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CONTENT

1. some libraries
2. matplotlib
    1. 2D curve
    2. 2 2D curves
    3. 3D curve
    4. styles
    5. Titles
    6. Subtitles
    7. Axes:
        1. Limits
        2. marks/intervals
    8. Save

some libraries

- Plotly : https://plot.ly/python/

Creates publication-quality interactive graphics

- Seaborn : https://seaborn.pydata.org/

Based on matplotlib .

Provides a high-level interface for drawing visually pleasing and informative statistical graphs.

- Ggplot : https://pypi.org/project/ggplot/

Python implementation of *grammar of graphics* (used in R: https://ggplot2.tidyverse.org/reference/ggplot.html)

- Altair: https://altair-viz.github.io/

Declarative Statistical Visualization Library

- …

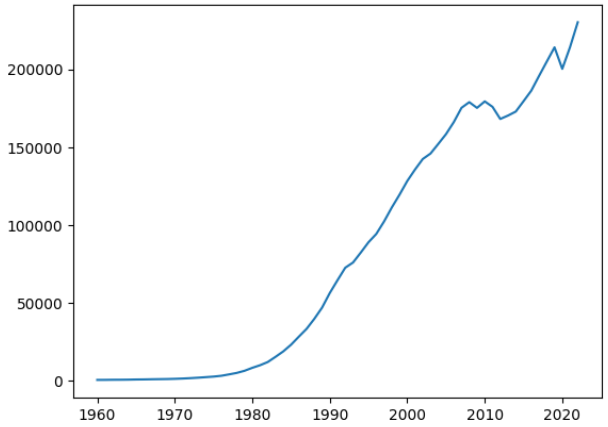
matplotlib

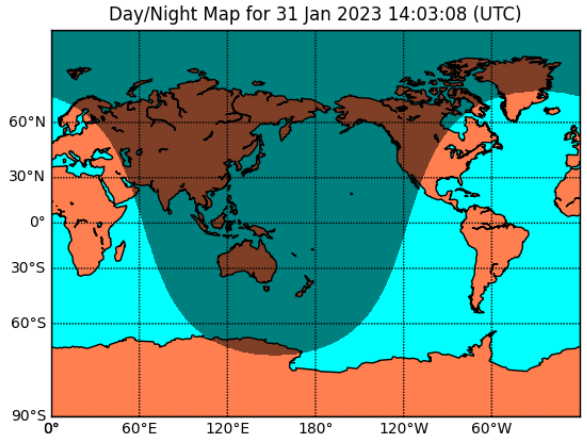
- Library that allows you to make graphs in Python: https://matplotlib.org/

