Unit 5:
Machine Learning

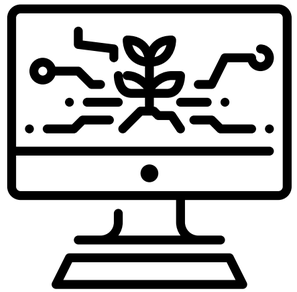
Agenda

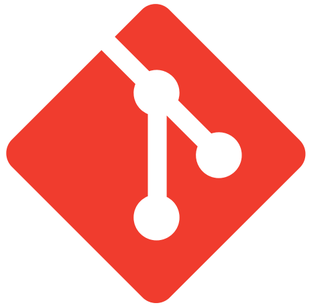
- **Review** Git & GitHub, Python Environments
- **Undertanding** Streamlit
- Streamit Basic **Syntax**
- **Customizing** Streamlit Layout
- **Hands-On** Examples & Use Cases
- **Recap** on Data Viz

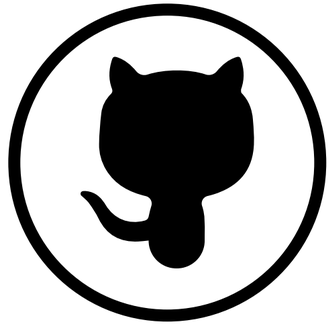
Introduction to Streamlit

Recap: Environments, Git & GitHub

- Use **virtual environments** to manage dependencies and avoid conflicts.
- **Git** tracks code changes & version control.
- Common commands:
  - git init
  - git status
  - git add
  - git commit -m "msg"
  - git push origin main
- Connect **GitHub**: git remote add origin <repo_url> → git push -u origin main
  - Pull latest updates: git pull origin main







Introduction to Streamlit

What is Streamlit?

- **Streamlit** is an open-source Python library that converts data scripts into shareable web apps with minimal code.
- It allows data scientists to build **interactive applications** in pure Python without needing front-end skills.
- Other frameworks: Dash (complex UI interactions & multi-page apps), Flask (to build an API or backend for web app), Django (full-stack)

Streamlit

1 **Rapid Prototyping**

2 **Python-Centric**

3 **Growing Ecosystem**

Steps

Install Streamlit

Run **pip install streamlit** in your terminal to install the package.

Create Your First App

Create a Python file and add your Streamlit code.

Run Your App

Execute **streamlit run main.py** to launch your web application.

Streamlit Basics

Basic Syntax

```python
import streamlit as st

st.write('Hello, world!') # Basic body text
hello = st.write('Hello, world (as variable)!')
print(hello) # Display the variable hello
```

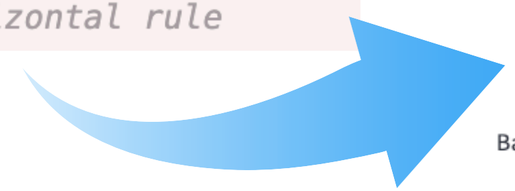
Hello, world!

Hello, world (as variable)!

Text Display

Streamlit provides multiple ways to display text, including **titles**, **headers**, **markdown**, and **LaTeX**.

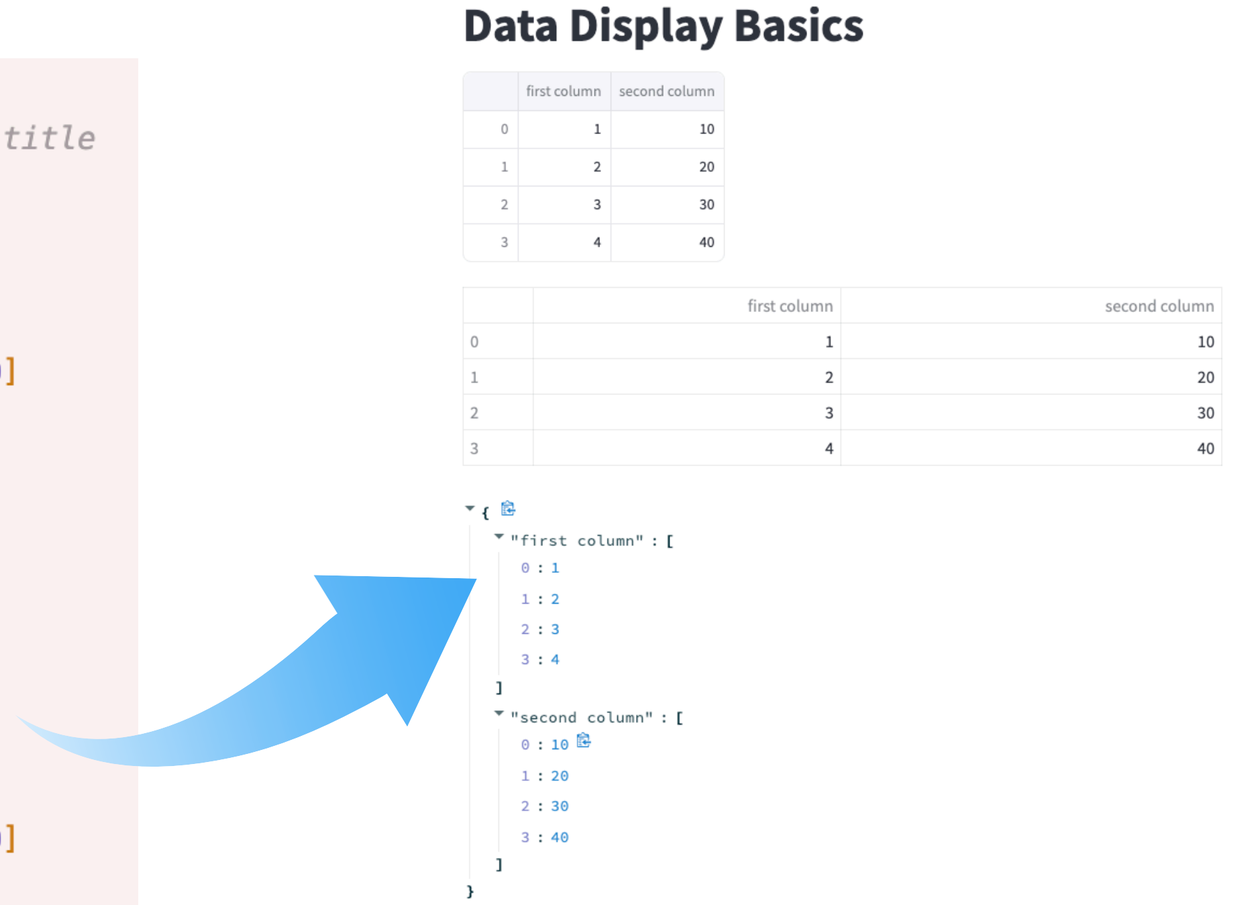
```
11  ### Text Display ###
12  st.title('Text Display Basics') # title
13  st.header('Header') # Larger text
14  st.subheader('Subheader') # Smaller text
15  st.code('print("Hello, world!")') # Code block
16  st.markdown('**Markdown**') # Markdown
17  st.latex(r'\int_a^b f(x) dx') # LaTeX
18  st.write("Basic Text") # Horizontal rule
```



