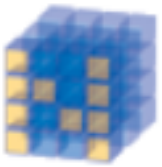
Introdução à programação para ciência e engenharia em *Python*

Iuri Soter Viana Segtovich

Parte 3: python científico

Gráficos (`from matplotlib import pyplot as plt`)

Python científico



NumPy

Base N-dimensional array package

SciPy library

Fundamental library for scientific computing

Matplotlib

Comprehensive 2D Plotting

IP[y]:
IPython

IPython

Enhanced Interactive Console

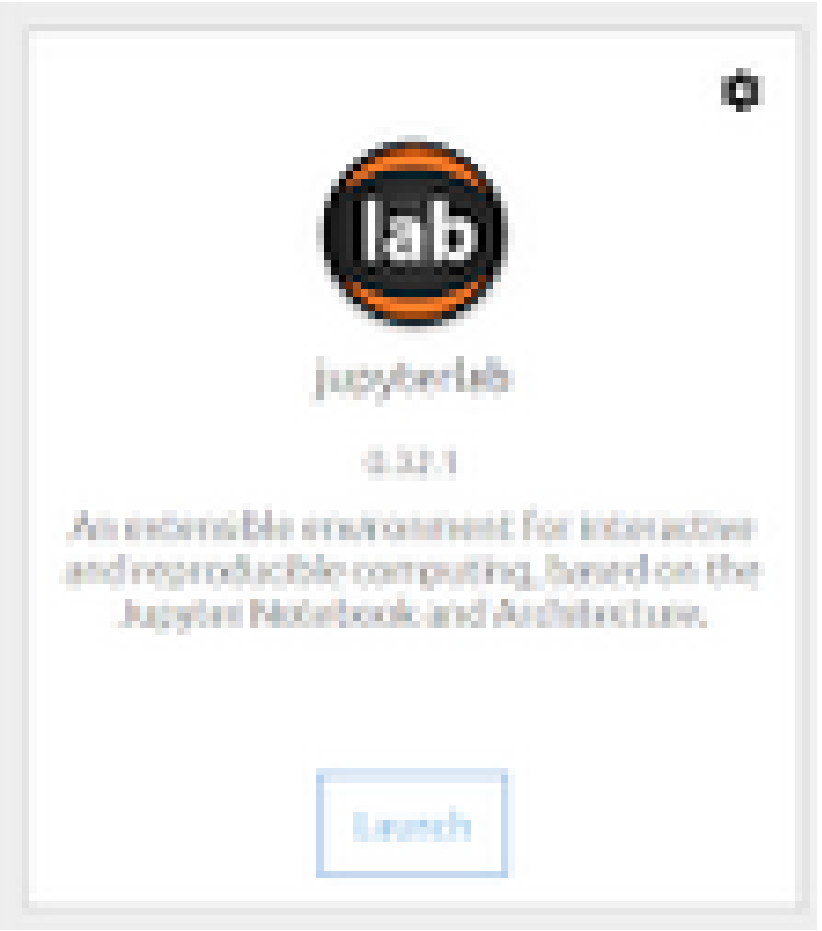
Sympy

Symbolic mathematics

pandas

Data structures & analysis

Anaconda navigator / Jupyter lab



matplotlib

Untitled.ipynb

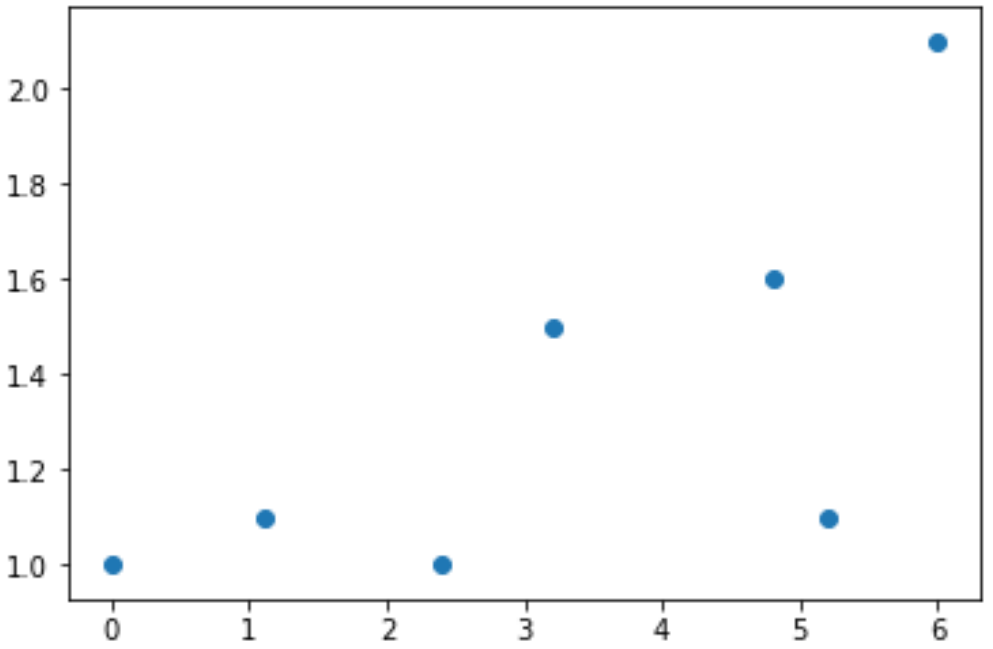
Code

In [2]:
```
from matplotlib import pyplot as plt
%matplotlib inline
```

In [ ]:

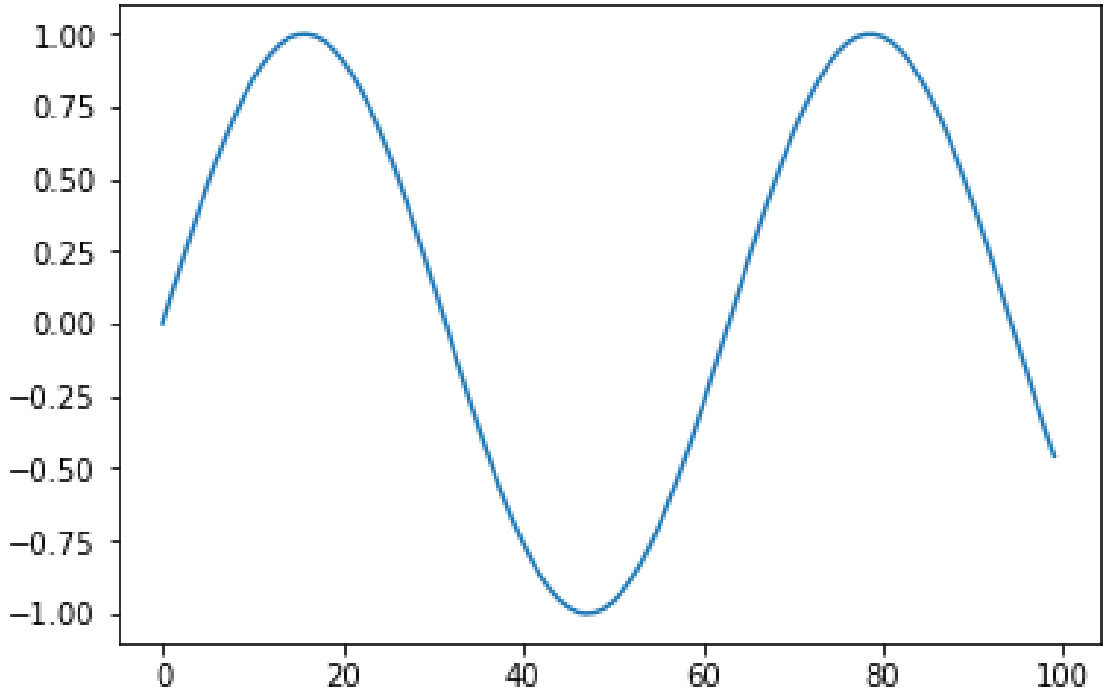
scatter

```
In [8]: T= [0.0, 1.1, 2.4, 3.2, 4.8, 5.2, 6.0]
        P= [1.0, 1.1, 1.0, 1.5, 1.6, 1.1, 2.1]

In [9]: plt.scatter(T,P)

Out[9]: <matplotlib.collections.PathCollection at 0x7fc03364dda0>
```



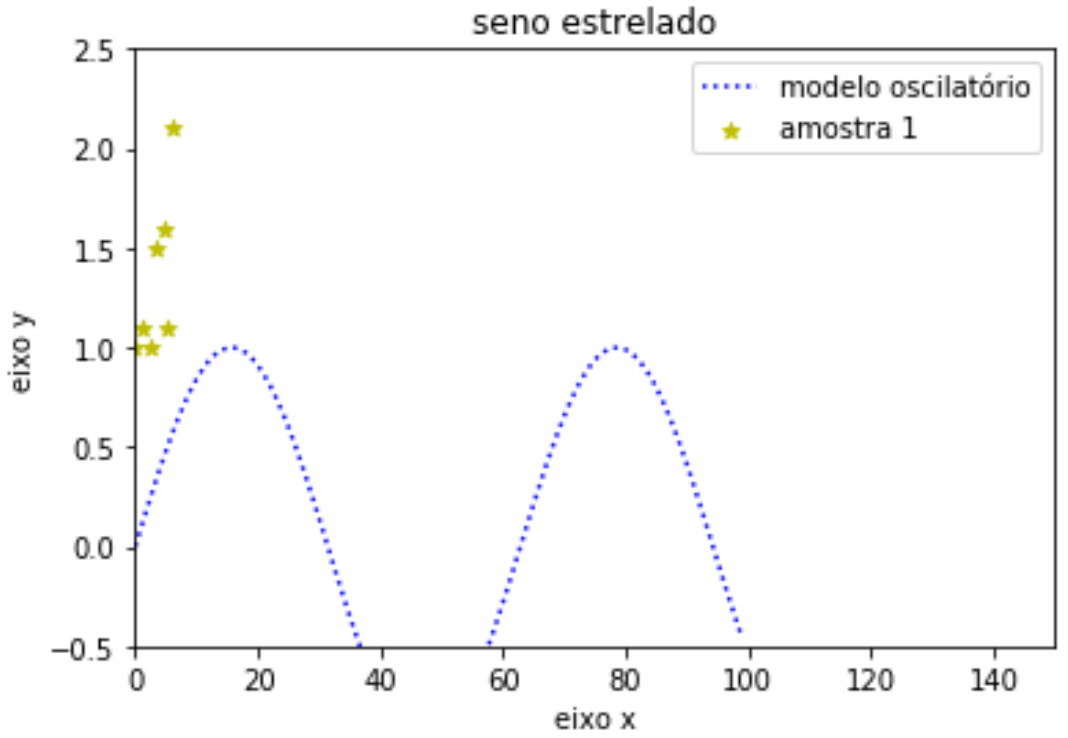
plot

```
In [18]: x=list(range(100))
         from math import sin
         y=[sin(xi/10) for xi in x]

In [20]: plt.plot(x,y)

Out[20]: [<matplotlib.lines.Line2D at 0x7fc033411400>]
```



