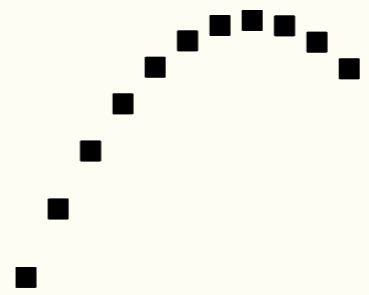
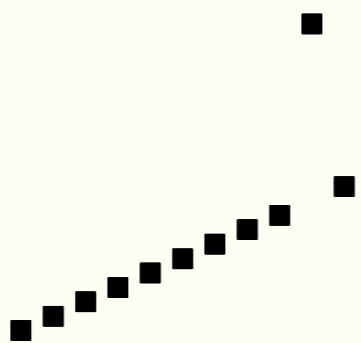
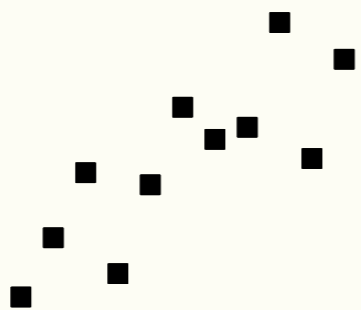
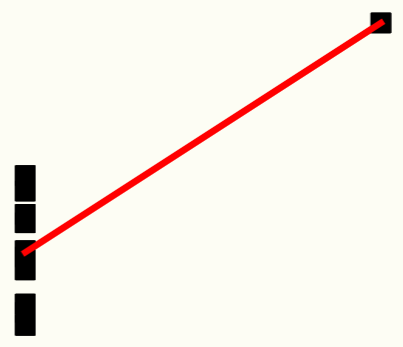
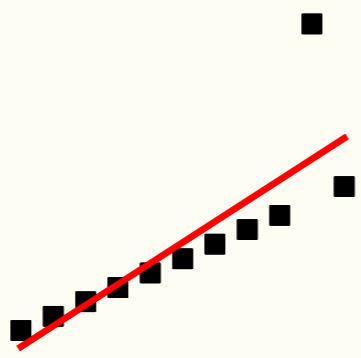
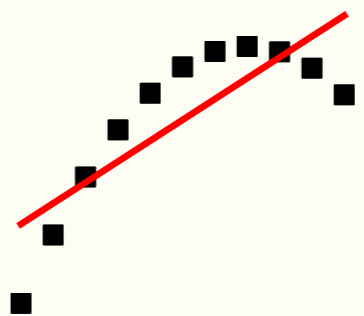
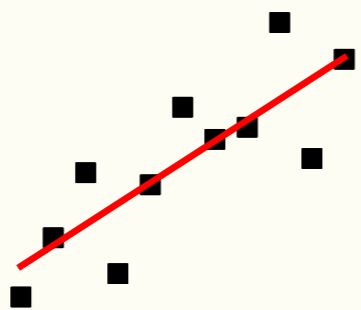


Let your data SPEAK!

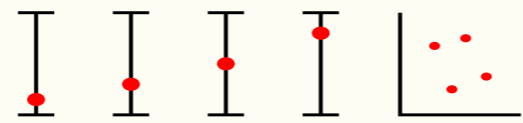
Introduction to data visualization

Bartosz Telenczuk
Kiel, 2012





position



shape



length



hue

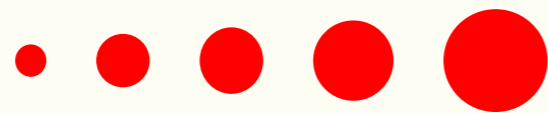


angle

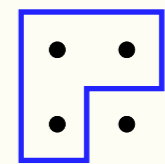


Grouping

area



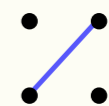
containment



saturation



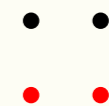
connection



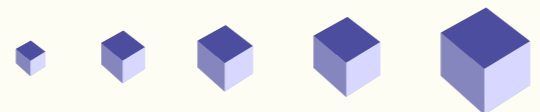
brightness



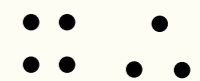
similarity



volume



proximity

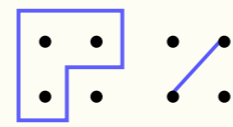


data

tabular

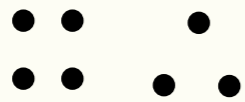
relational

spatial



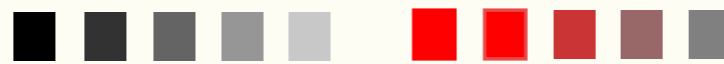
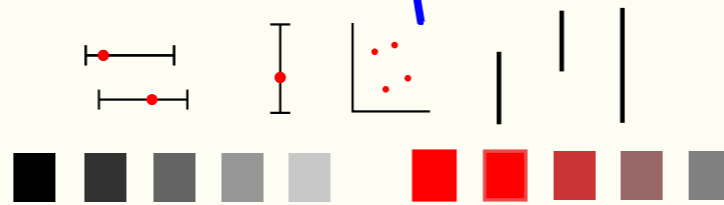
categorical

ordered



ordinal

quantitative



Carte Figurative des pertes successives en hommes de l'Armée Française dans la Campagne de Russie 1812-1813.

Dressée par M. Minard, Inspecteur Général des Ponts et Chaussées en retraite Paris, le 20 Novembre 1869

Les nombres d'hommes présents sont représentés par les largeurs des zones colorées à raison d'un millimètre pour dix mille hommes; ils sont de plus écrits en lettres des zones. Le rouge désigne les hommes qui entrent en Russie, le noir ceux qui en sortent. — Les renseignements qui ont servi à dresser la carte ont été puisés dans les ouvrages de M. M. Chiers, de Ségur, de Fezensac, de Chambray et le journal inédit de Jacob, pharmacien de l'Armée depuis le 28 Octobre. Pour mieux faire juger à l'œil la diminution de l'armée, j'ai supposé que les corps du Prince Jérôme et du Maréchal Davout qui avaient été détachés sur Minsk et Mohilow a eu rejoint ces Orscha et Witebsk, avaient toujours marché avec l'armée.

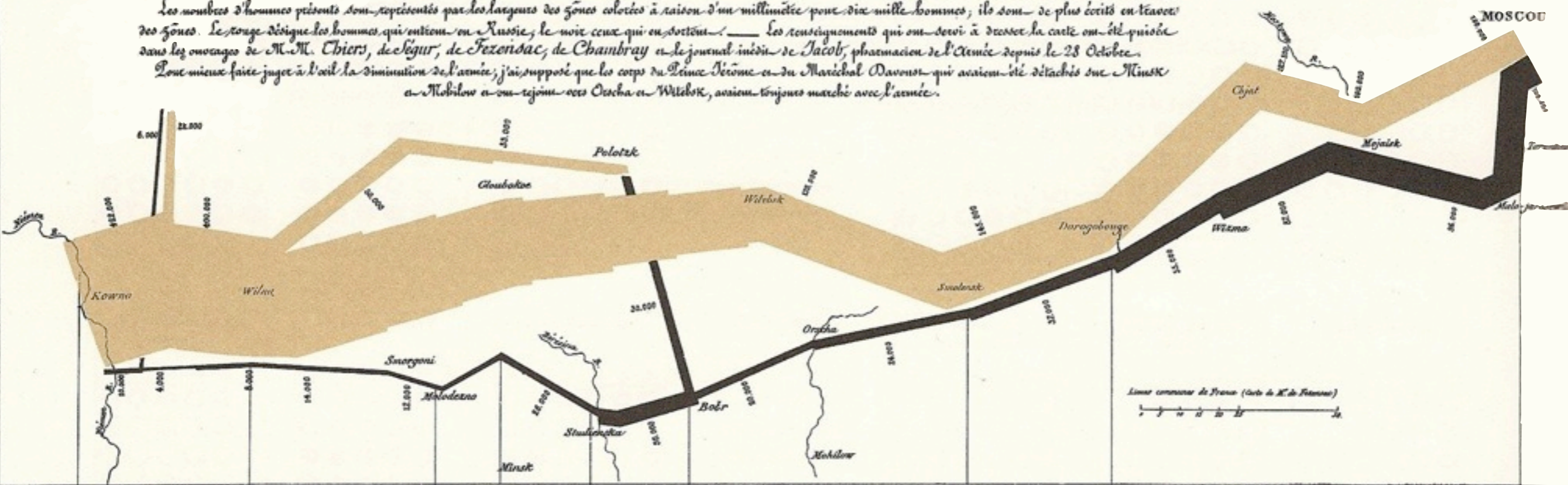
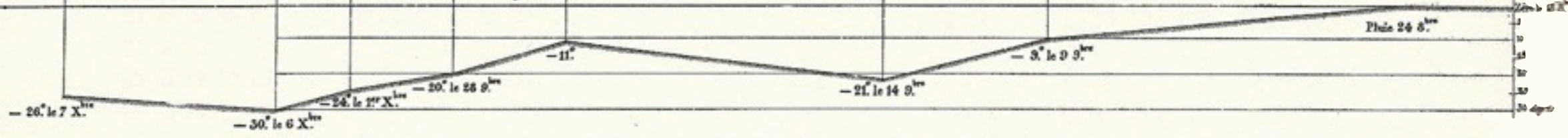


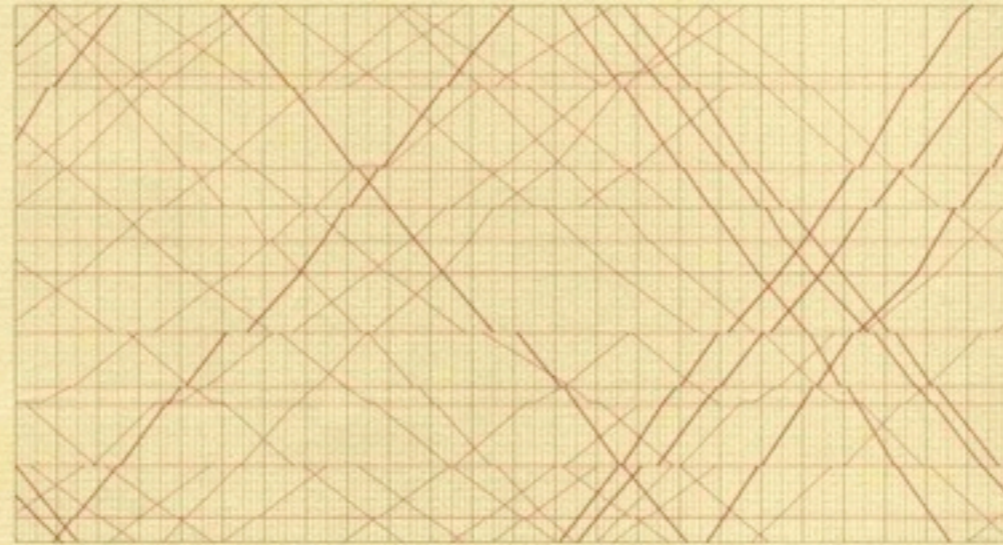
TABLEAU GRAPHIQUE de la température en degrés du thermomètre de Réaumur au dessous de zéro.



