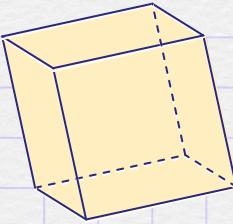
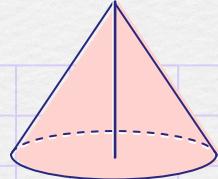


$$V = s^3$$



$$V = \frac{1}{3} Bh$$

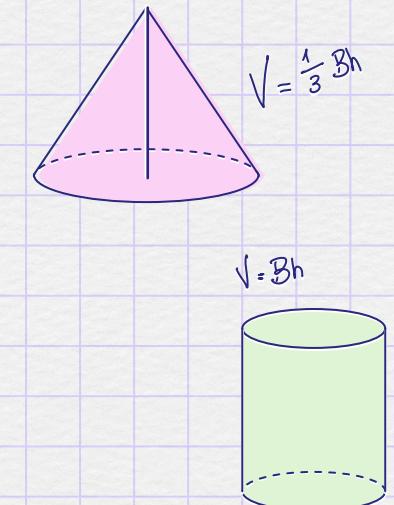
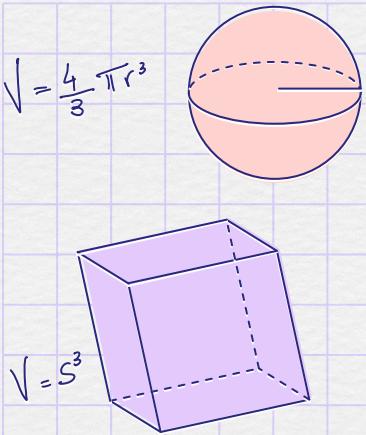


# Equation to Animation: Crafting Dynamic Math Visuals on the Web

Slides



<https://bit.ly/codemash2025-math-precompiler>



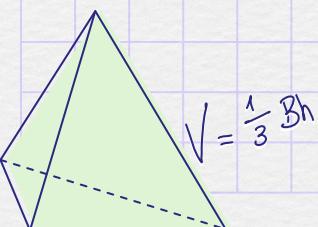
# Courtney Yatteau

Developer Advocate at Esri

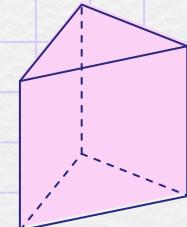


# Workshop Goals

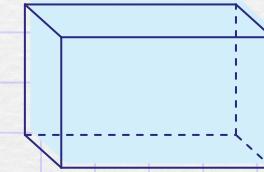
- Understand data visualization basics
- Master key libraries
- Build interactive visuals
- Integrate geospatial elements
- Apply concepts in real projects



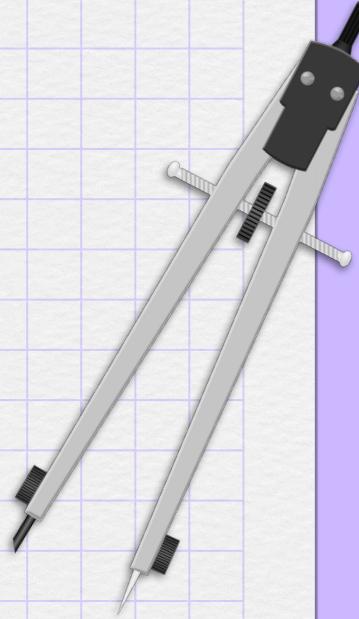
$$V = \frac{1}{3} Bh$$

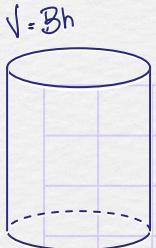


$$V = Bh$$



$$V = wh$$





# Agenda

## 1. Introduction

Goals & value of data visualization.

## 2. Tools & Setup

Overview of D3.js, Chart.js, and environment setup.

## 3. Chart.js

Building basic charts and graphs.

## 4. D3.js

Creating customizable and unique charts and graphs.

