Data Visualization

Agenda

1. Google Sheets Charts
2. Python Matplotlib
3. Questions

Google Sheets Charts

All Google Sheets Materials are on GitHub

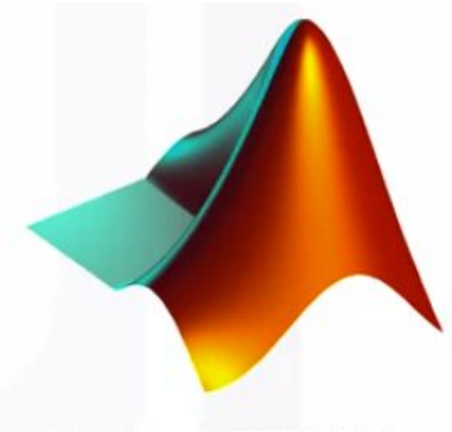
1. Source Excel Files
2. Steps in PDF Files
3. Solution Links

Python Matplotlib

John Hunter (Matplotlib Creator)

- Neurobiologist
- Part of a team analyzing **Electrocorticography Signals (ECoG)**
  - **Electrocorticography** is the process of recording electrical activity in the brain

- The team
  - used a proprietary software (**MATLAB** based version) for analysis
  - had only one license and were taking turns in using it

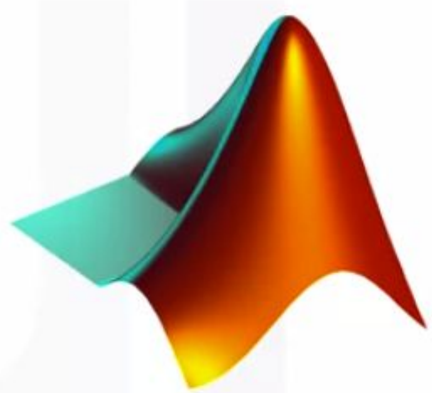


- **John** replace the proprietary software with **Matplotlib**

Python Matplotlib

- MatLab-style Plotting Library (Created in 2002)
- Originally developed as an **ECoG** visualization tool
- Most popular data visualization library in Python
- Well supported in different environments
  - Python scripts
  - web app servers
  - iPython (Interactive shell)
  - **Jupyter Notebook**