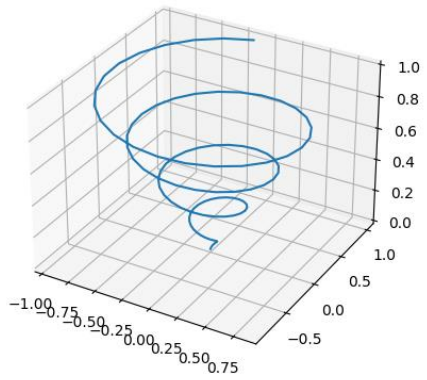
- Output
  - JPG, PNG
  - PDF
  - …

- types
  - 2D
  - 3D

- Supports
  - Maps
  - interactive graphics

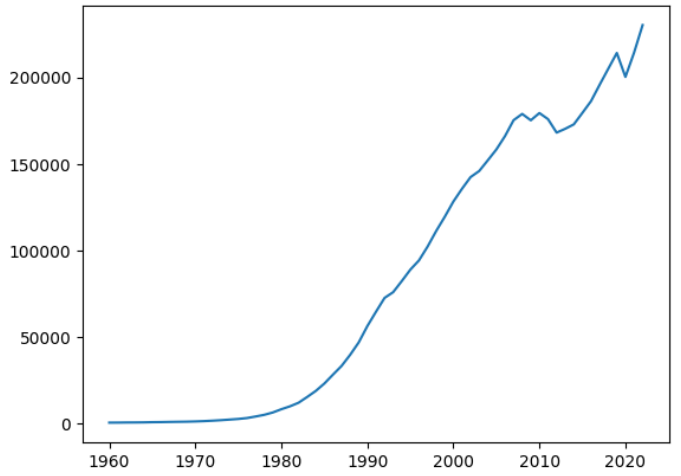






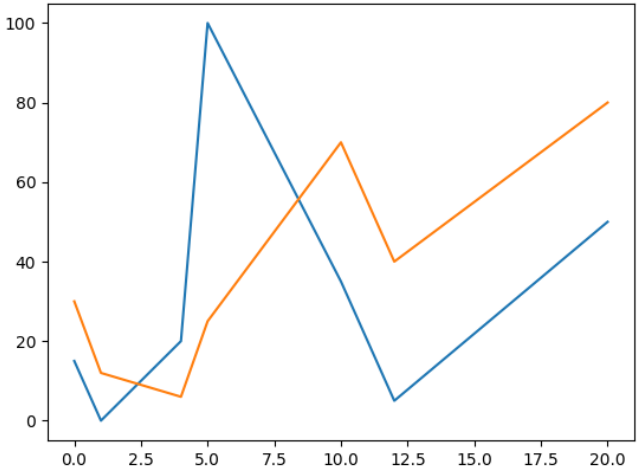
Matplotlib : 2D curve

```
import matplotlib.pyplot as plt

pib = [497.946, 518.393, 581.837, 601.147, 652.559, 759.178, 810.268, 907.654, 981.593, 1053.194, 1188.209,
1375.146, 1622.383, 1918.162, 2270.262, 2628.54, 3144.265, 4041.243, 4998.643, 6355.729, 8260.433, 9924.528,
12000.915, 15333.022, 18828.741, 23114.269, 28247.884, 33283.267, 39728.635, 46935.787, 56356.228, 64622.267,
72651.574, 75980.307, 82379.517, 89028.557, 94351.591, 102330.96, 111353.381, 119603.305, 128414.445, 135775.009,
142554.263, 146067.858, 152248.388, 158552.704, 166260.469, 175483.401, 179102.781, 175416.437, 179610.779,
176096.171, 168295.569, 170492.269, 173053.691, 179713.159, 186489.811, 195947.21, 205184.124, 214374.62,
200518.859, 214470.702, 230526.0]
print(pib)
anos = [1960, 1961, 1962, 1963, 1964, 1965, 1966, 1967, 1968, 1969, 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977,
        1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995,
        1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013,
        2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022]

plt.plot(anos, pib)
plt.show()
```



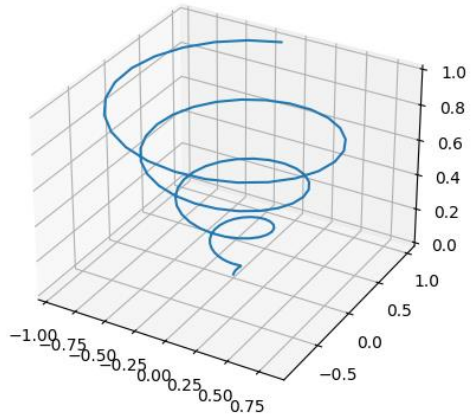
Matplotlib : 2 2D curves

```
import matplotlib.pyplot as plt

x = [0, 1, 4, 5, 10, 12, 20]
y1 = [15, 0, 20, 100, 35, 5, 50]
y2 = [30, 12, 6, 25, 70, 40, 80]
plt.plot(x, y1)
plt.plot(x, y2)
plt.show()
```