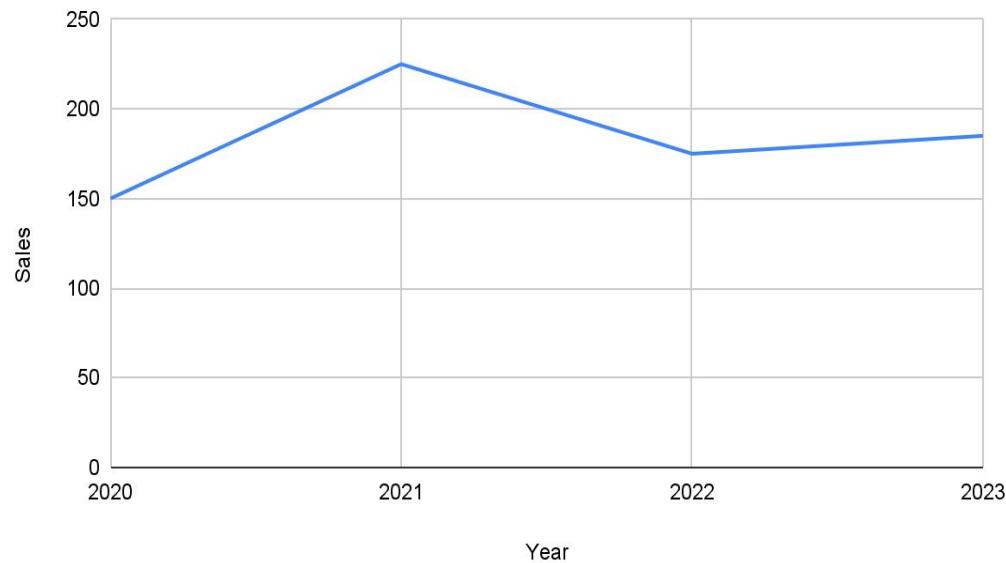
## 5. Wrap-Up

Key takeaways and Q&A.