EEG/ECoG Visualization Tool



Analogous to Matlab scripting interface

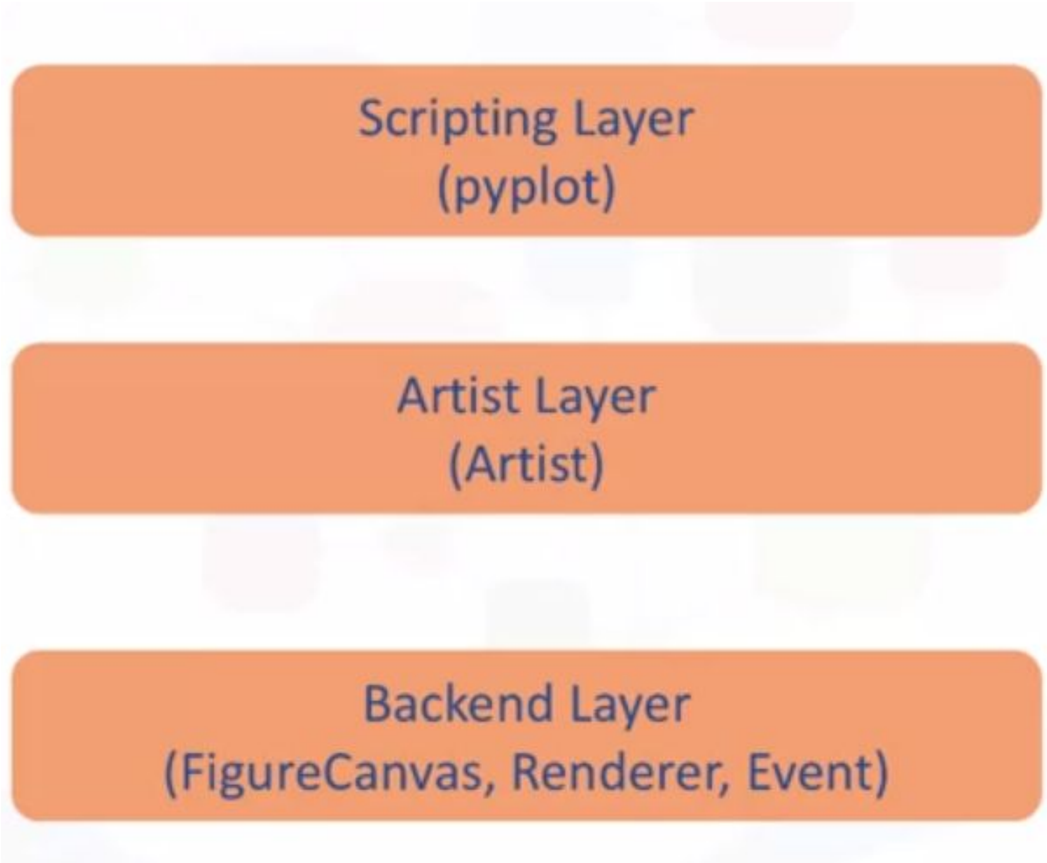
Jupyter Notebook

- open source web app
- allows to create & share documents that contain code and text
- spun off from **iPython** in **2014**

- **Jupyter name** is a reference to three programming languages:
  - **Ju**lia
  - **Pyt**hon
  - **R**
- **Jupyter logo**
  - homage to **Galileo**'s discovery of the **moons of Jupiter**
  - documented in **notebooks** attributed to **Galileo**

Matplotlib Architecture

1. **`Back-end Layer`**
2. **`Artist Layer`**
    - appropriate programming paradigm for
        - web app server
        - UI app
        - script to be shared with others
3. **`Scripting Layer`** (idea from MATLAB)
    - appropriate layer for everyday purposes
    - lighter interface to simplify common tasks
    - for a quick and easy generation of plots



Matplotlib Architecture: 1) Back-end Layer

has built-in classes, such as:

1. **FigureCanvas:** *matplotlib.backend_bases.FigureCanvasBase*
   - defines and encompasses the area into which the figure is drawn

2. **Renderer:** *matplotlib.backend_bases.RendererBase*
   - knows how to draw (generate image) on the **FigureCanvas**

3. **Event:** *matplotlib.backend_bases.Event*
   - handles user inputs such as keyboard strokes and mouse clicks

- https://github.dev/matplotlib/matplotlib/blob/main/lib/matplotlib/backend_bases.py
- https://github.dev/matplotlib/matplotlib/blob/main/lib/matplotlib/backends/backend_agg.py

Matplotlib Architecture: 2) Artist Layer

- Contains one main abstract class (the **Artist**)

- **Artist**
  - knows how to use the **Renderer** to draw (put ink) on the **FigureCanvas**
  - https://github.dev/matplotlib/matplotlib/blob/main/lib/matplotlib/artist.pyi

- Everything you see on a **Matplotlib figure** is an **Artist instance**
  - **Example**: title, lines, tick labels, images, …
  - all of them correspond to an individual **Artist instance**