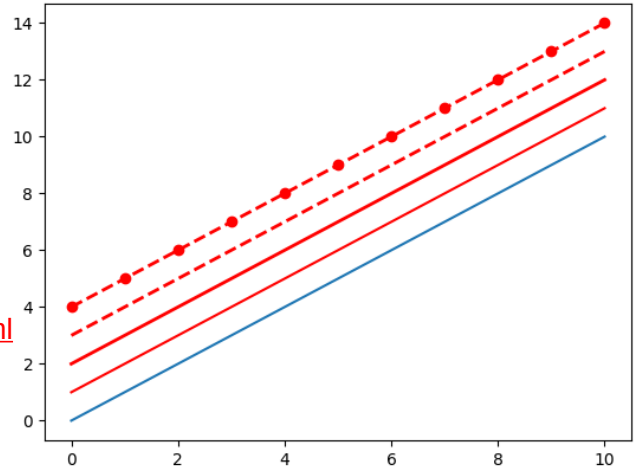
Matplotlib : 3D Curve

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

fig = plt.figure()

ax = plt.axes(projection='3d')

z = np.linspace(0, 1, 100)
x = z * np.sin(25 * z)
y = z * np.cos(25 * z)

ax.plot3D(x, y, z)
plt.show()
```



matplotlib : styles

```
import matplotlib.pyplot as plt

x = [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10]
y = x
y1 = [i + 1 for i in x]
y2 = [i + 2 for i in x]
y3 = [i + 3 for i in x]
y4 = [i + 4 for i in x]
plt.plot(x, y)
plt.plot(x, y1, color="red") # plt.plot(x, y1, c="red")
plt.plot(x, y2, c="red", linewidth=2) # plt.plot(x, y2, c="red", lw=2)
plt.plot(x, y3, c="red", lw=2, linestyle="--") # plt.plot(x, y3, c="red", lw=2, ls="--")
plt.plot(x, y4, c="red", lw=2, ls="--", marker="o")
plt.show()
```

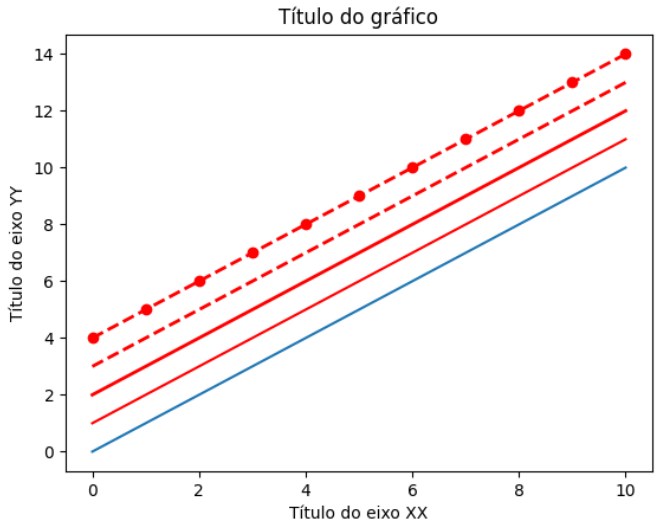


Possible values:

- color(c): https://matplotlib.org/2.0.2/api/colors_api.html
  - Ex: “ blue ”, “b”, “ red ”, “r”, “#0000ff”, “#ff0000”
- linewidth (lw): any float
  - Eg: 1, 1.5, 2
- linestyle (ls): https://matplotlib.org/stable/gallery/lines_bars_and_markers/linestyles.html
  - Ex: “--”, “ dashed ”, “:”, “ dotted ”
- marker : https://matplotlib.org/stable/api/markers_api.html
  - For example: "o", "*", "1"

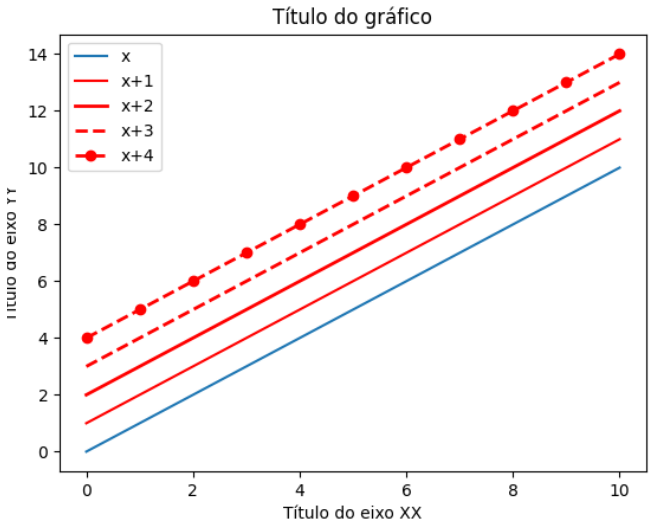
matplotlib : headings