Les Cosaques passent au galop le Nilouze gelé.

Visualization design principles



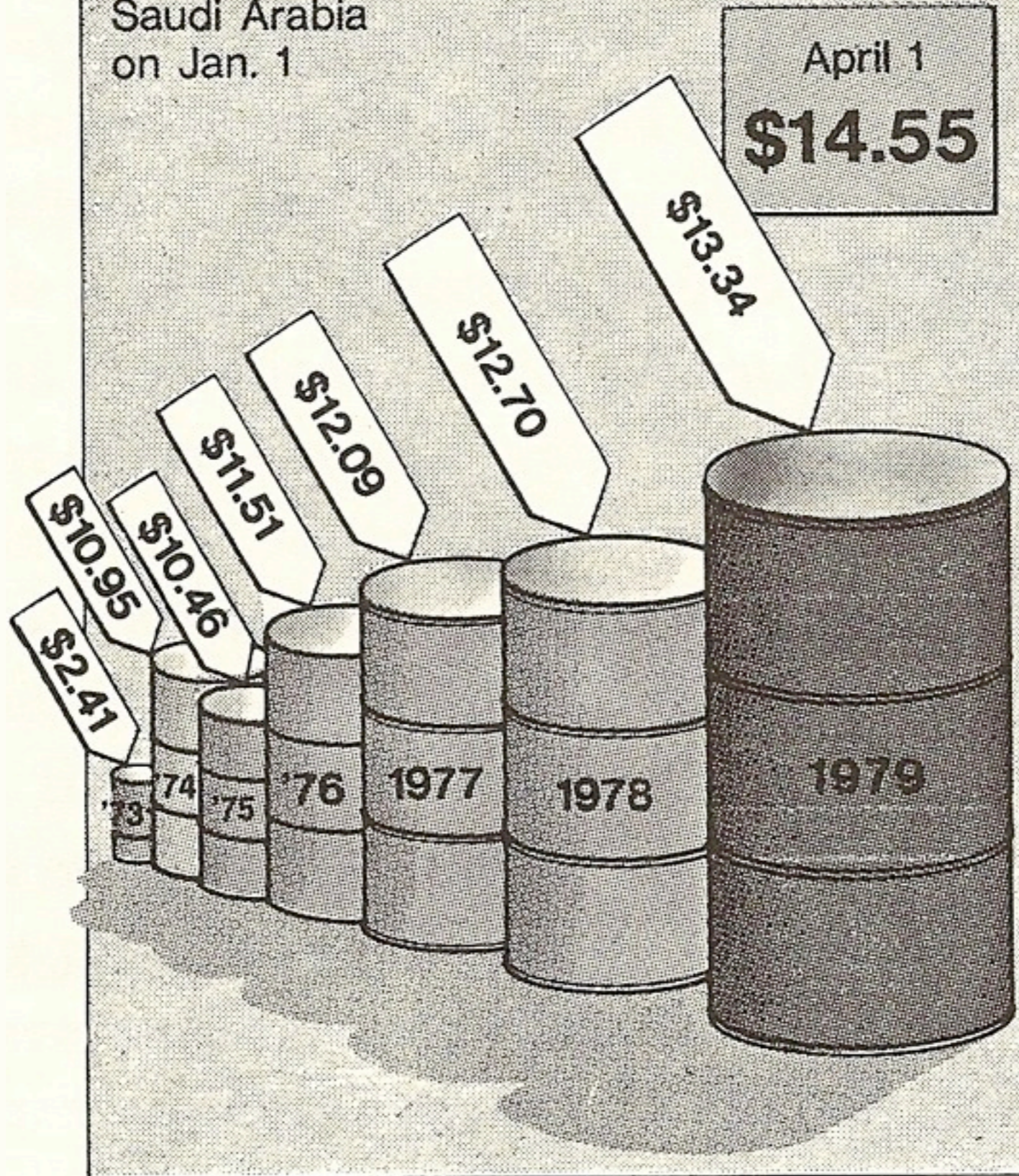


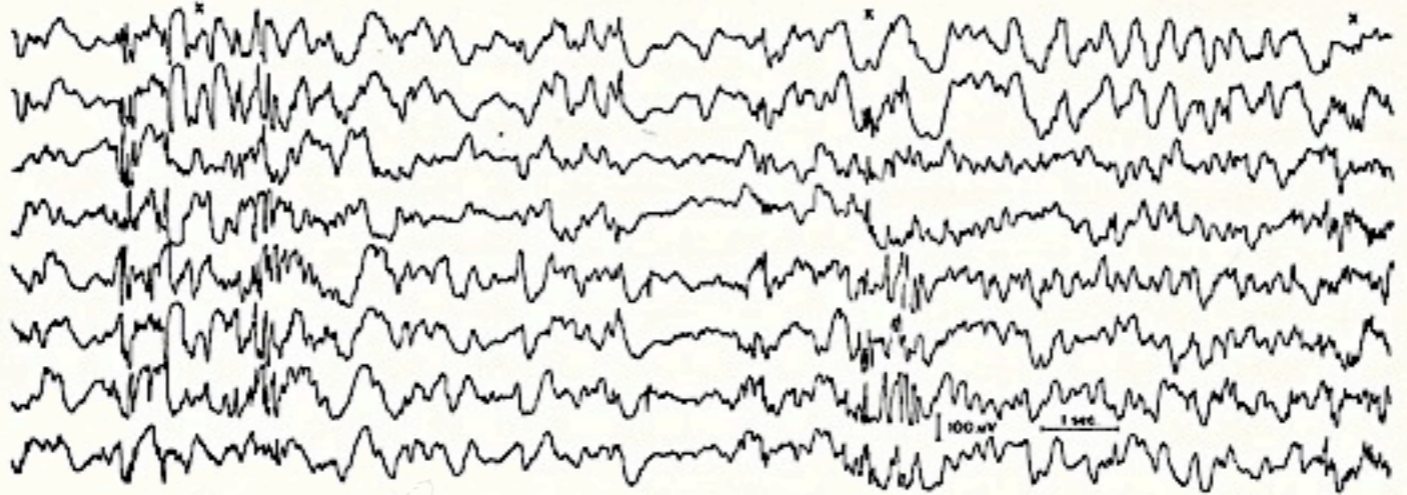
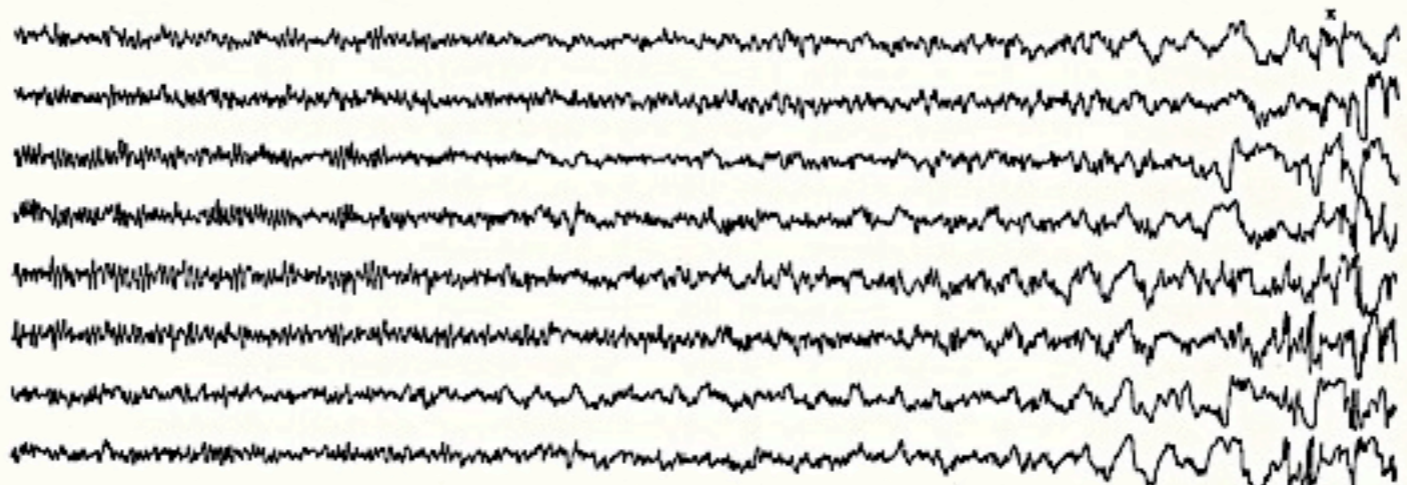
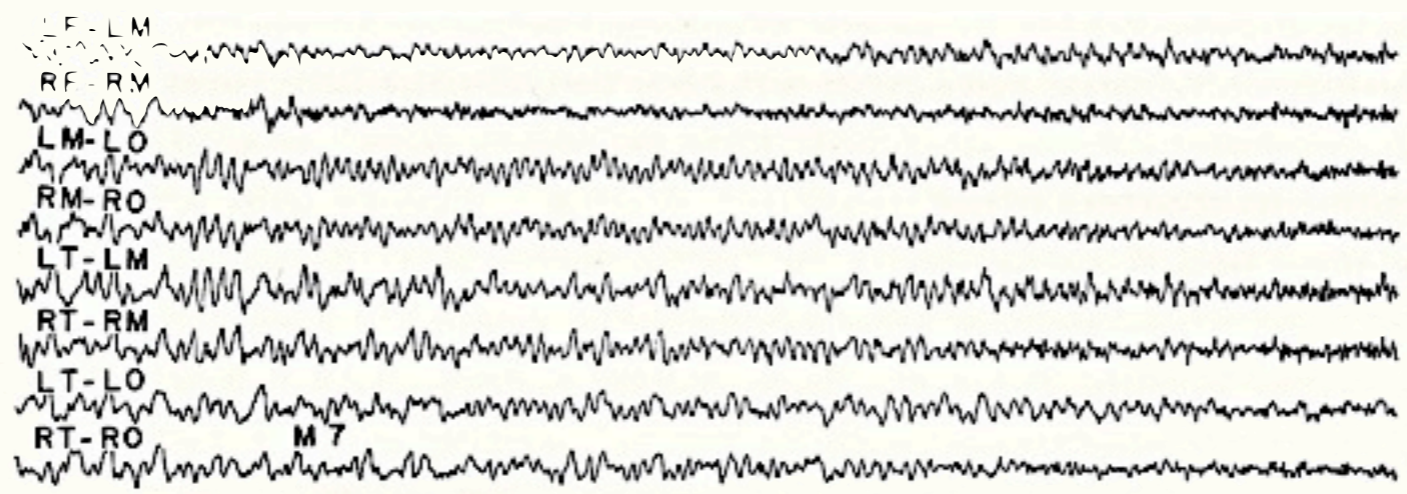
The Visual Display
of Quantitative Information