Matplotlib Architecture: 2) Artist Layer Types

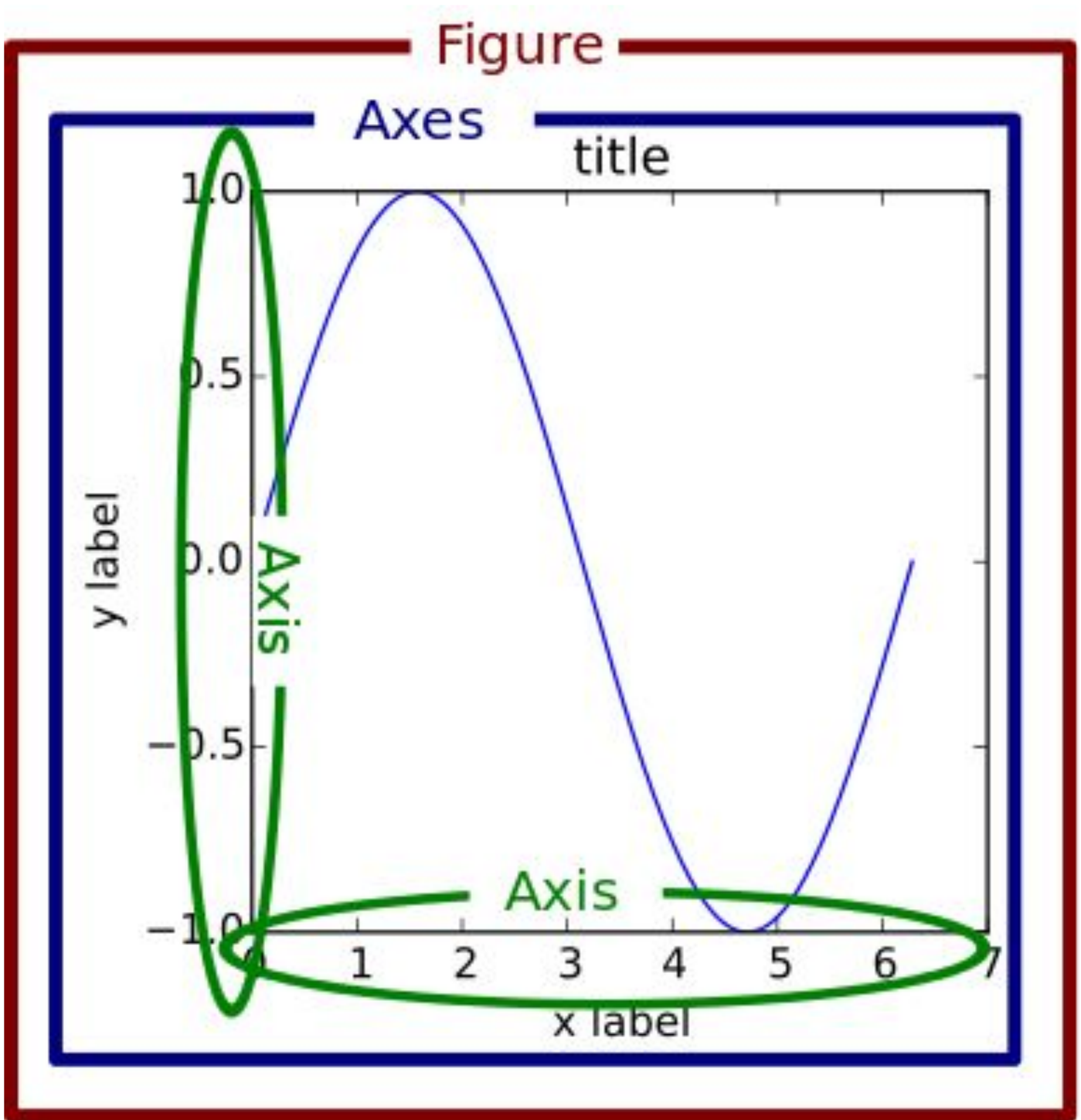
1. **Primitive Artist**: as Line, Rectangle, Circle, Text

2. **Composite Artist:** may contain other **Artists**
    - **Example 1: Figure Artist** https://github.dev/matplotlib/matplotlib/blob/main/lib/matplotlib/figure.py
        - top-level Matplotlib object
        - contains and manages all of the elements in a given graphic
    - **Example 2: Axes Artist** https://github.dev/matplotlib/matplotlib/blob/main/lib/matplotlib/axes/_axes.py
        - most important Composite Artist
        - where most of the plotting methods are defined
            - including methods to create/manipulate ticks, axis lines, grid, background
    - **Other Examples: Tick Artist**

Axes

- The plotting area
  - including all axis
  - don’t mean plural of **Axis**

- When pronounced with short e
  - axes is the plural of axe
- When pronounced with long e
  - axes is the plural of axis



Matplotlib Architecture: 3) Scripting Layer

- Developed for scientists who are not professional programmers

- Essentially the **Matplotlib.pyplot** that automates:
  - defining **FigureCanvas**
  - defining **Artist**
  - connecting **Artist** with **FigureCanvas**
  - https://github.dev/matplotlib/matplotlib/blob/main/lib/matplotlib/pyplot.py

- Comparing with **Layer 2 (Artist Layer)** which is:
  - heavy and for developers
  - not for individuals who want to perform **quick EDA** of some data

Questions

Links

https://github.com/fcai-b/dv

References

1. https://www.coursera.org/learn/foundations-data
2. https://www.coursera.org/learn/what-is-datascience
3. https://www.coursera.org/learn/python-for-data-visualization
4. https://www.coursera.org/learn/google-sheets---advanced-topics