```
import matplotlib.pyplot as plt

x = [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10]
y = x
y1 = [i + 1 for i in x]
y2 = [i + 2 for i in x]
y3 = [i + 3 for i in x]
y4 = [i + 4 for i in x]
plt.plot(x, y)
plt.plot(x, y1, color="red")
plt.plot(x, y2, c="red", linewidth=2)
plt.plot(x, y3, c="red", lw=2, linestyle=":")
plt.plot(x, y4, c="red", lw=2, ls="--", marker="o")

plt.title('Título do gráfico')
plt.xlabel('Título do eixo XX')
plt.ylabel('Título do eixo YY')

plt.show()
```



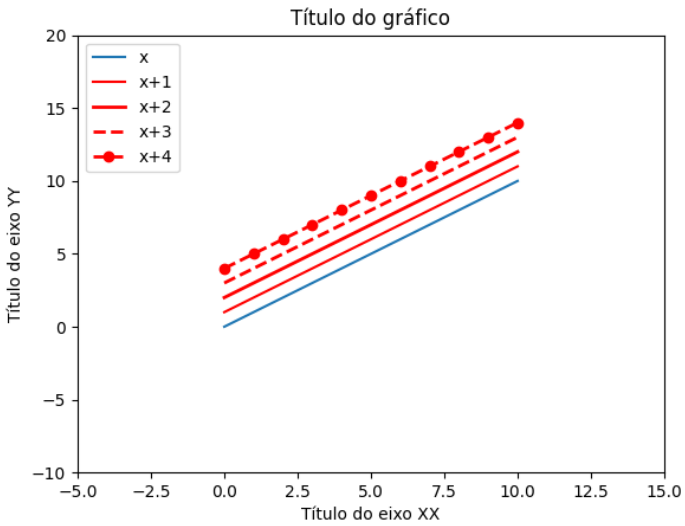
Matplotlib : subtitles

```
import matplotlib.pyplot as plt

x = [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10]
y = x
y1 = [i + 1 for i in x]
y2 = [i + 2 for i in x]
y3 = [i + 3 for i in x]
y4 = [i + 4 for i in x]
plt.plot(x, y, label="x")
plt.plot(x, y1, color="red", label="x+1")
plt.plot(x, y2, c="red", linewidth=2, label="x+2")
plt.plot(x, y3, c="red", lw=2, linestyle="--", label="x+3")
plt.plot(x, y4, c="red", lw=2, ls="--", marker="o", label="x+4")

plt.title('Título do gráfico')
plt.xlabel('Título do eixo XX')
plt.ylabel('Título do eixo YY')

plt.legend(loc='upper left')

plt.show()
```



Matplotlib : axis limits

```
import matplotlib.pyplot as plt

x = [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10]
y = x
y1 = [i + 1 for i in x]
y2 = [i + 2 for i in x]
y3 = [i + 3 for i in x]
y4 = [i + 4 for i in x]
plt.plot(x, y, label="x")
plt.plot(x, y1, color="red", label="x+1")
plt.plot(x, y2, c="red", linewidth=2, label="x+2")
plt.plot(x, y3, c="red", lw=2, linestyle="--", label="x+3")
plt.plot(x, y4, c="red", lw=2, ls="--", marker="o", label="x+4")

plt.title('Título do gráfico')
plt.xlabel('Título do eixo XX')
plt.ylabel('Título do eixo YY')