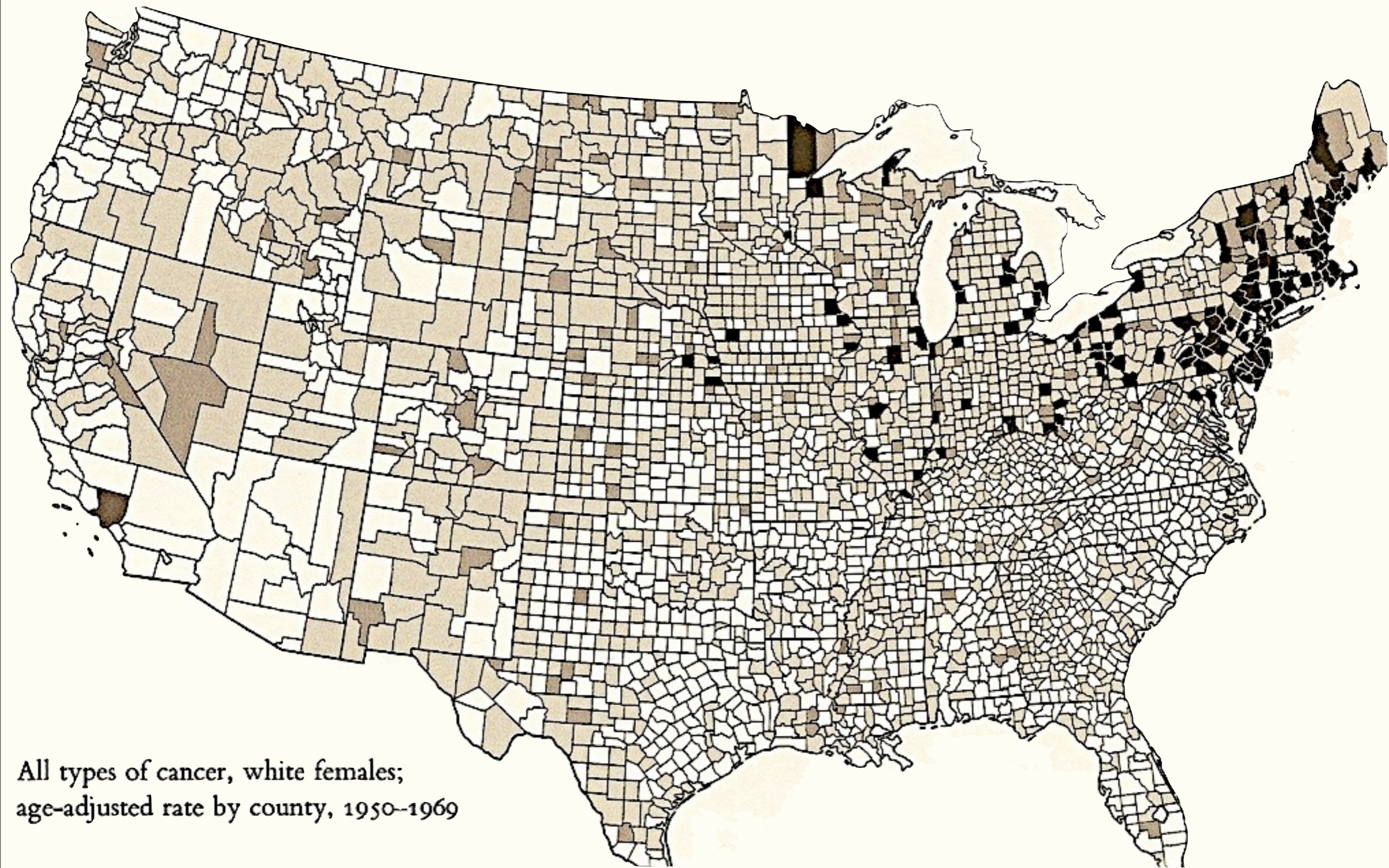
EDWARD R. TUFTE

IN THE BARREL...