Data Display

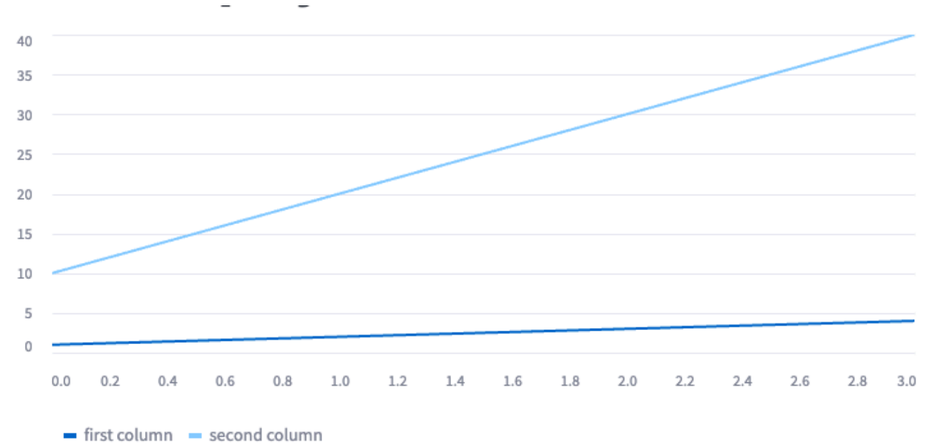
Streamlit makes it easy to display tables and structured data from **Pandas** and **JSON**.

```python
### Data Display ###
st.title('Data Display Basics') # title

# DataFrames (interactive)
df = pd.DataFrame({
    'first column': [1, 2, 3, 4],
    'second column': [10, 20, 30, 40]
})
st.dataframe(df)

# DataFrames (non-interactive)
st.table(df)

# JSON
st.json({
    'first column': [1, 2, 3, 4],
    'second column': [10, 20, 30, 40]
})
```