savefig

In [29]:
```
plt.scatter(T,P,marker='*',color='y',label='amostra 1')
plt.plot(x,y,ls=':',color='b', label='modelo oscilatório')
plt.title("seno estrelado")
plt.ylabel("eixo y")
plt.xlabel("eixo x")
plt.xlim(0,150)
plt.ylim(-.5,2.5)
plt.legend()
plt.savefig("Figura1.png")
```

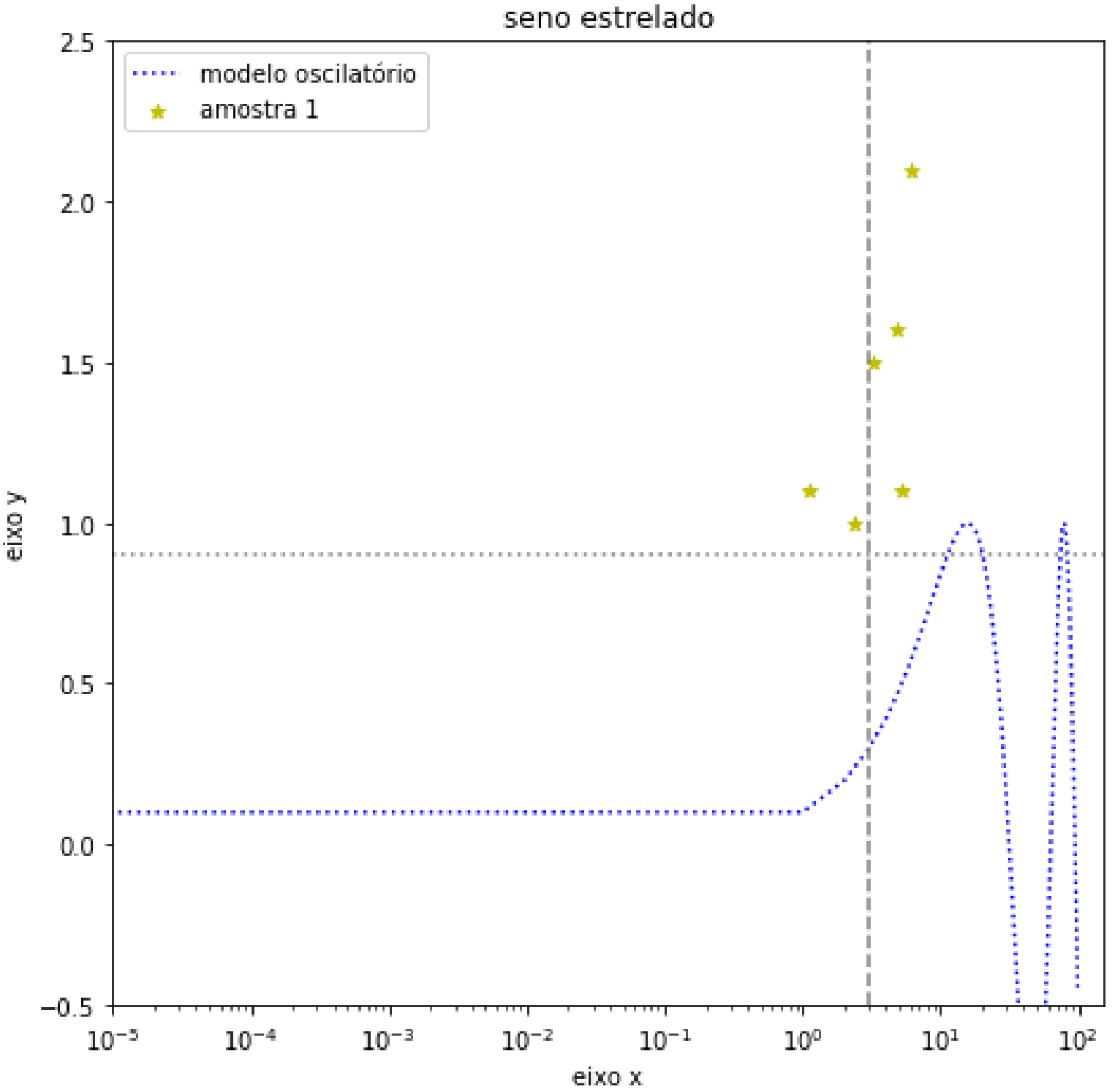


Multi-plot-Fu

https://static1.squarespace.com/static/530562f9e4b06fd3c041e221/t/5956de46099c01c37e5fa0b3/1498865226277/MatplotlibHotTopics.pdf