Price per bbl. of
light crude, leaving
Saudi Arabia
on Jan. 1







All types of cancer, white females;
age-adjusted rate by county, 1950-1969

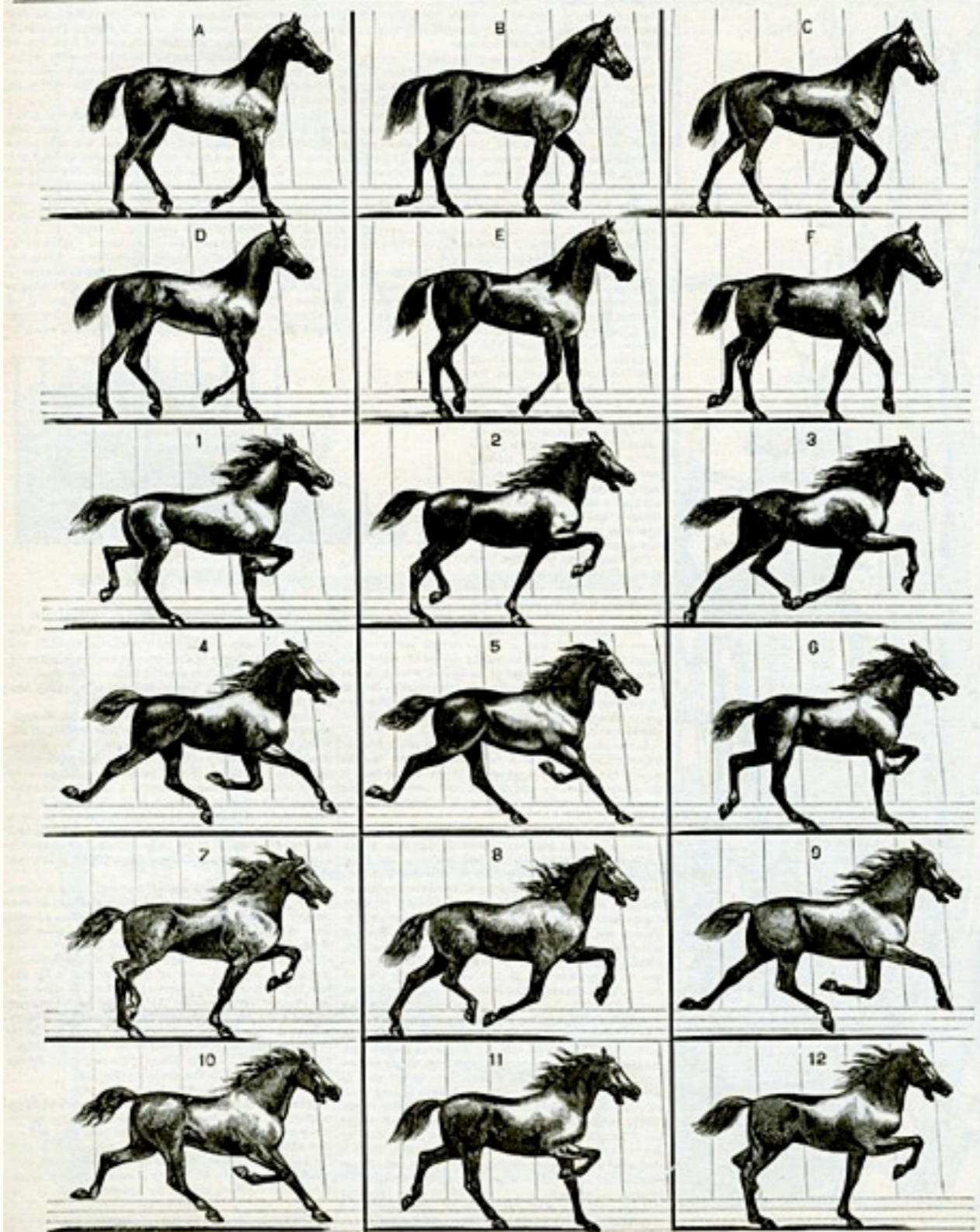
SCIENTIFIC AMERICAN

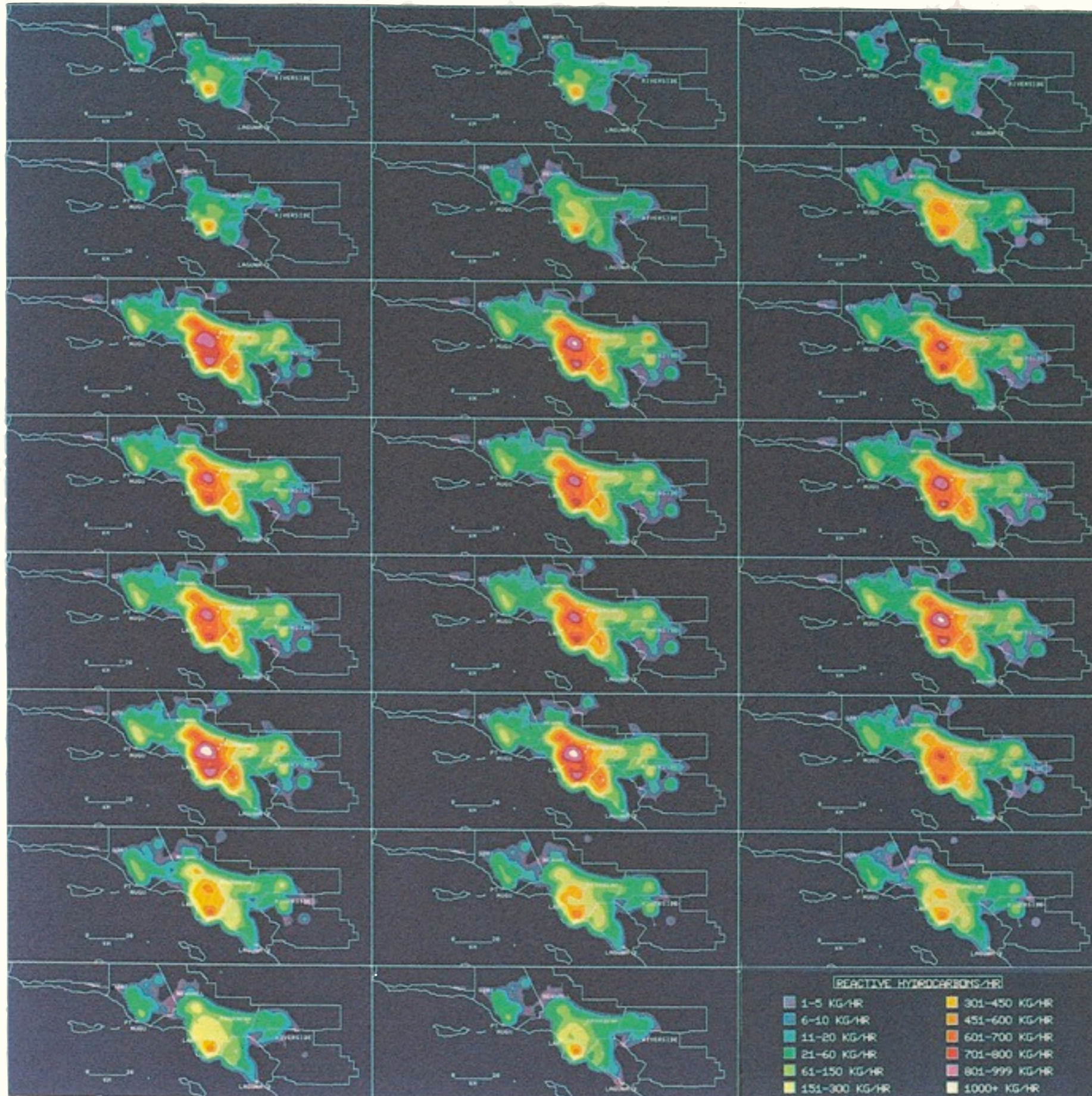
A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES

Vol. XXXIII.—No. 16.
[NEW SERIES.]

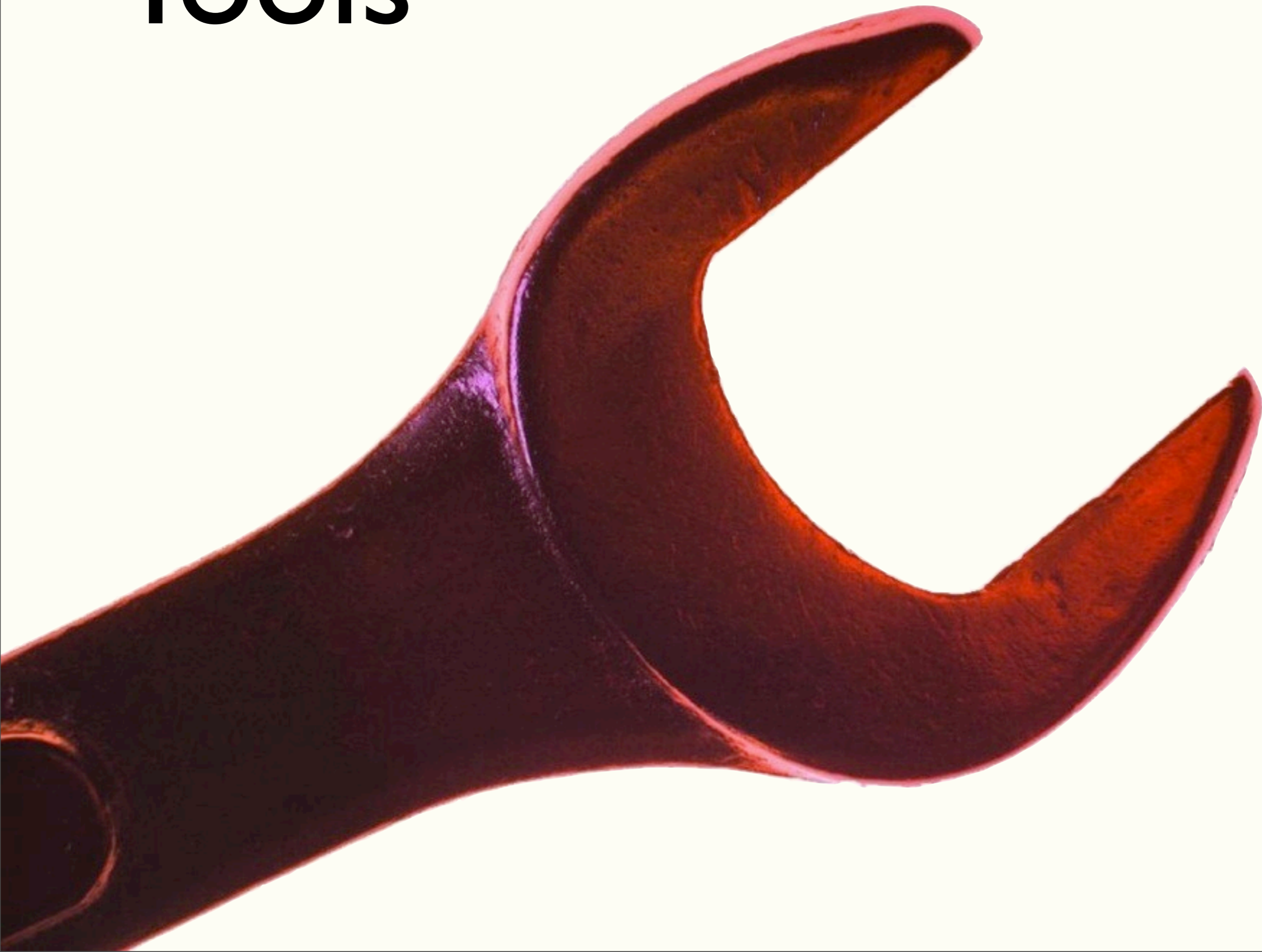
NEW YORK, OCTOBER 19, 1878.

[\$2.50 per Annum.
[PREPAID IN ADVANCE.]