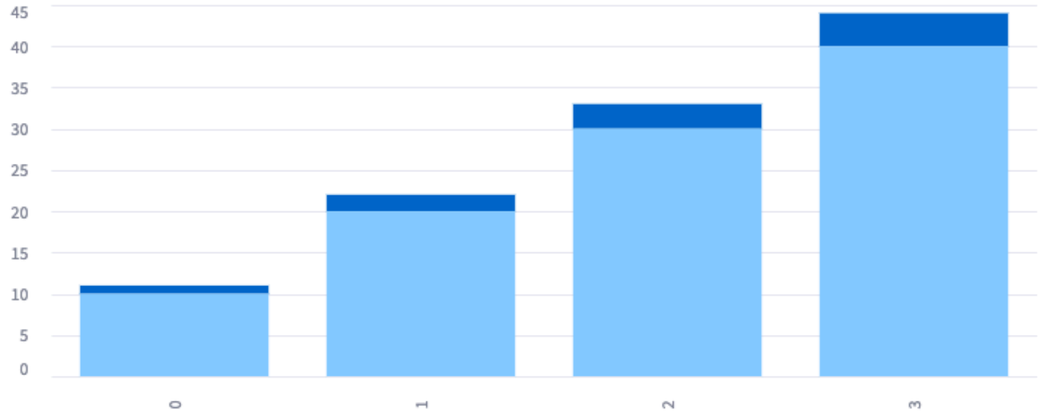


Data Display II: Built-In Viz

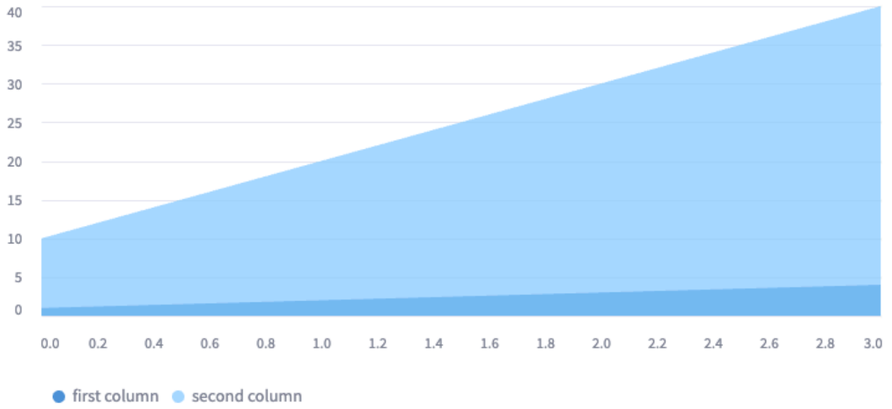
Streamlit offers built-in plotting functions for quick visualizations:



1 **st.line_chart()**



2 **bar_chart()**



3 **st.area_chart()**

Data Display III: Using Viz Libraries

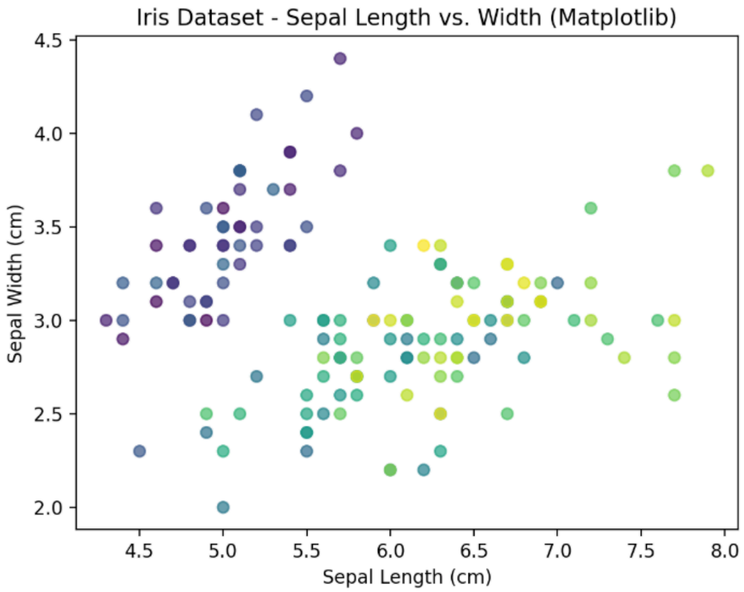
Streamlit supports external visualization libraries for more customization.

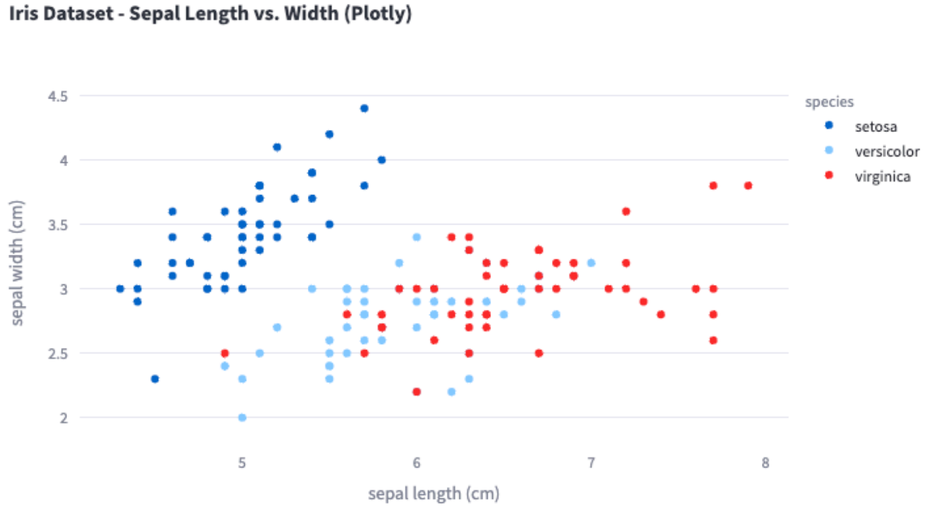
Matplotlib

Create Matplotlib figures in your normal workflow, then display with **st.pyplot(fig)**.

Plotly

Build interactive Plotly charts and render them with **st.plotly_chart(fig)**.