O caminho OOP

```
in_to_cm=0.393701 #0.393701 polegadas por centimetro
fig=plt.figure(figsize=(19*in_to_cm,19*in_to_cm)) #tamanho em polegadas
ax=fig.add_subplot(111)
ax.scatter(T,P,marker='*',color='y',label='amostra 1')
ax.plot(x,y,ls=':',color='b', label='modelo oscilatório')
ax.set_title("seno estrelado")
ax.set_ylabel("eixo y")
ax.set_xlabel("eixo x")
ax.set_xlim(1e-5,150)
ax.set_ylim(-.5,2.5)
ax.axhline(.9,color='gray',ls=':')
ax.axvline(3,color='grey',ls='--')
ax.set_xscale("log")
ax.legend(loc=2)
fig.savefig("Figura2.png")
fig.canvas.draw()
```

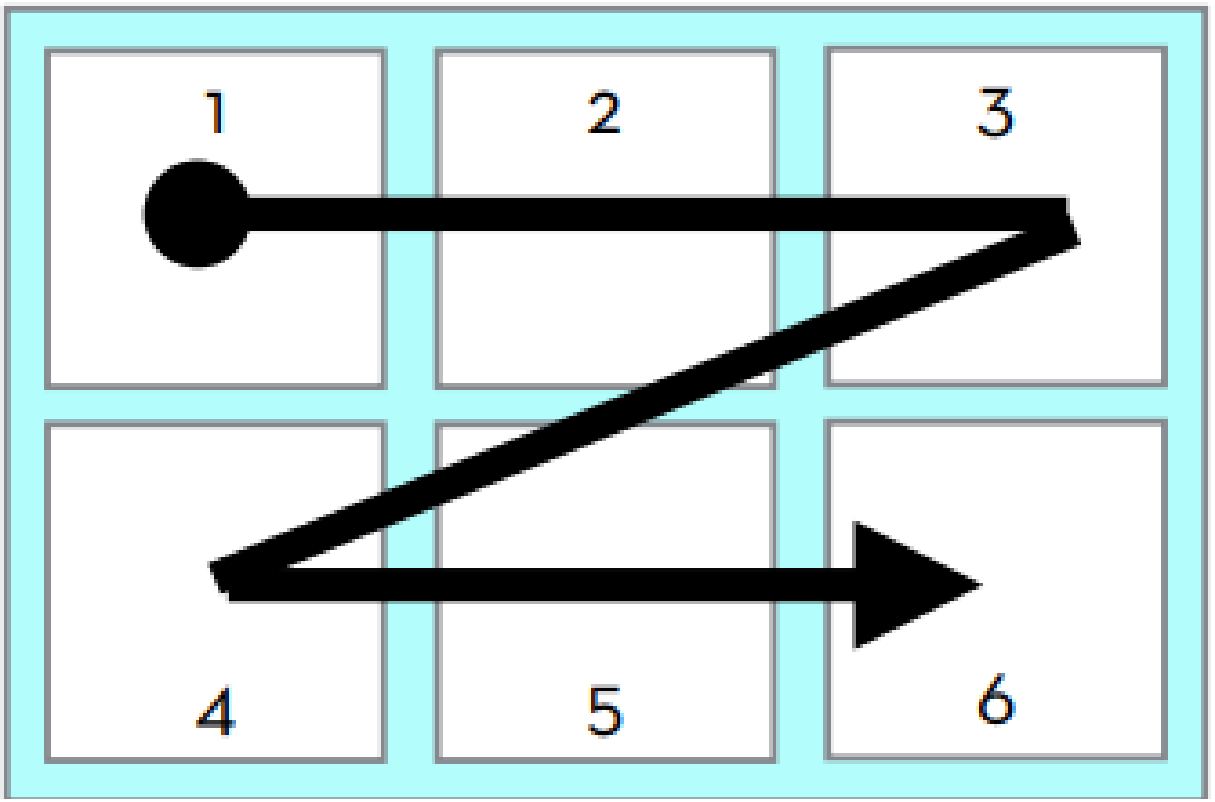

seno estrelado
modelo oscilatório
amostra 1
eixo y
eixo x
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}

