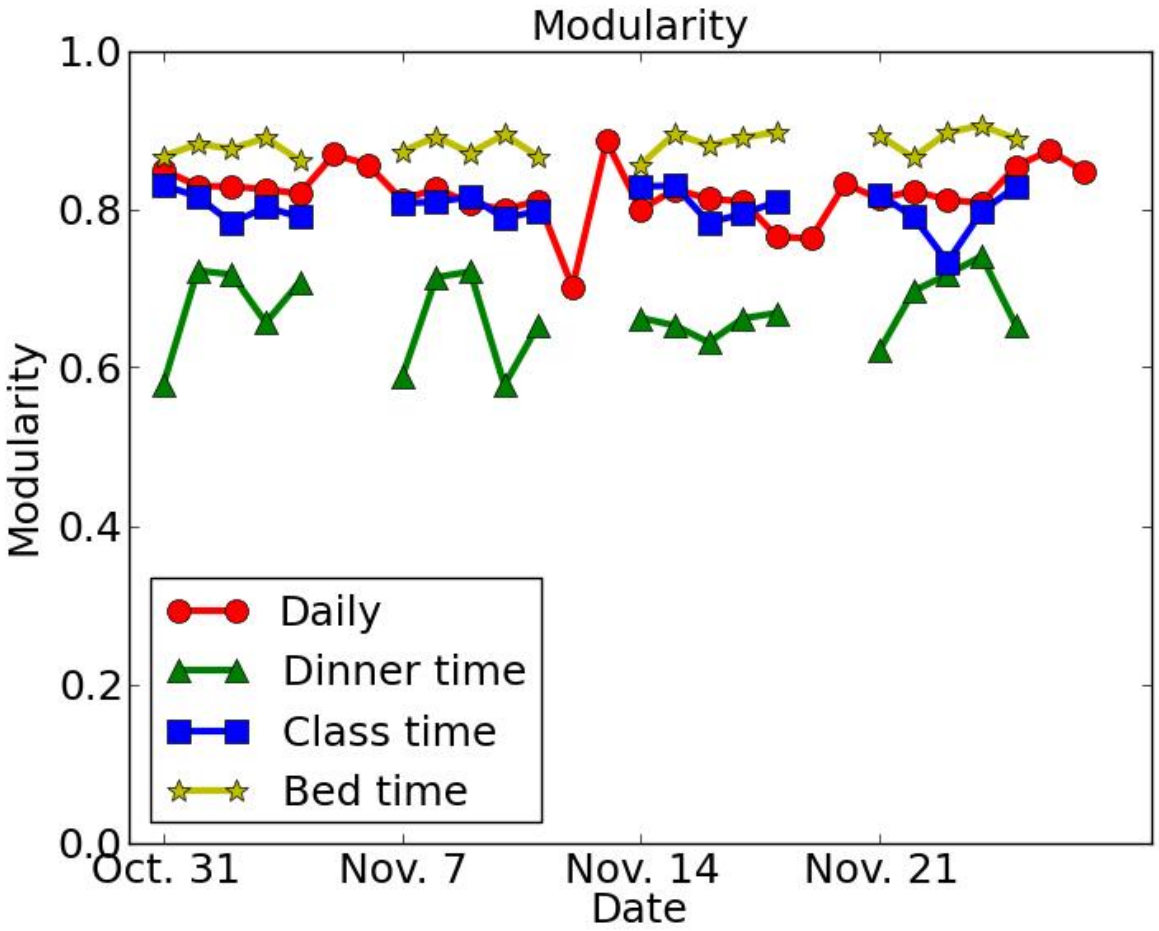

```
import numpy as np
import matplotlib.pyplot as plt

plt.subplots_adjust(hspace=0.4)
t = np.arange(0.01, 20.0, 0.01)

# log y axis
plt.subplot(221)
plt.semilogy(t, np.exp(-t/5.0))
plt.title('semilogy')
plt.grid(True)

# log x axis
plt.subplot(222)
plt.semilogx(t, np.sin(2*np.pi*t))
plt.title('semilogx')
plt.grid(True)

# log x and y axis
plt.subplot(223)
plt.loglog(t, 20*np.exp(-t/10.0), basex=2)
plt.grid(True)
plt.title('loglog base 4 on x')

# with errorbars: clip non-positive values
ax = plt.subplot(224)
ax.set_xscale("log", nonposx='clip')
ax.set_yscale("log", nonposy='clip')

x = 10.0**np.linspace(0.0, 2.0, 20)
y = x**2.0
plt.errorbar(x, y, xerr=0.1*x, yerr=5.0+0.75*y)
ax.set_ylim(ymin=0.1)
ax.set_title('Errorbars go negative')

plt.show()
```