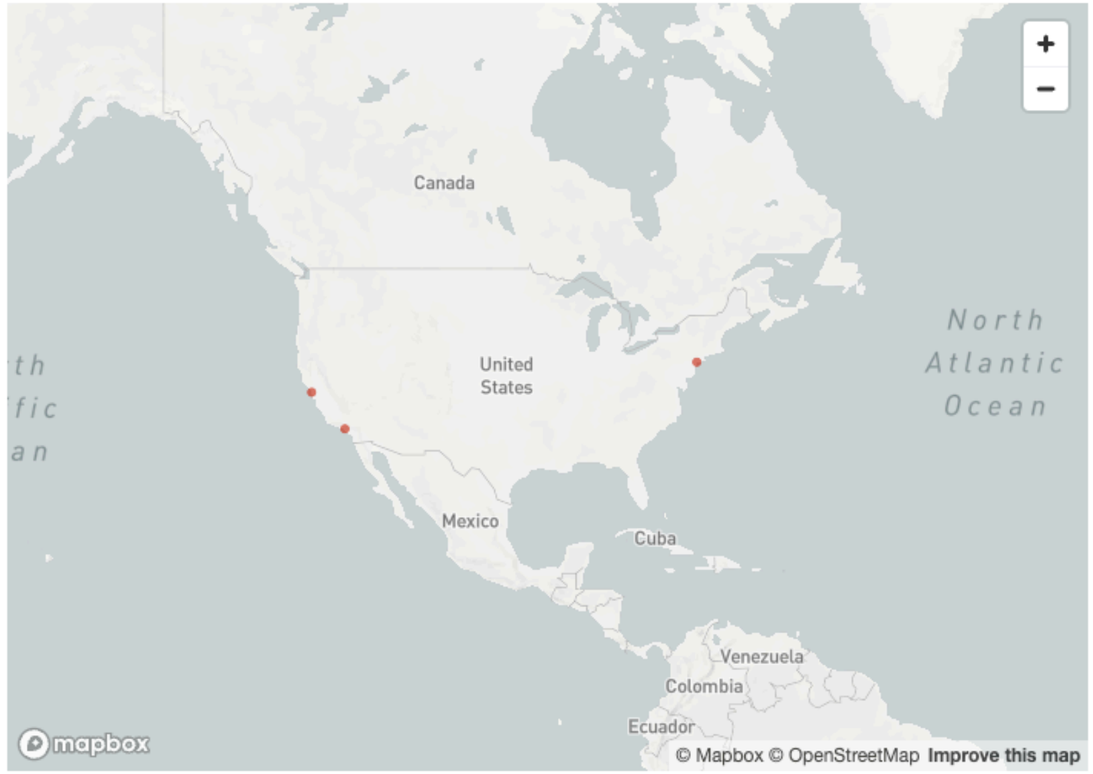




Data Display IV: Maps and Geospacial Data

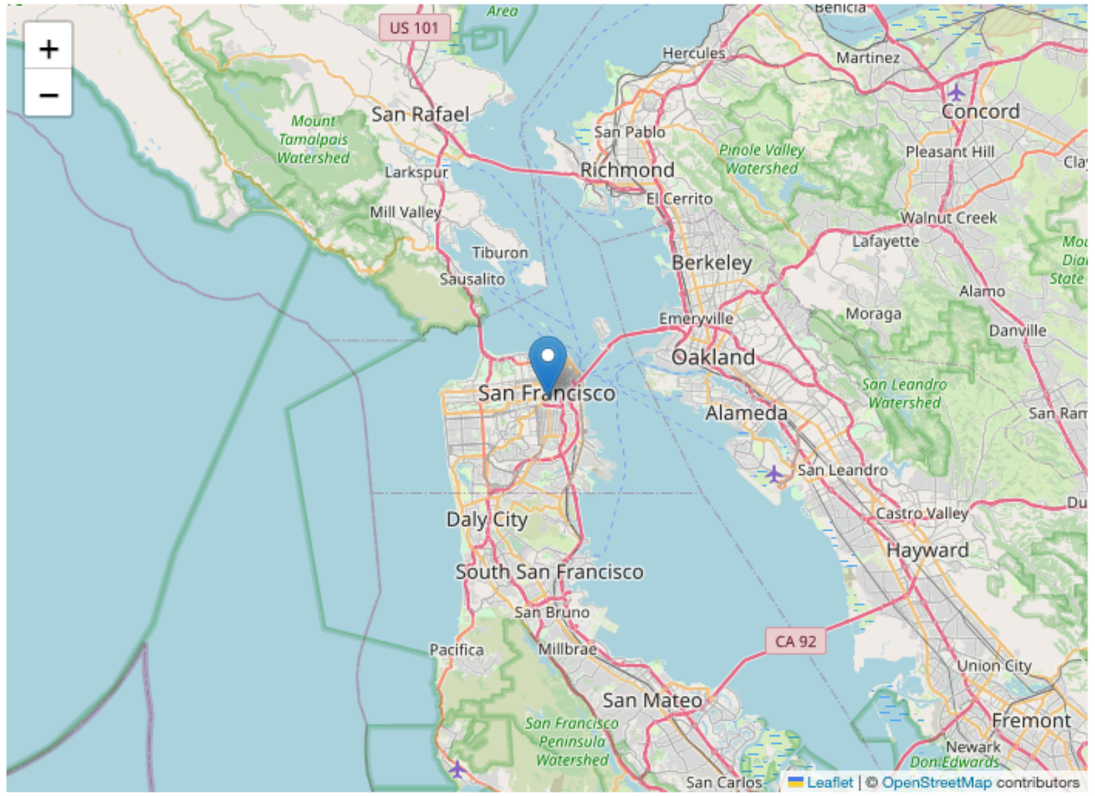
Basic Maps

Display geographic data using **st.map(data)** with a DataFrame containing lat/lon columns.



Custom Maps

Create advanced maps using Folium, Pydeck...