Tools



GET DATA

`urllib2`

PARSE IT

`csv, beautifulsoup`

PROCESS

`numpy, scipy`

VISUALIZE

`matplotlib,
chaco, mayavi2`

PUBLISH

`LaTeX, cherrypy`

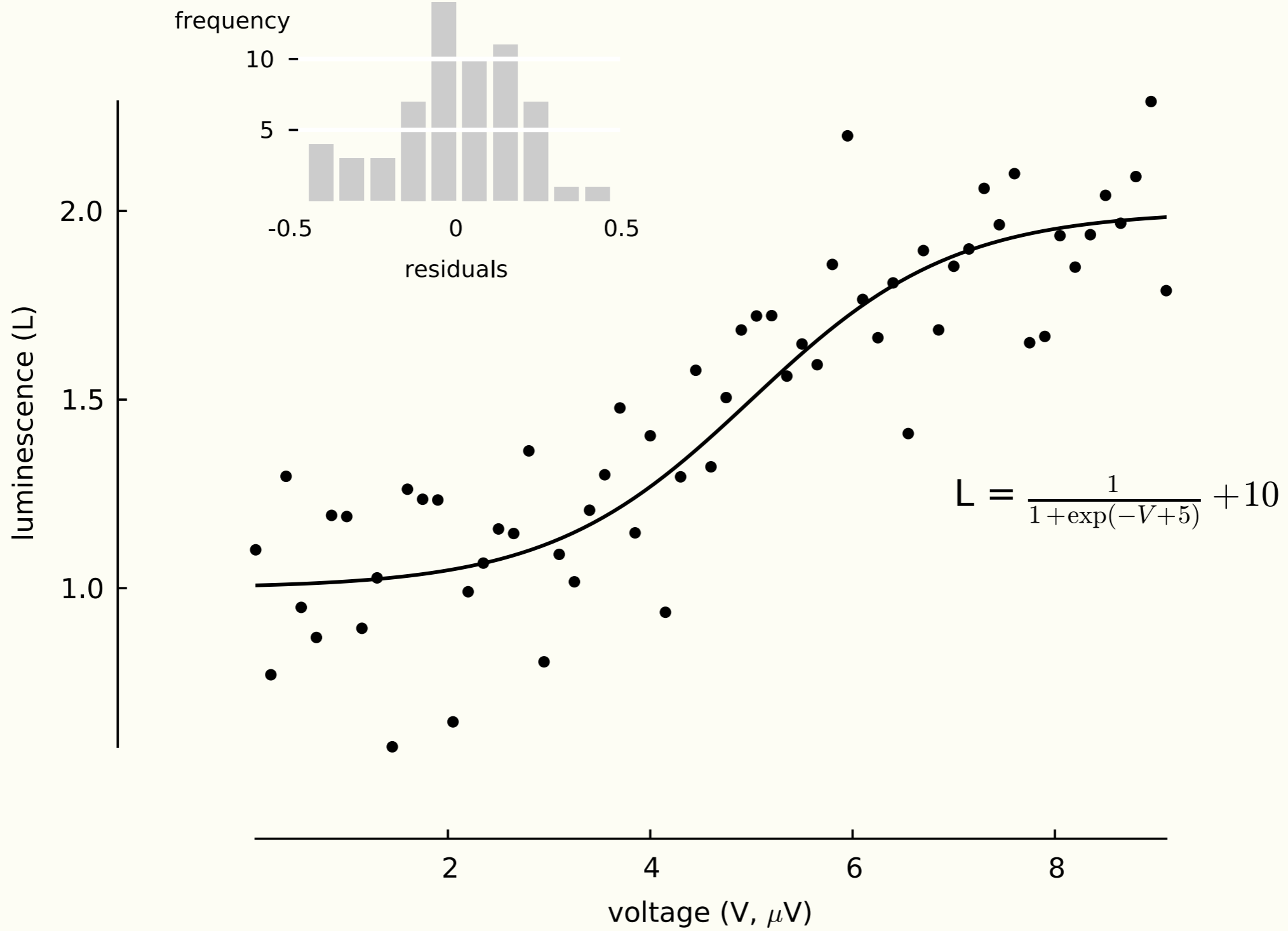


matplotlib



John Hunter

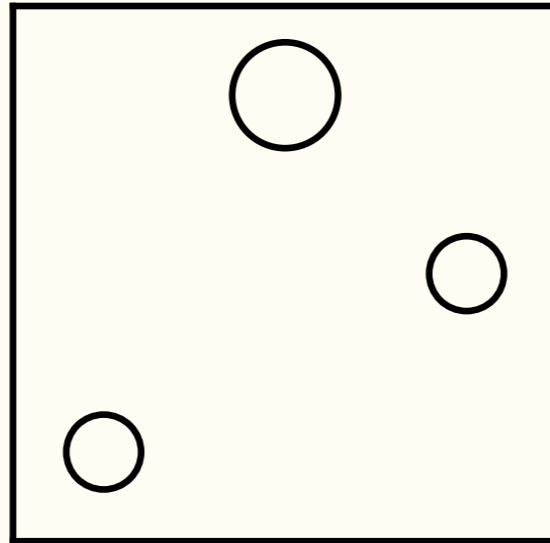
1968-2012



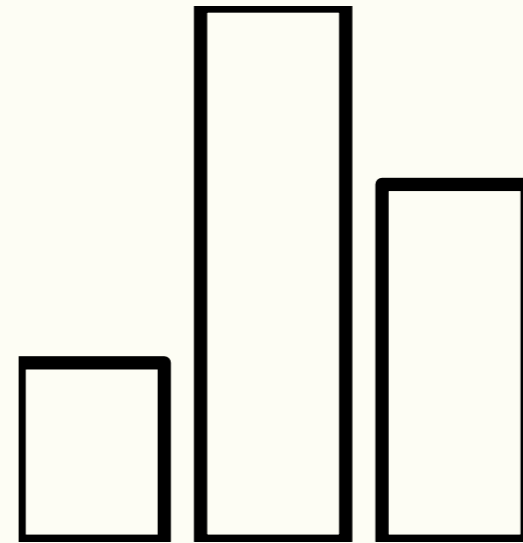
plot



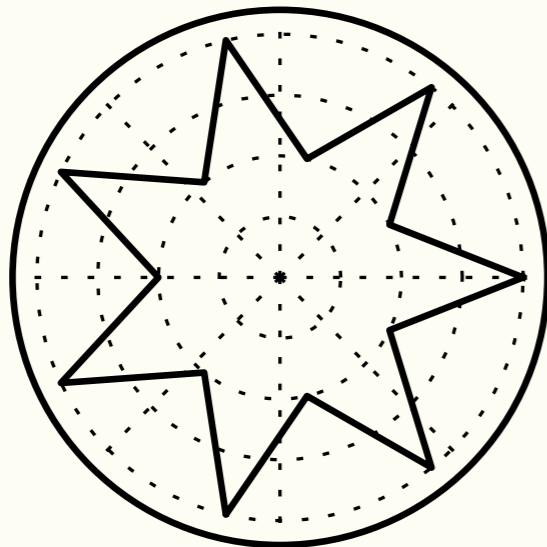
scatter



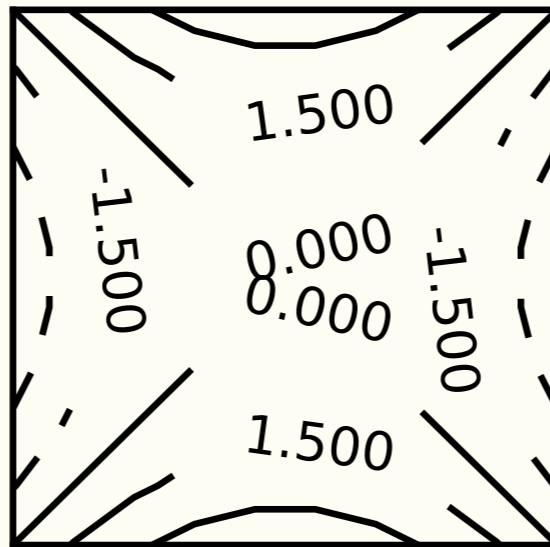
bar



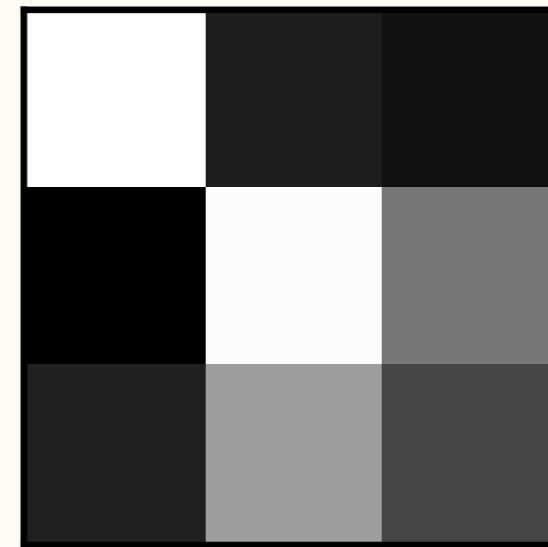
polar



contour



imshow



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

t = np.linspace(0, 2*np.pi, 100)
y = np.sin(t)

plt.plot(t, y)

plt.xlabel('angle')
plt.ylabel('amplitude')
plt.xlim([0, 2*np.pi])
plt.xticks([0, np.pi, 2*np.pi],
           ['0', r'$\pi$', r'$2\pi$'])

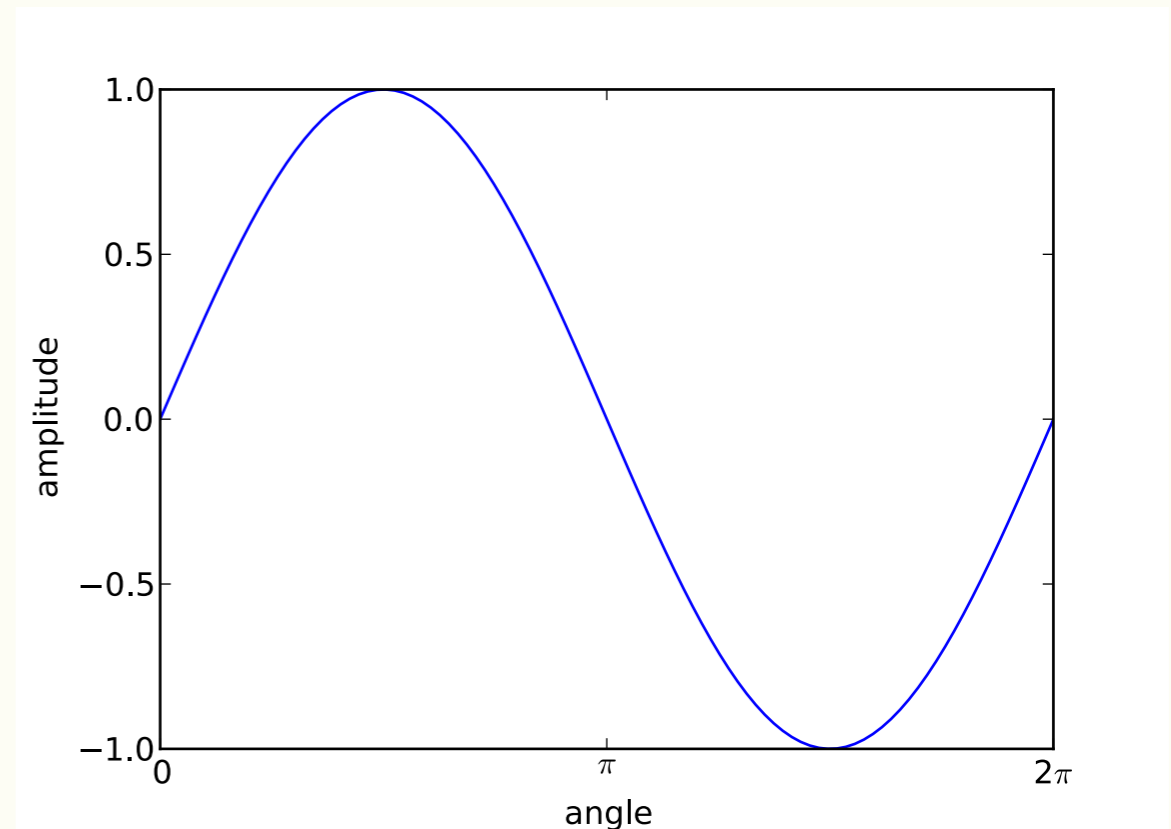
plt.show()
```

#generate data

#add axis labels

#set data limits

#add tick labels





Wedge



Arrow



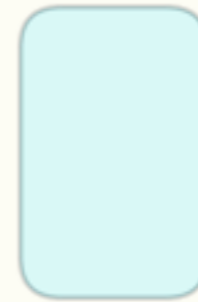
Line2D



Rectangle



Ellipse



FancyBoxPatch



Circle



Polygon



PathPatch