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

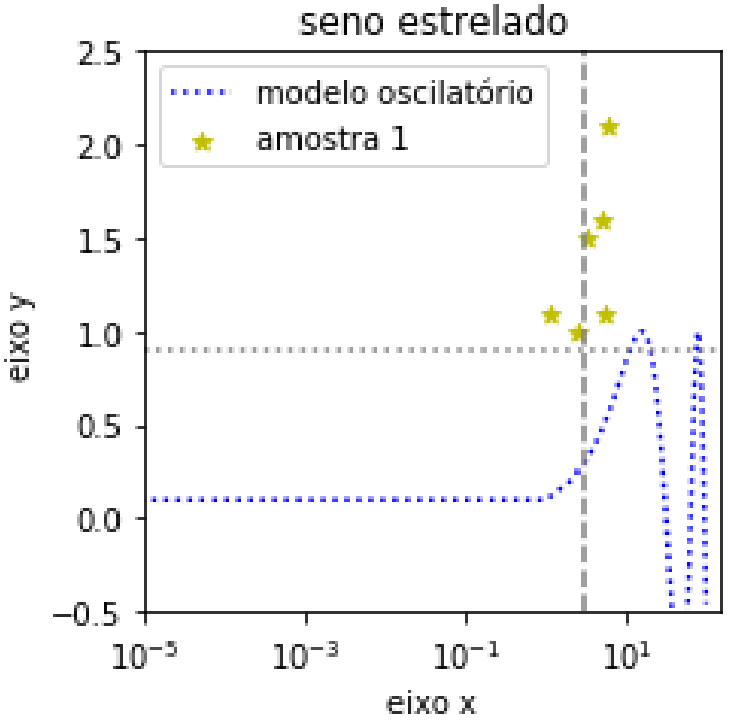
Number of Columns

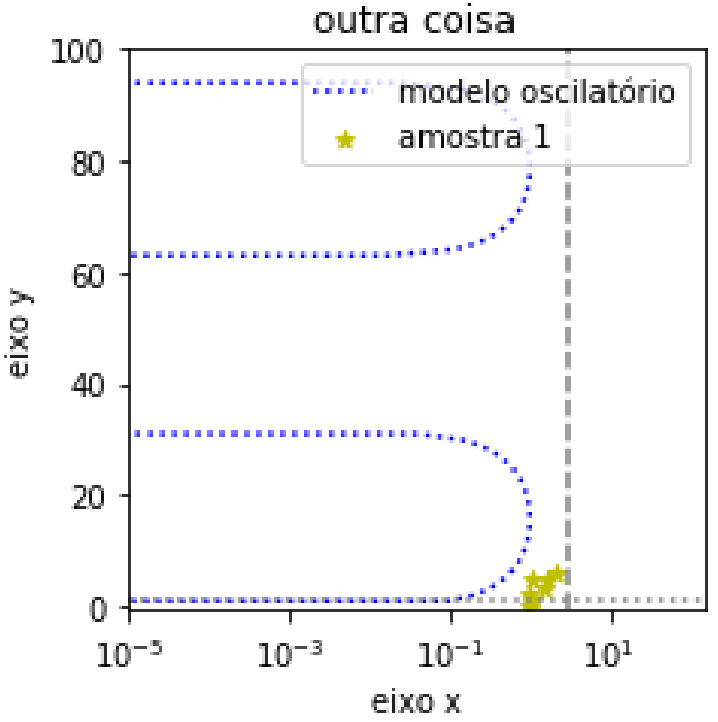
Number of Rows

Axes index in that grid



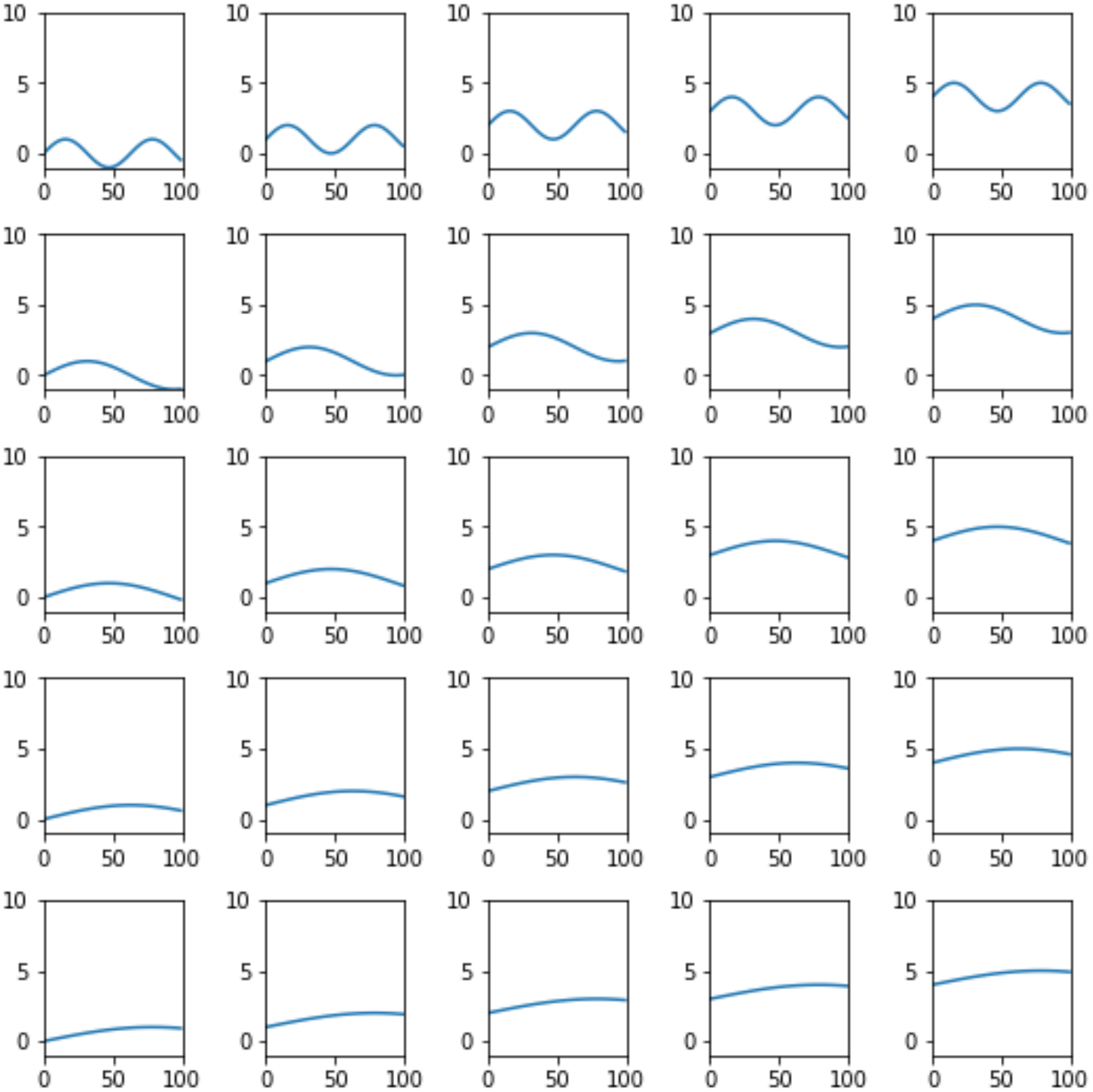
```
in_to_cm=0.393701 #0.393701 polegadas por centimetro
fig=plt.figure(figsize=(19*in_to_cm,19*in_to_cm)) #tamanho em polegadas
ax_seno_estrelado=fig.add_subplot(221)
for ax in (ax_seno_estrelado,):
    ax.scatter(T,P,marker='*',color='y',label='amostra 1')
    ax.plot(x,y,ls=':',color='b', label='modelo oscilatório')
    ax.set_title("seno estrelado")
    ax.set_ylabel("eixo y")
    ax.set_xlabel("eixo x")
    ax.set_xlim(1e-5,150)
    ax.set_ylim(-.5,2.5)
    ax.axhline(.9,color='gray',ls=':')
    ax.axvline(3,color='grey',ls='--')
    ax.set_xscale("log")
    ax.legend(loc=2)
ax_outra_coisa=fig.add_subplot(224)
for ax in (ax_outra_coisa,):
    ax.scatter(P,T,marker='*',color='y',label='amostra 1')
    ax.plot(y,x,ls=':',color='b', label='modelo oscilatório')
    ax.set_title("outra coisa")
    ax.set_ylabel("eixo y")
    ax.set_xlabel("eixo x")
    ax.set_xlim(1e-5,150)
    ax.set_ylim(-.5,2.5)
    ax.axhline(.9,color='gray',ls=':')
    ax.axvline(3,color='grey',ls='--')
    ax.set_xscale("log")
    ax.legend(loc=2)
fig.savefig("Figura3.png")
fig.canvas.draw()
```


seno estrelado
modelo oscilatório
amostra 1
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
eixo y
10^{-5}
10^{-3}
10^{-1}
10^{1}
eixo x


outra coisa
modelo oscilatório
amostra 1
100
80
60
40
20
0
eixo y
10^{-5}
10^{-3}
10^{-1}
10^{1}
eixo x