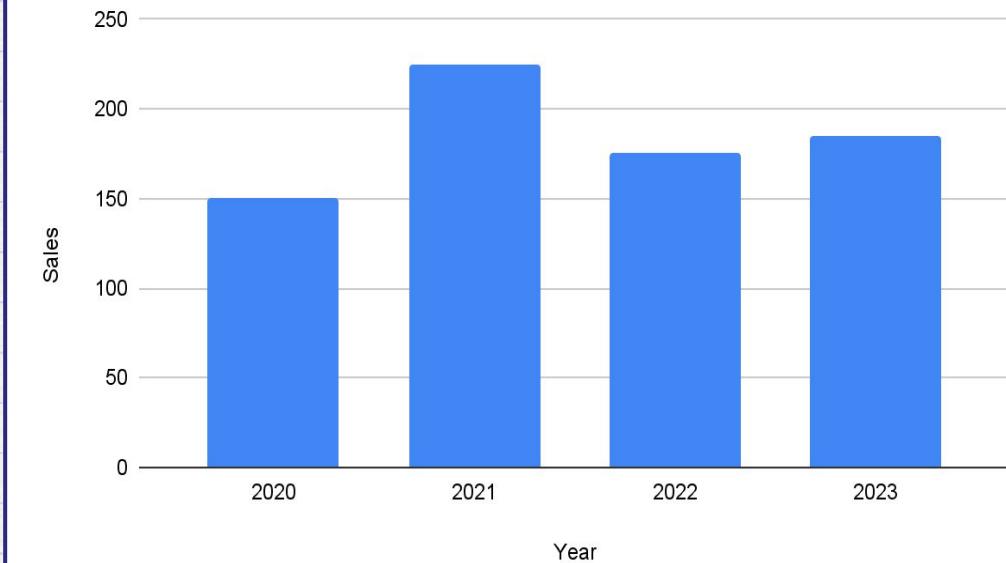


# Why Data Visualization?

Sales vs. Year



Sales vs. Year



Year	2020	2021	2022	2023
Sales	150	225	175	185

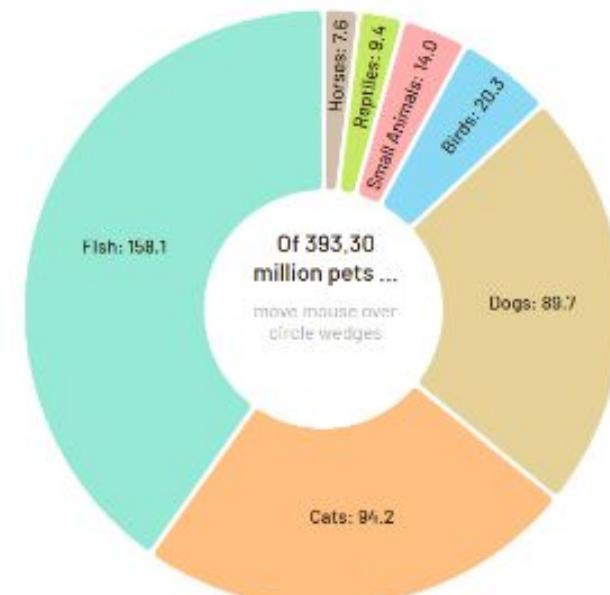
# Interactivity

## Pet Ownership in the U.S. – 2017

source: americanpetproducts.org

### Number of Pets: (millions)

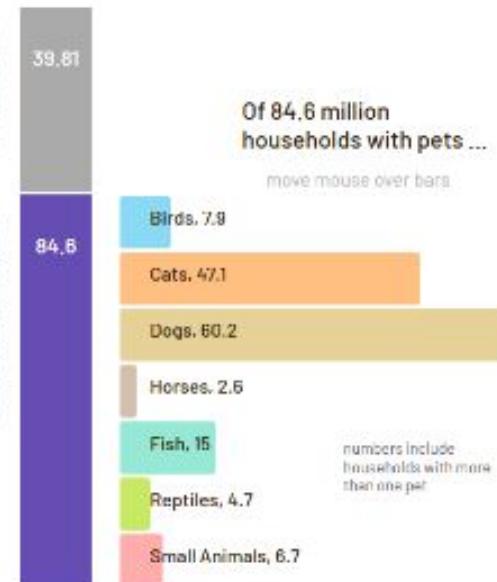
- lowest to highest number
- alphabetical



Of 393,30  
million pets ...  
move mouse over  
circle wedges.