```
import matplotlib.pyplot as plt
import matplotlib.patches as mpatches

fig = plt.figure(figsize=(5,5))           # create figure container
ax = plt.axes([0,0,1,1], frameon=False)  # create axes container

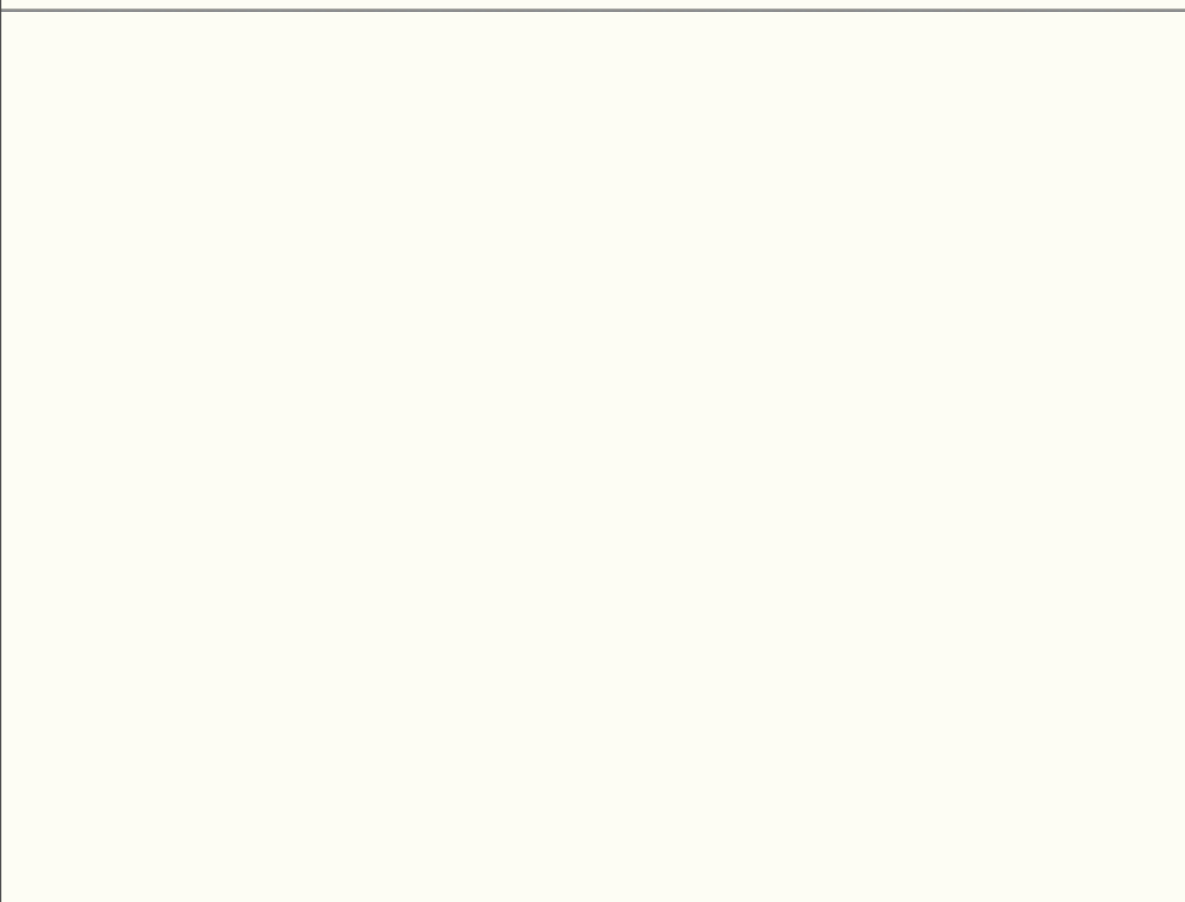
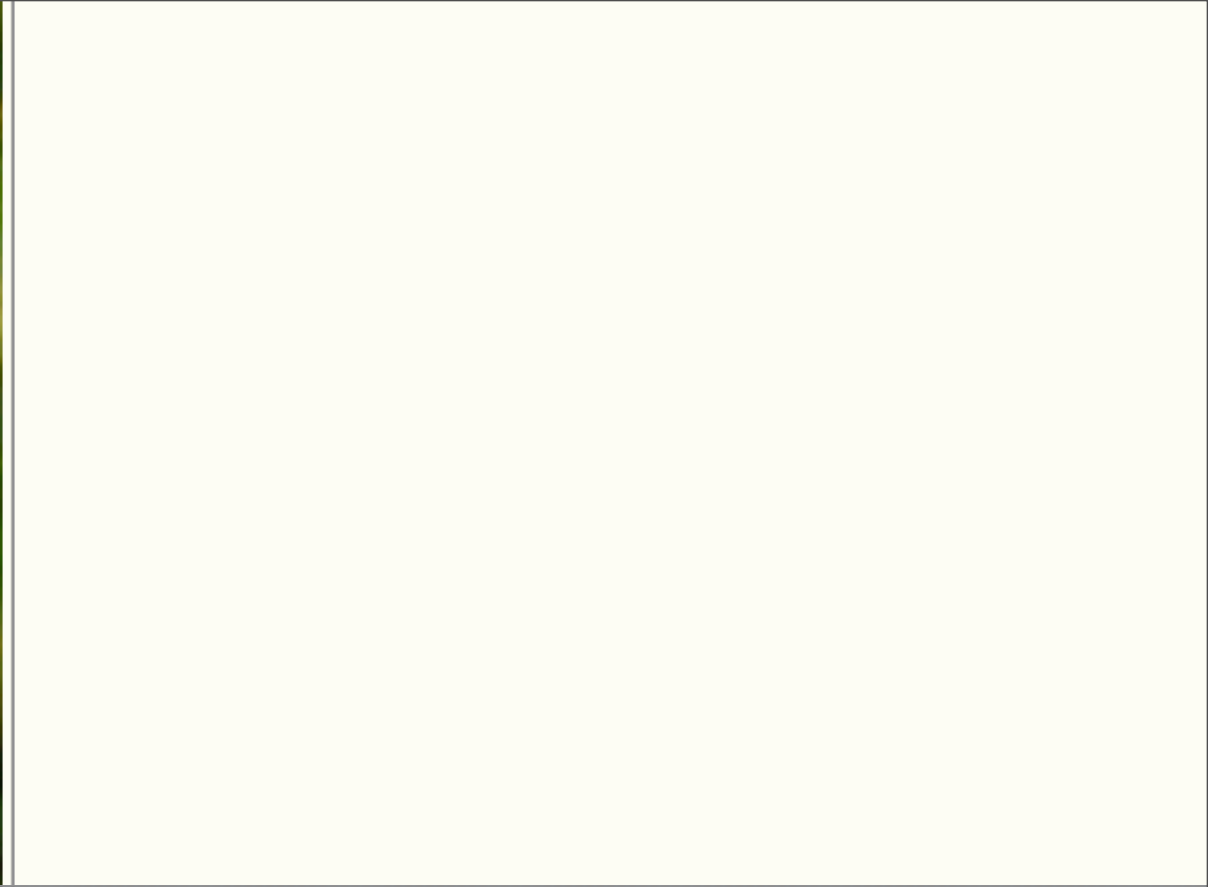
art = mpatches.Circle((0.5, 0.5), 0.5,   # create an artist
                      ec="none")