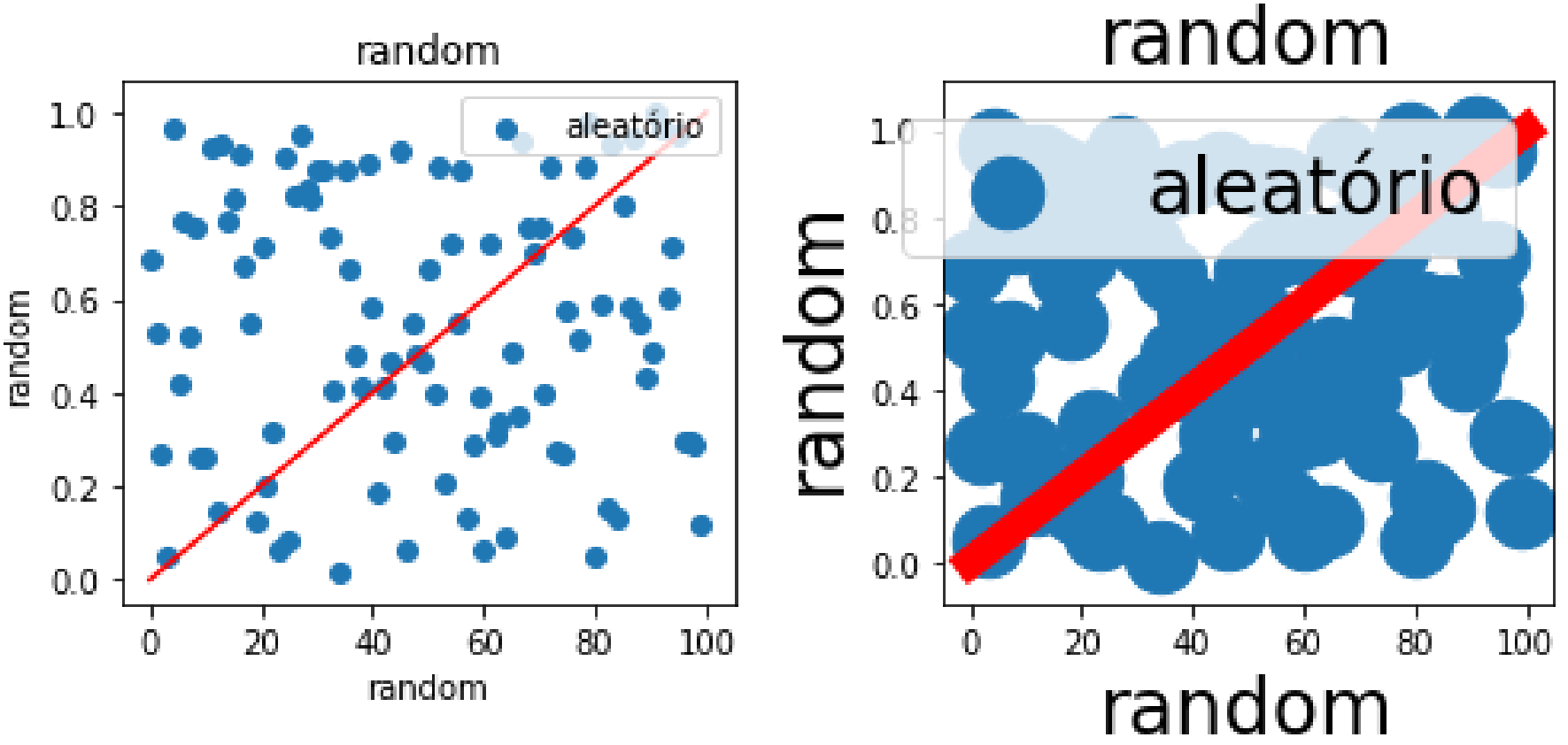
```
T= [0.0, 1.1, 2.4, 3.2, 4.8, 5.2, 6.0]
P= [1.0, 1.1, 1.0, 1.5, 1.6, 1.1, 2.1]
x=list(range(100))

nx=5
ny=5
y=[[None for i in range(nx)] for j in range(ny)]
ax_varios=fig.subplots(nx,ny)
for i in range(nx):
    for j in range (ny):
        y[i][j]=[j+sin(xi/10/(i+1)) for xi in x]
```

```
in_to_cm=0.393701 #0.393701 polegadas por centimetro
fig=plt.figure(figsize=(19*in_to_cm,19*in_to_cm)) #tamanho em polegadas
nx=5
ny=5
ax_varios=fig.subplots(nx,ny)
for i in range(nx):
    for j in range (ny):
        ax=ax_varios[i][j]
        ax.plot(x,y[i][j])
        ax.set_xlim(0,100)
        ax.set_ylim(-1,10)
fig.tight_layout()
fig.savefig("Figura4.png")
fig.canvas.draw()
```


10
5
0
0
50
100

fontsize, labelsize

```
in_to_cm=0.393701 #0.393701 polegadas por centimetro
fig=plt.figure(figsize=(18*in_to_cm,9*in_to_cm)) #tamanho em polegadas
ax1=fig.add_subplot(121)
ax1.scatter(xr,yr,label='aleatório')
ax1.plot([0,100],[0,1],color='r')
ax1.set_title("random")
ax1.set_xlabel("random")
ax1.set_ylabel("random")
ax1.legend(loc=1)
ax2=fig.add_subplot(122)
ax2.scatter(xr,yr,label='aleatório',s=500)
ax2.plot([0,100],[0,1],lw=10,color='r')
ax2.set_title("random",fontsize=24)
ax2.set_xlabel("random",fontsize=24)
ax2.set_ylabel("random",fontsize=24)
ax2.legend(loc=1,fontsize=24)
fig.tight_layout()
fig.savefig("Figura5.png")
fig.canvas.draw()
```