Streamlit Components

Data Display IV: Maps and Geospacial Data

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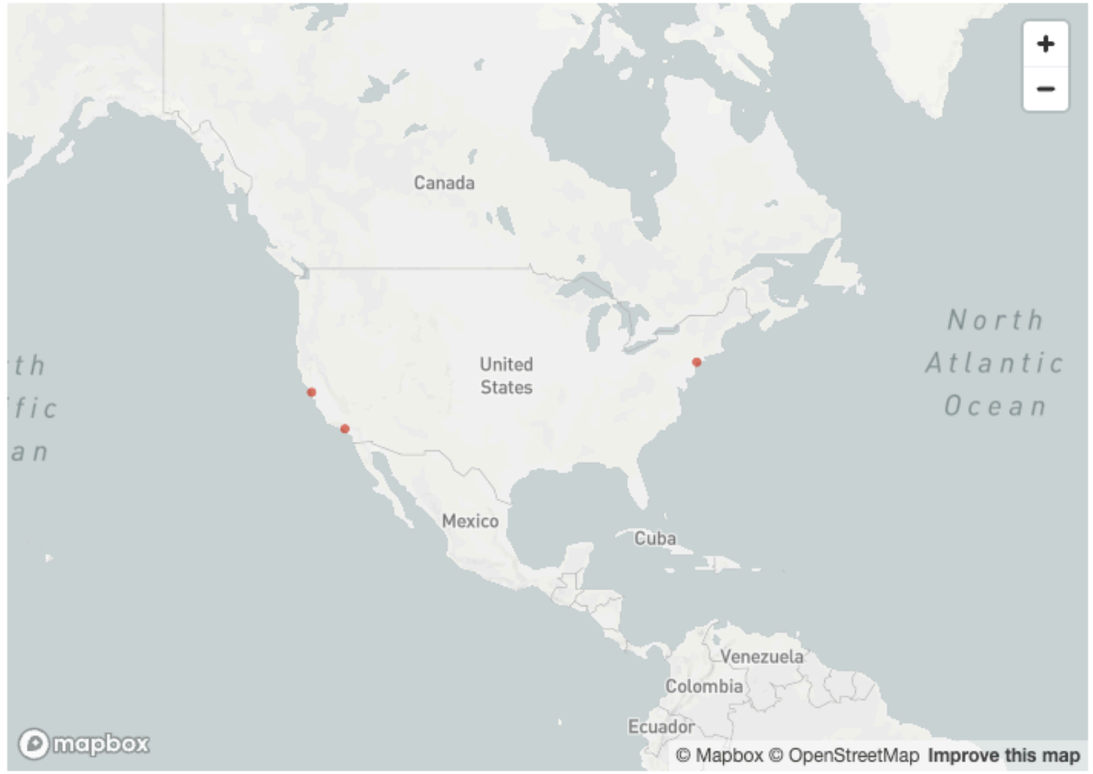

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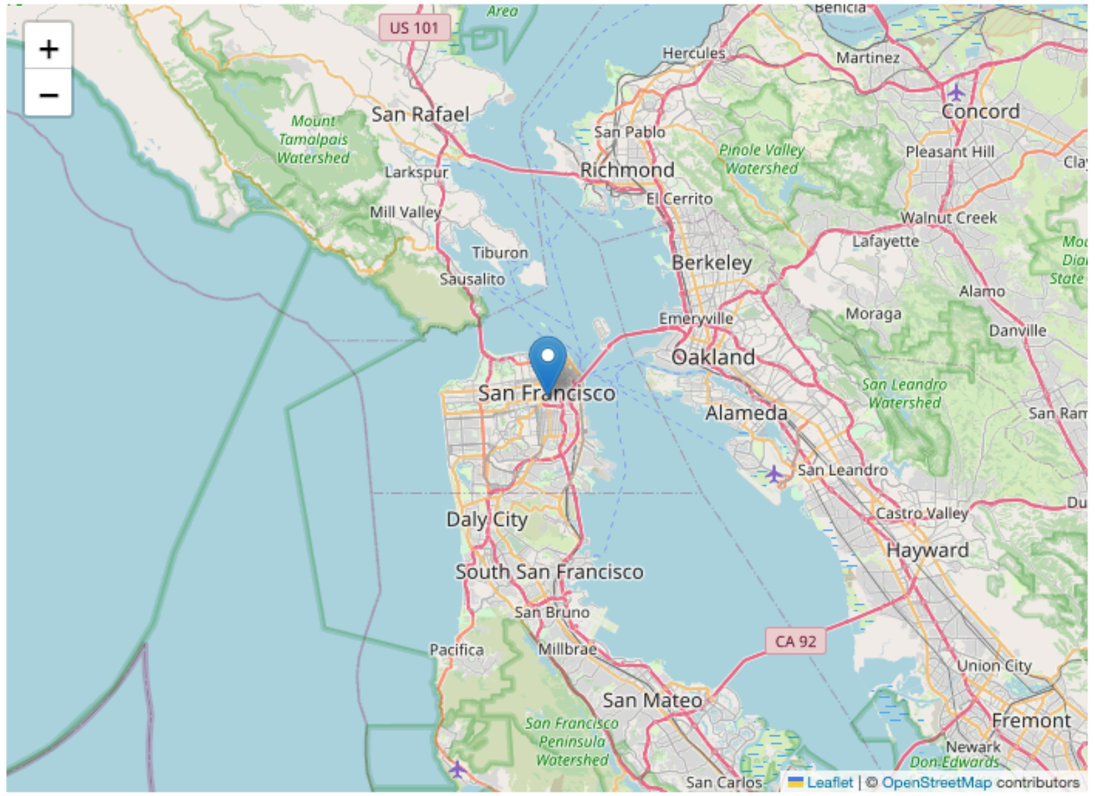


Media Elements: Images, Audio, Video

Streamlit supports multimedia elements for better user engagement.