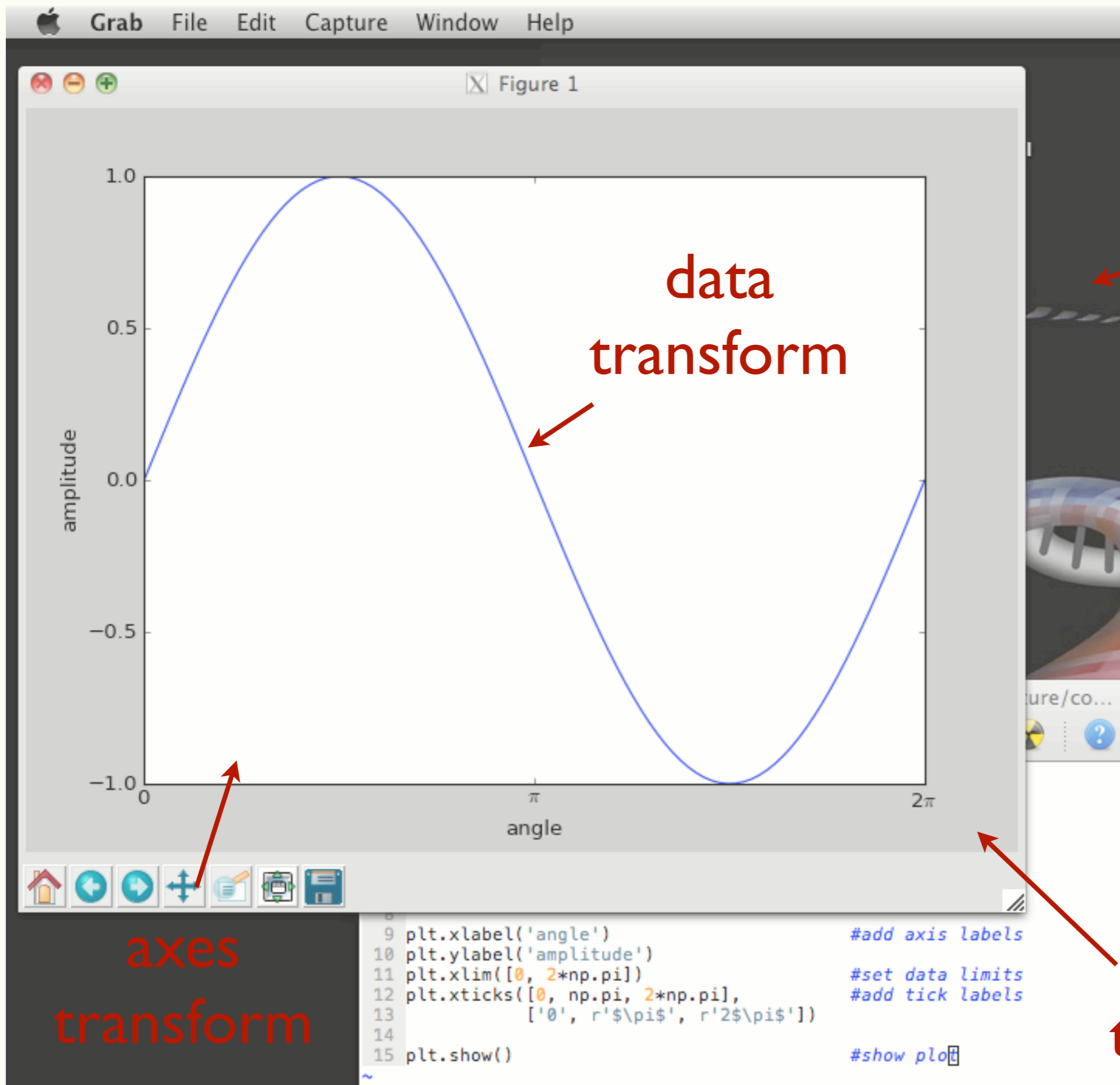
ax.add_patch(art)                        # add the artist to the
                                         # container

ax.set_xticks([])                        # remove axes ticks
ax.set_yticks([])

plt.show()
```







display transform

data transform

axes transform

figure transform

```
9 plt.xlabel('angle') #add axis labels
10 plt.ylabel('amplitude') #add axis labels
11 plt.xlim([0, 2*np.pi]) #set data limits
12 plt.xticks([0, np.pi, 2*np.pi], ['0', r'$\pi$', r'$2\pi$']) #add tick labels
13
14
15 plt.show() #show plot
```



```
import numpy as np
import matplotlib.pyplot as plt
from matplotlib import patches
from matplotlib import transforms
```

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

```
x = 10*np.random.randn(1000)
```

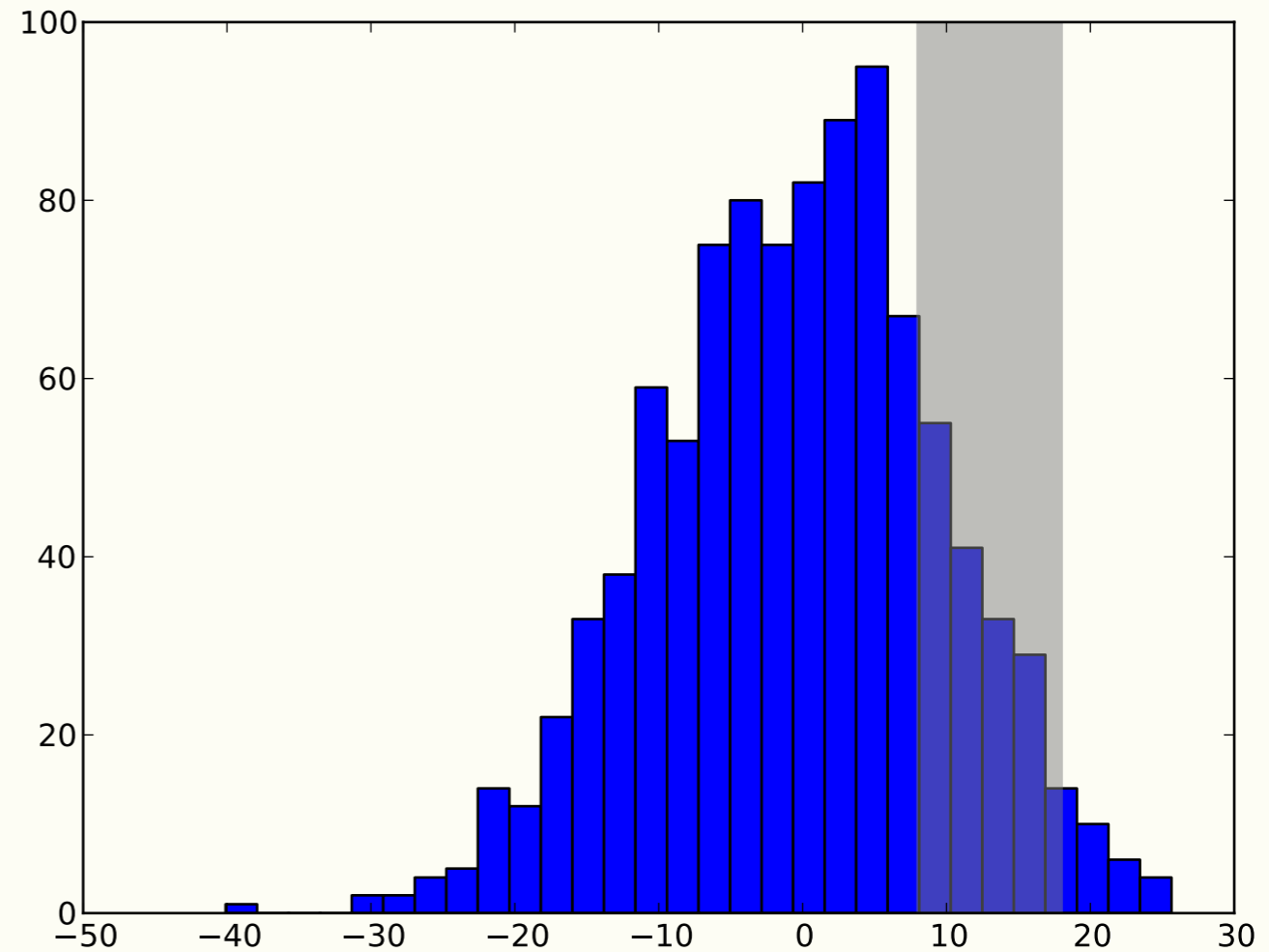
```
ax.hist(x, 30)
```

```
trans = transforms.blended_transform_factory(
    ax.transData, ax.transAxes)
```

```
rect = patches.Rectangle((8,0), width=10, height=1,
                          transform=trans, color='gray',
                          alpha=0.5)
```

```
ax.add_patch(rect)
```

```
plt.show()
```



Interactivity




```
import numpy
from matplotlib.pyplot import figure, show

def onpick(event):
    i = event.ind
    ax.plot(xs[i], ys[i], 'ro')
    fig.canvas.draw()

xs, ys = numpy.random.rand(2,100)

fig = figure()
ax = fig.add_subplot(111)
line, = ax.plot(xs, ys, 'o', picker=5)