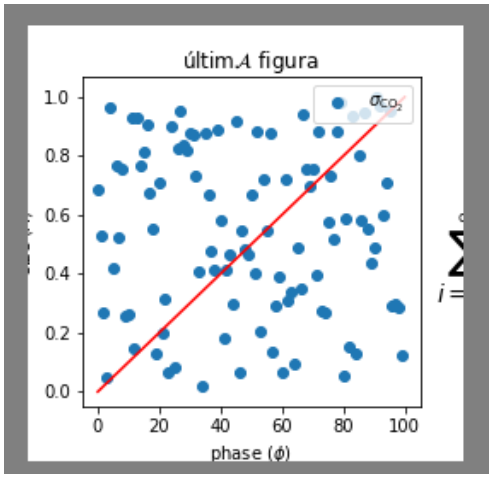

random
aleatório
1.0
0.8
0.6
0.4
0.2
0.0
random
0
20
40
60
80
100
random
random
aleatório
1.0
0.8
0.6
0.4
0.2
0.0
random
0
20
40
60
80
100
random

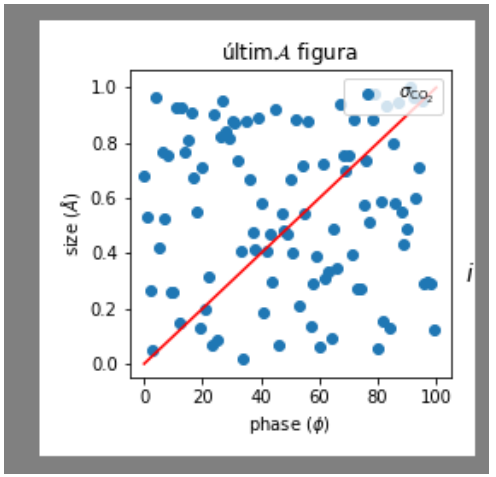
```
in_to_cm=0.393701 #0.393701 polegadas por centimetro

fig1=plt.figure(figsize=(9*in_to_cm,9*in_to_cm)) #tamanho em polegadas
ax1=fig1.add_subplot(111)
ax1.scatter(xr,yr,label=r'$\sigma_\mathrm{CO_2}$')
ax1.plot([0,100],[0,1],color='r')
ax1.set_title(r'$\alpha_i > \beta_i$', fontsize=20)
ax1.text(110., 0.4, r'$\sum_{i=0}^\infty x_i+ \times \mathrm{sin}(2 \omega t)$',fontsize=20)
ax1.set_xlabel(r'phase $(\phi)$')
ax1.set_ylabel(r'size $(\AA)$')
ax1.set_title(r"últim$\mathcal{A}$ figura")
ax1.legend(loc=1)
fig1.savefig("Figura6")
fig1.canvas.draw()
```

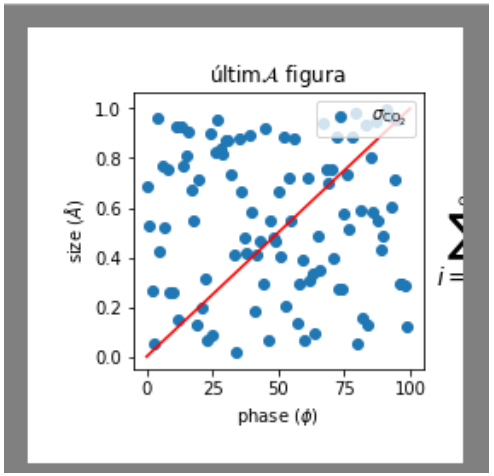
```
fig1.tight_layout()
fig1.savefig("Figura6_tight_layout")
```

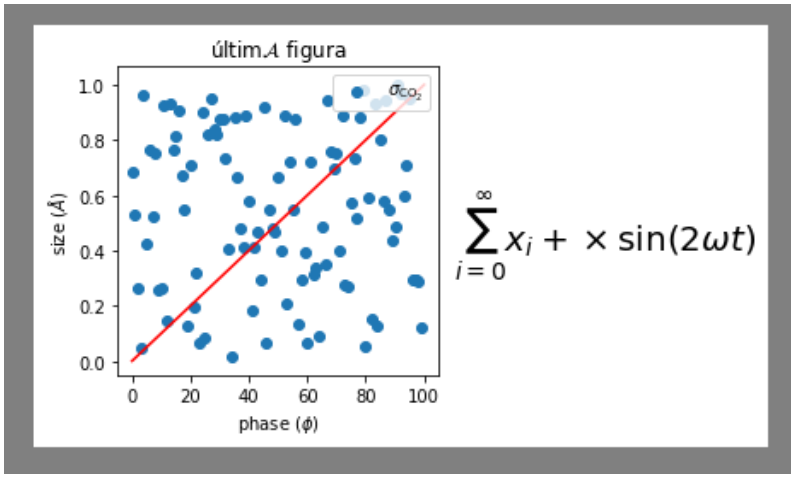
```
fig1.savefig("Figura6_bbox_inches_tight.png",bbox_inches='tight')
```

```
fig1.tight_layout(pad=2)
fig1.savefig("Figura6_pad_2.png")
```


último figura
σ_{CO_2}
size (Å)
phase (ϕ)


último figura
σ_{CO_2}
size (Å)
phase (ϕ)


último figura
σ_{CO_2}
size (Å)
phase (ϕ)


último figura
σ_{CO_2}
size (Å)
phase (ϕ)
$\sum_{i=0}^{\infty} x_i + \times \sin(2\omega t)$