Images

Display images with **st.image()**. Support for local files, URLs, and NumPy arrays.

Sample Image

Audio

Play audio files with **st.audio()**. Supports most common audio formats.

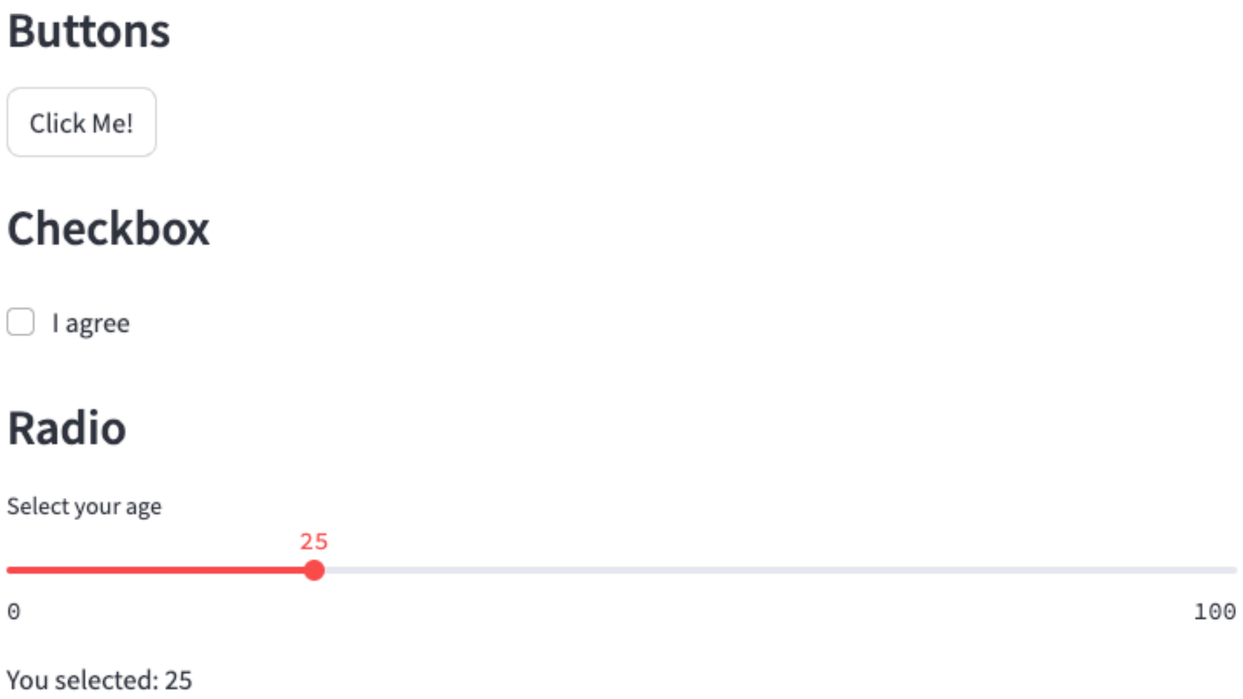
0:00 / 0:00

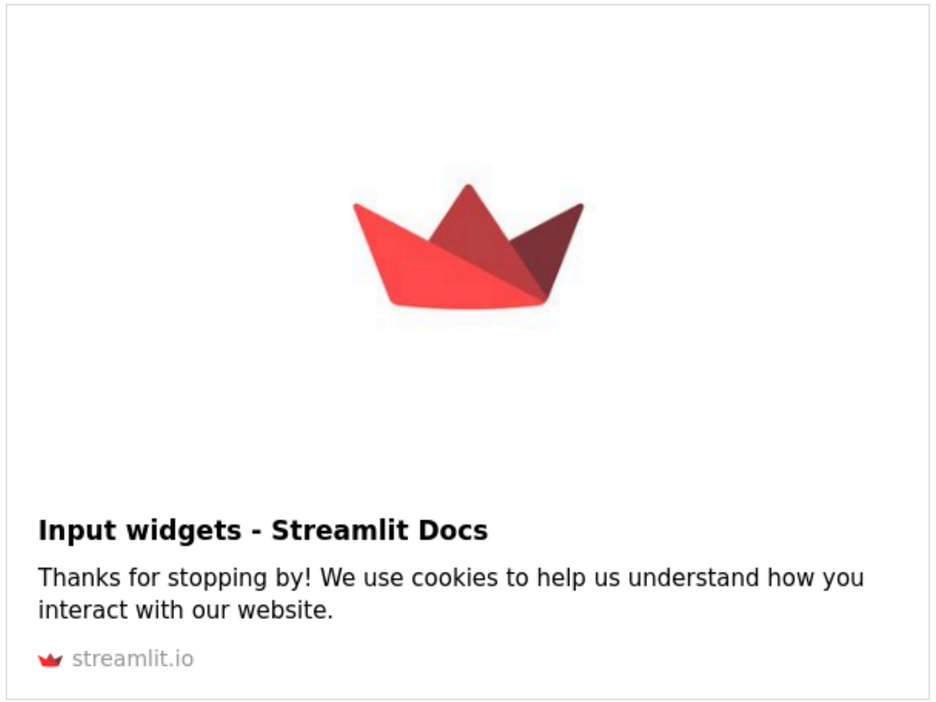
Video

Embed videos with **st.video()**. Works with files, URLs, and YouTube links.