fig.canvas.mpl_connect('pick_event', onpick)
show()
```

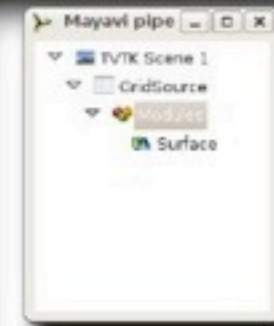
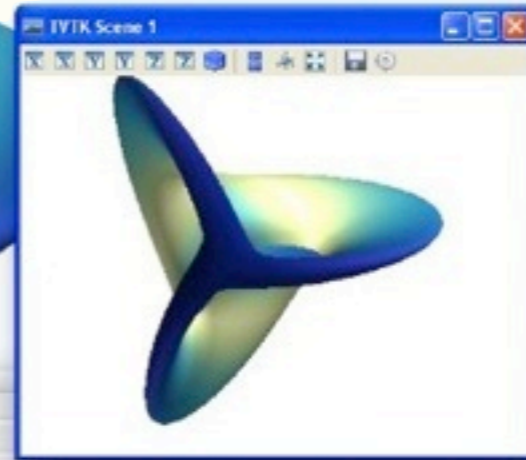
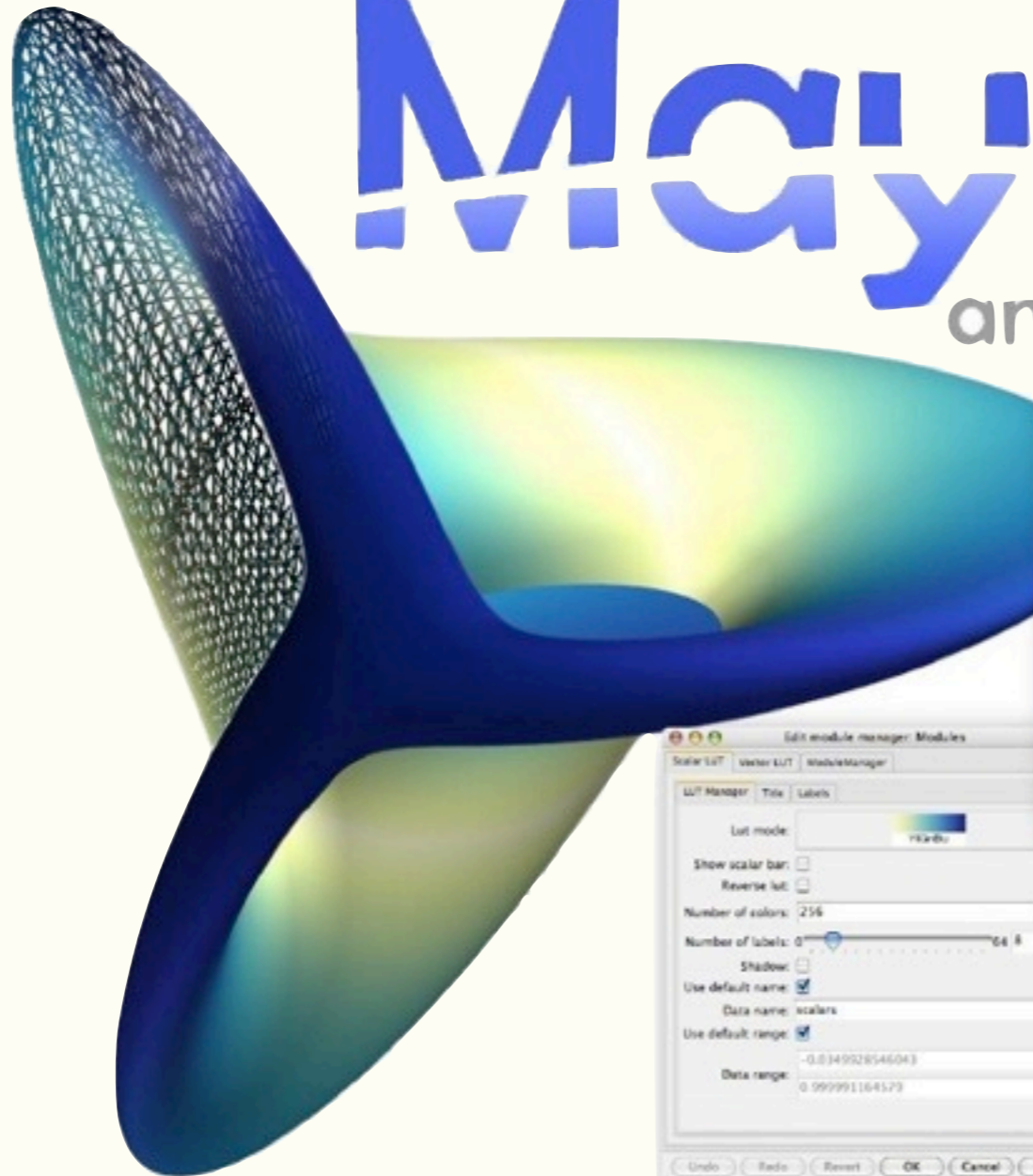
define a handler
indices of clicked points
plot the points in red
update axes

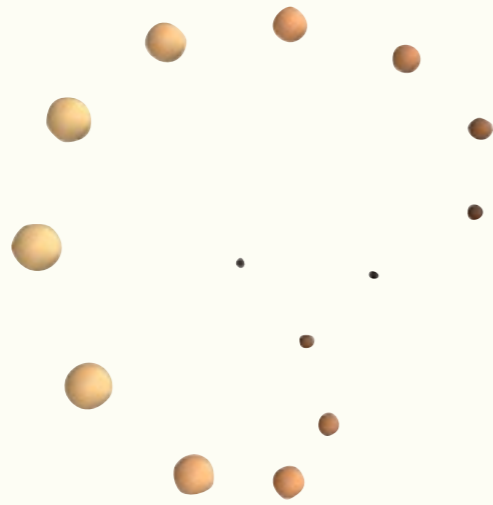
5 points tolerance

connect handler to event
enter the main loop

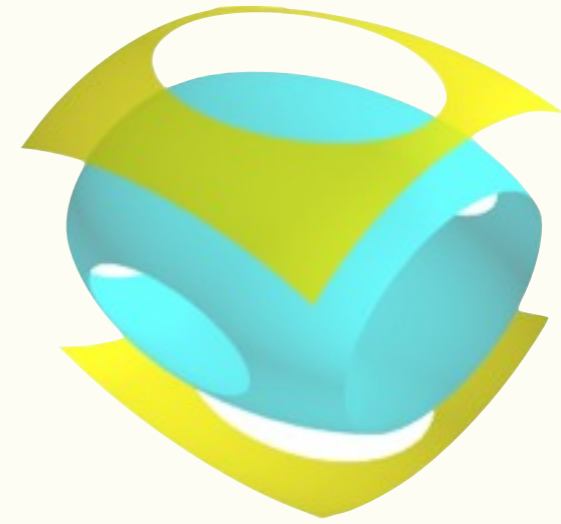
Mayavi

an ETS project





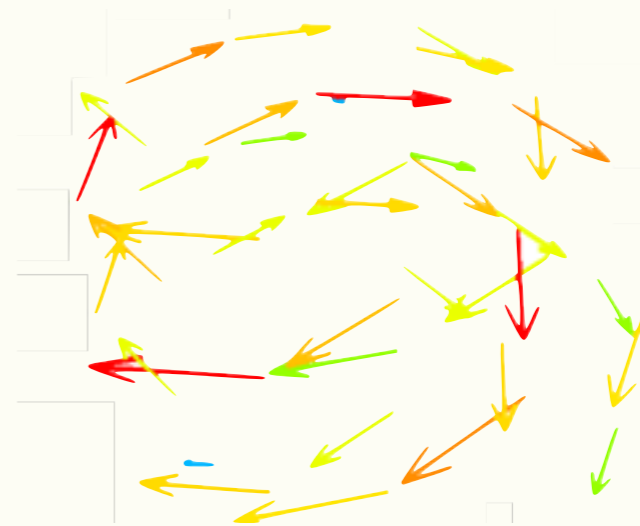
`points3d()`



`contour3d()`



`plot3d()`

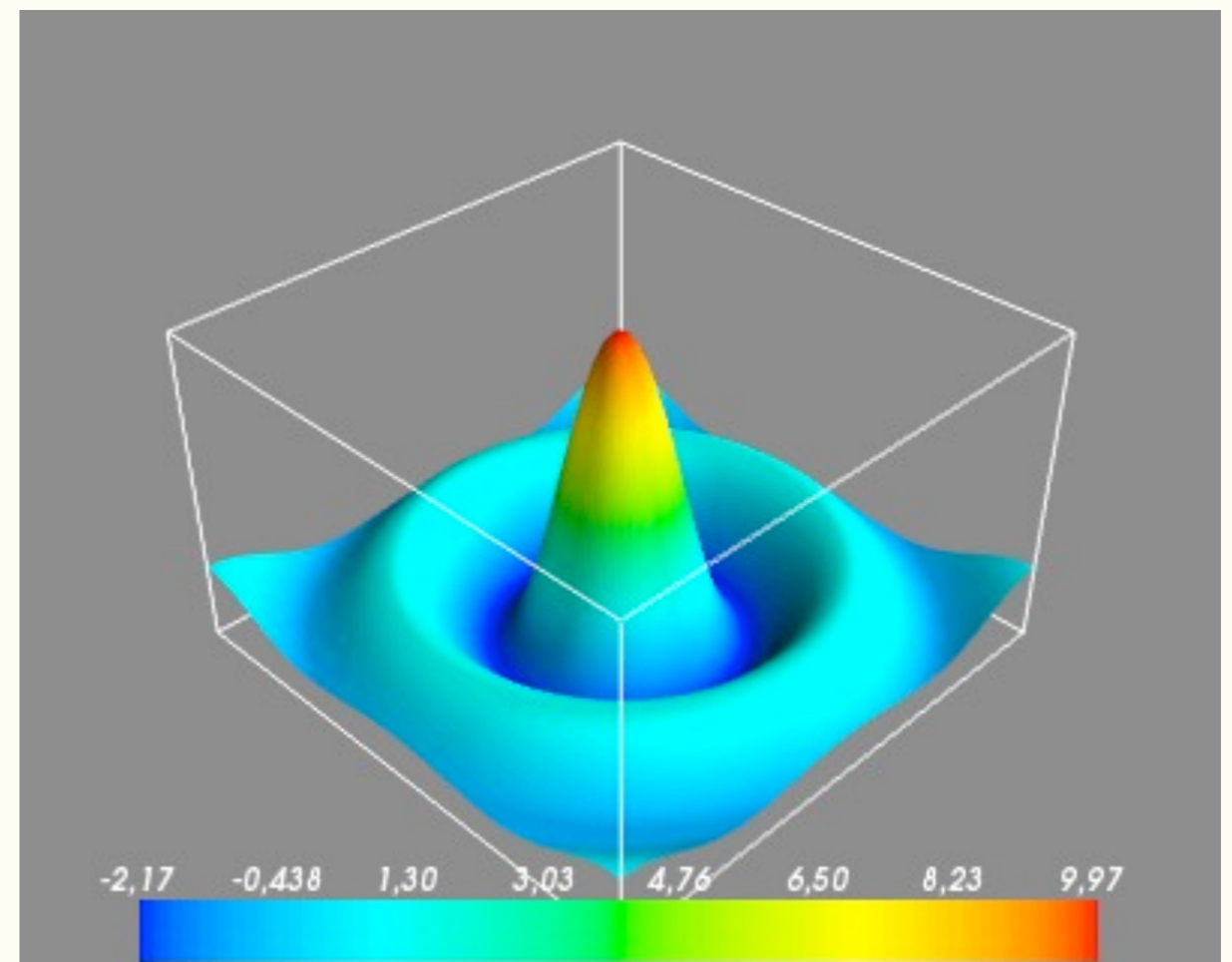


`quiver3d()`

```
from enthought.mayavi import mlab
import numpy as np

x, y = np.ogrid[-10:10:100j, -10:10:100j]
r = np.sqrt(x**2 + y**2)
z = np.sin(r)/r

mlab.surf(x,y, 10*z)
mlab.outline()
mlab.colorbar()
```





With John Cleese, Michael Palin, Grahame Chapman, Eric Idle, Terry Jones, Carol Cleveland

from the BBC Television Series