一个例子



See final_example02.py

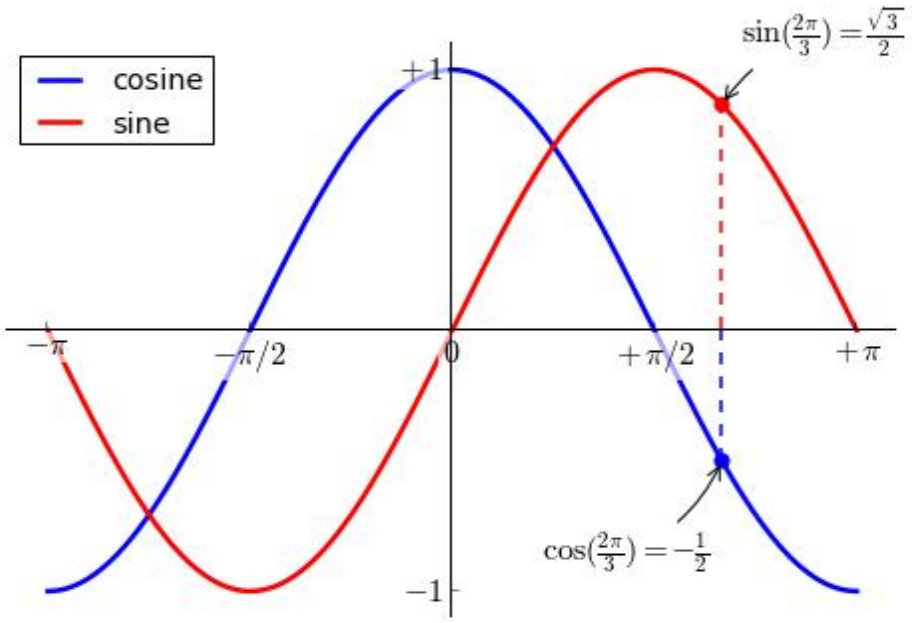
一个例子



See final_example03.py

用matplotlib画图的第三种方法

用pylab模块快速画图
（与第一种方法类似）



See final_example04.py （用的是pylab）
详细过程：
http://www.labri.fr/perso/nrougier/teaching/matplotlib/#beyond-this-tutorial

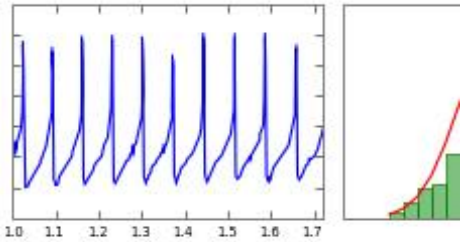
参考建议

matplotlib

home | examples | gallery | pyplot | docs »

Introduction

matplotlib is a python 2D plotting library which produces publication quality figures in a variety of
shell (ala MATLAB® or Mathematica®†), web application servers, and six graphical user interfac



matplotlib tries to make easy things easy and hard things possible. You can generate plots, histo
thumbnail gallery, and examples directory

For simple plotting the `pyplot` interface provides a MATLAB-like interface, particularly when cor
interface or via a set of functions familiar to MATLAB users.