Widgets & User Interactions

- Widgets allow users to interact with the app dynamically.
- Includes buttons, checkboxes, sliders, text inputs, and more.

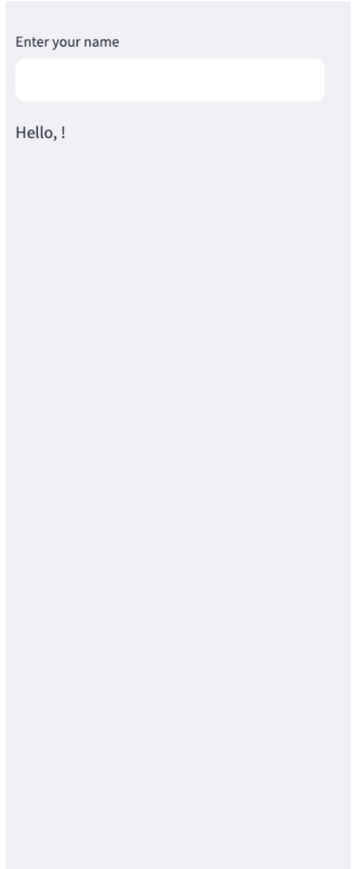


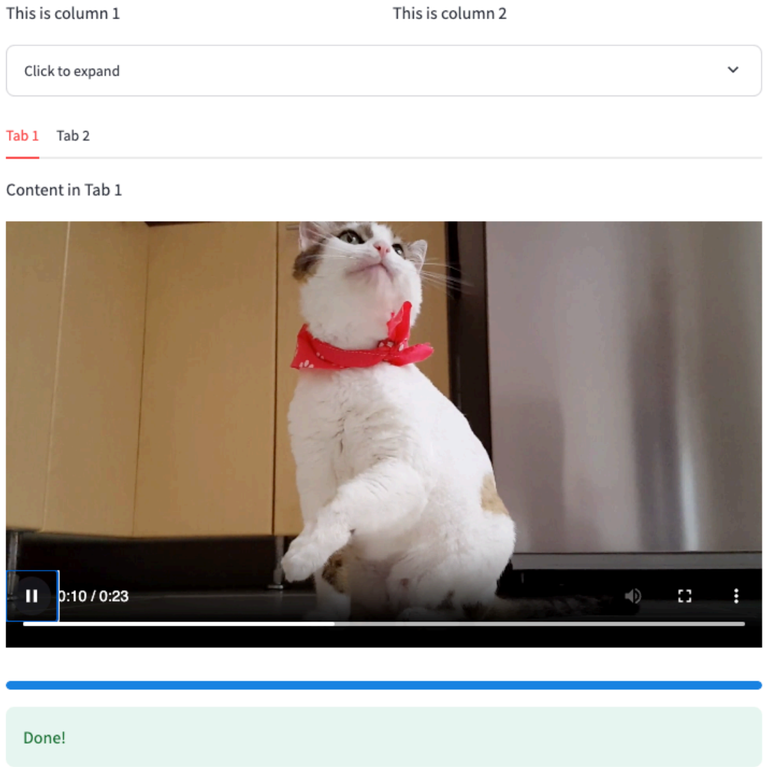


Streamlit Layout

Introduction to Layouts

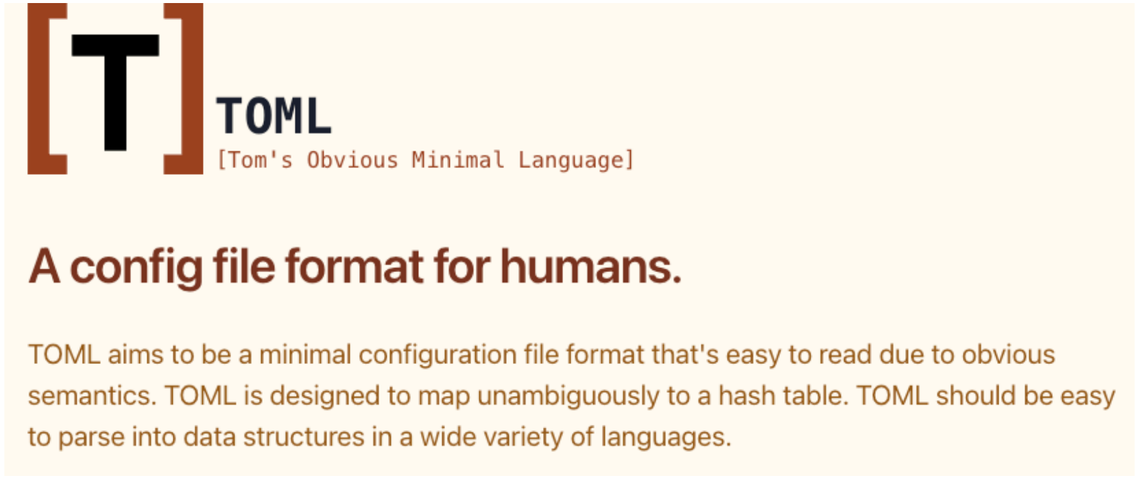
- Use columns, sidebars, tabs, and expanders to organize content.
- Use progress bars and status messages for better UX.





config.toml

- Streamlit allows theme customization through config.toml.