plt.legend(loc='upper left')

plt.xlim([-5,15])
plt.ylim([-10,20])

plt.show()
```

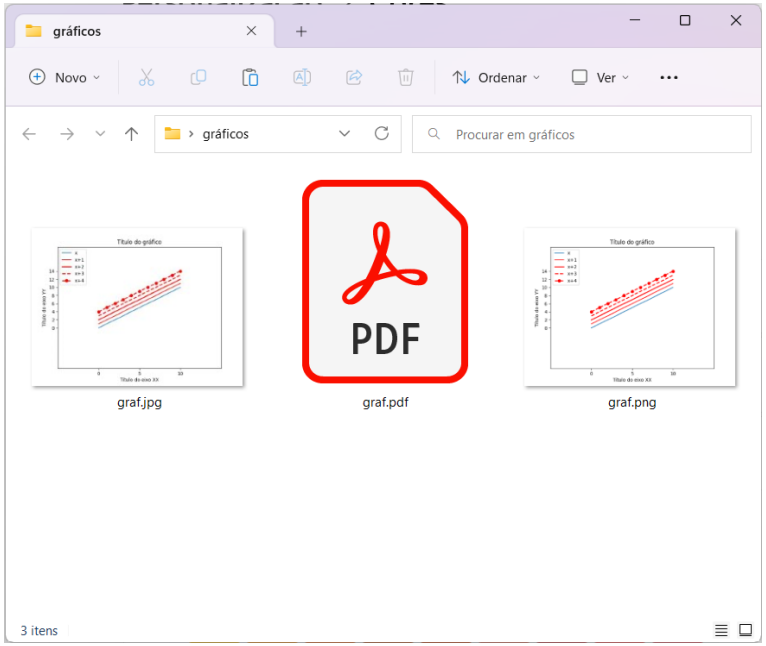


Matplotlib : axis marks/ranges

```
import matplotlib.pyplot as plt

x = [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10]
y = x
y1 = [i + 1 for i in x]
y2 = [i + 2 for i in x]
y3 = [i + 3 for i in x]
y4 = [i + 4 for i in x]
plt.plot(x, y, label="x")
plt.plot(x, y1, color="red", label="x+1")
plt.plot(x, y2, c="red", linewidth=2, label="x+2")
plt.plot(x, y3, c="red", lw=2, linestyle="--", label="x+3")
plt.plot(x, y4, c="red", lw=2, ls="--", marker="o", label="x+4")

plt.title('Título do gráfico')
plt.xlabel('Título do eixo XX')
plt.ylabel('Título do eixo YY')

plt.legend(loc='upper left')

plt.xlim([-5,15])
plt.ylim([-10,20])

plt.xticks([0, 5, 10])
plt.yticks([0, 2, 4, 6, 8, 10, 12, 14])

plt.show()
```

matplotlib : save

```python
import matplotlib.pyplot as plt

x = [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10]
y = x
y1 = [i + 1 for i in x]
y2 = [i + 2 for i in x]
y3 = [i + 3 for i in x]
y4 = [i + 4 for i in x]
plt.plot(x, y, label="x")
plt.plot(x, y1, color="red", label="x+1")
plt.plot(x, y2, c="red", linewidth=2, label="x+2")
plt.plot(x, y3, c="red", lw=2, linestyle="--", label="x+3")
plt.plot(x, y4, c="red", lw=2, ls="--", marker="o", label="x+4")

plt.title('Título do gráfico')
plt.xlabel('Título do eixo XX')
plt.ylabel('Título do eixo YY')

plt.legend(loc='upper left')

plt.xlim([-5,15])
plt.ylim([-10,20])

plt.xticks([0, 5, 10])
plt.yticks([0, 2, 4, 6, 8, 10, 12, 14])

plt.savefig("graf/graf.png")
plt.savefig("graf/graf.jpg")
plt.savefig("graf/graf.pdf")
```



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Do conhecimento à prática.