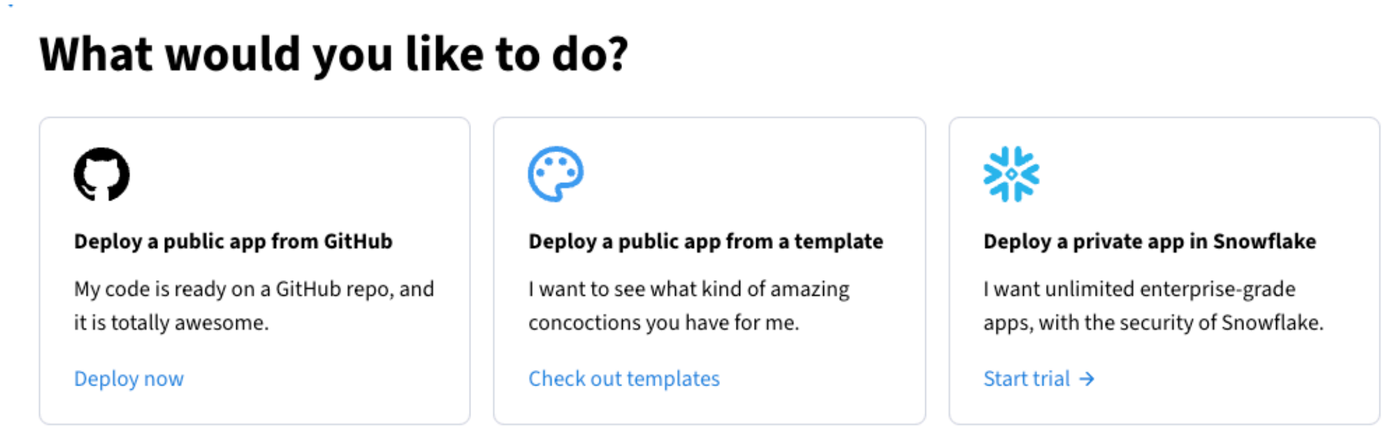



```
[theme]
primaryColor = "#FF4B4B"
backgroundColor = "#FFFFFF"
secondaryBackgroundColor = "#F0F2F6"
textColor = "#262730"
```

Streamlit Deployment

Deployment in Streamlit Cloud

1️⃣ Push your script to GitHub
2️⃣ Go to Streamlit Cloud
3️⃣ Connect GitHub repo & deploy
4️⃣ Share the public URL



Best Practices. When to use Streamlit?

- Model Testing & Debugging (ML & AI Prototyping).
- Fast Dashboards & Real-Time Data Apps
- Interactive Data Exploration & EDA (Exploratory Data Analysis)
- Deployment of Interactive Reports
- Real-Time Monitoring & Alerting

❌ When **NOT** to Use Streamlit

- For large-scale web apps – Streamlit isn't Flask or Django.
- For complex authentication – It lacks built-in user management.
- For performance-heavy tasks – Large datasets can slow down Streamlit if not optimized.
- For multi-user collaboration in real-time
- Streamlit is not designed for multi-user sessions like Dash or Shiny.

Recap Data Viz

Basics of Data Viz

https://www.data-to-viz.com

Univariate Analysis (Single Variable)

- **Categorical Data**: Use bar charts (value_counts(), st.bar_chart()) or pie charts to show frequency.
- **Numerical Data**: Use histograms (plt.hist(), st.hist_chart()) for distribution or box plots to detect outliers.

Bivariate Analysis (Two Variables)

- **Categorical vs. Categorical**: Use stacked bar charts or heatmaps (pd.crosstab()).
- **Numerical vs. Numerical**: Use scatter plots (plt.scatter(), st.scatter_chart()) to see relationships or correlation heatmaps.
- **Categorical vs. Numerical**: Use box plots (sns.boxplot()) to compare distributions across categories.

Type of Variables (VS)	Method/Technique	One-Line Description
Categorical (incl. Discrete numerical) VS Categorical	Crosstab	A **table** showing the **frequency** of occurrences for combinations of two categorical variables.
	Chi-square tests	Tests the **independence** of two categorical variables by comparing observed frequencies to expected frequencies.
	Cramér's V	Measures the **strength** of **association** between two categorical variables.
	Stacked or grouped bar charts	**Visualizes** the **frequency** or proportion of categories between two categorical variables.
	Frequency heat maps	Displays **frequencies** using **color** gradients for combinations of two categorical variables.
Categorical VS Continuous	Violin Plots	Combines a box plot with a kernel density plot to show the **distribution** of a continuous variable for **each category.**
	Bar Charts	Shows the **mean** (or another measure of central tendency) of the continuous variable for **each category**.
	Side by side Box Plots	Displays the **distribution** of the continuous variable for each category, showing **quartiles** and potential **outliers**.
Continuous VS Continuous	Correlation coefficients, Covariance	Quantifies the **strength** and **direction** of the relationship between two continuous variables.
	Regression analysis, Coefficient of Determination	Describes the **relationship** between two continuous variables and measures how well the regression line fits the data.
	Scatter plots	Plots individual **data points** based on their values for two continuous variables to **visualize relationships**.
	Line plots	**Connects** individual **data points with lines**, typically used to represent sequences or **time series** data.
	Correlation Heatmaps	**Visualizes correlation** coefficients between pairs of continuous variables using color gradients.
	QQ Plot	Compares the **quantiles** of a variable's distribution to the quantiles of a **standard normal distribution**.

Thank you