### Number of Households: (millions)

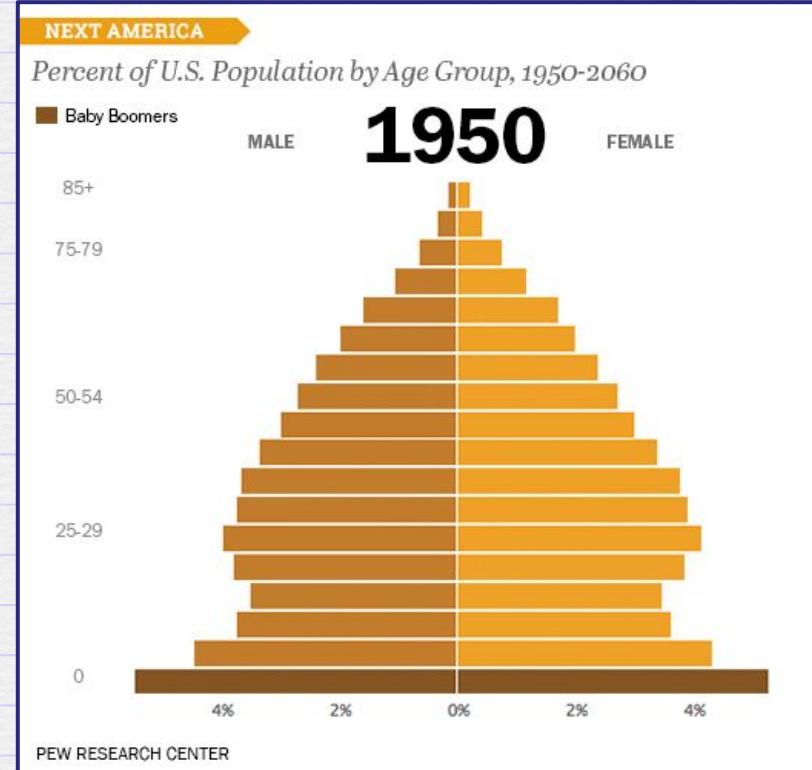
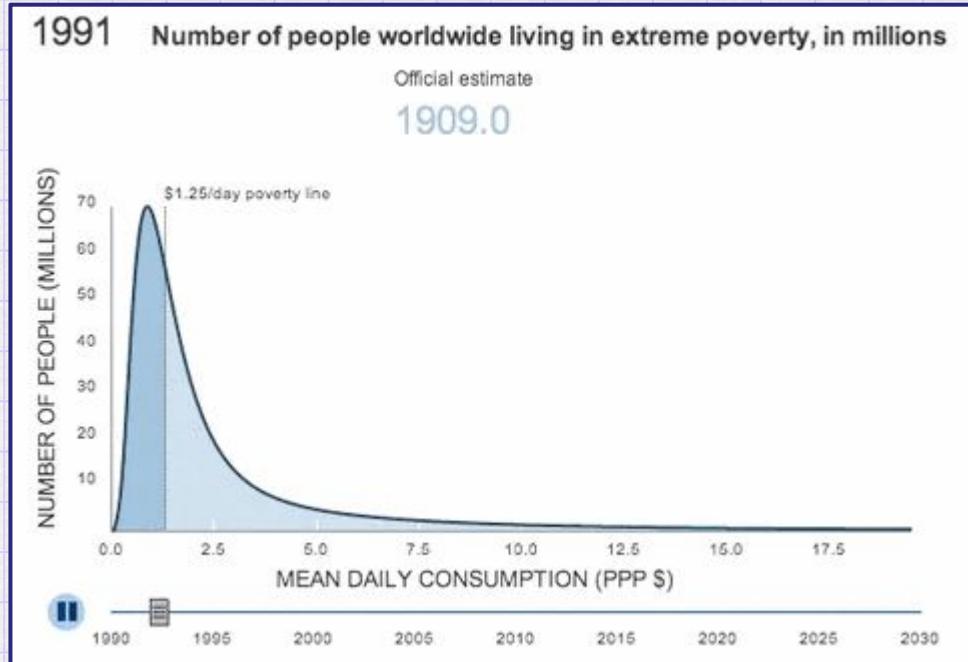
households without pets      households with pets



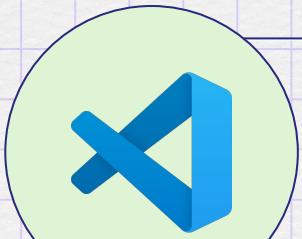
Of 84.6 million  
households with pets ...  
move mouse over bars.

numbers include  
households with more  
than one pet

# Real-World Examples



# Tools & Setup



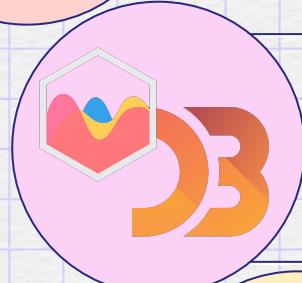
Visual  
Studio Code

Install [here](#).



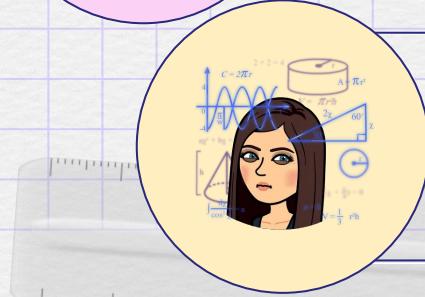
VS Code  
Extensions

Live Server - install [here](#)  
Prettier - install [here](#)



CDN Links for  
JS Libraries

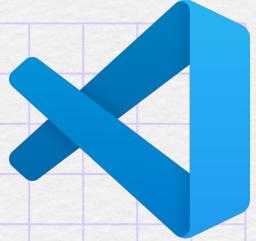
```
<script src="https://cdn.jsdelivr.net/npm/chart.js@4.4.7/dist/chart.umd.min.js"></script>
<script src="https://cdn.jsdelivr.net/npm/d3@7.9.0/dist/d3.min.js"></script>
```



Workshop  
Modules Site

Sign up [here](#)

# Visual Studio Code Setup

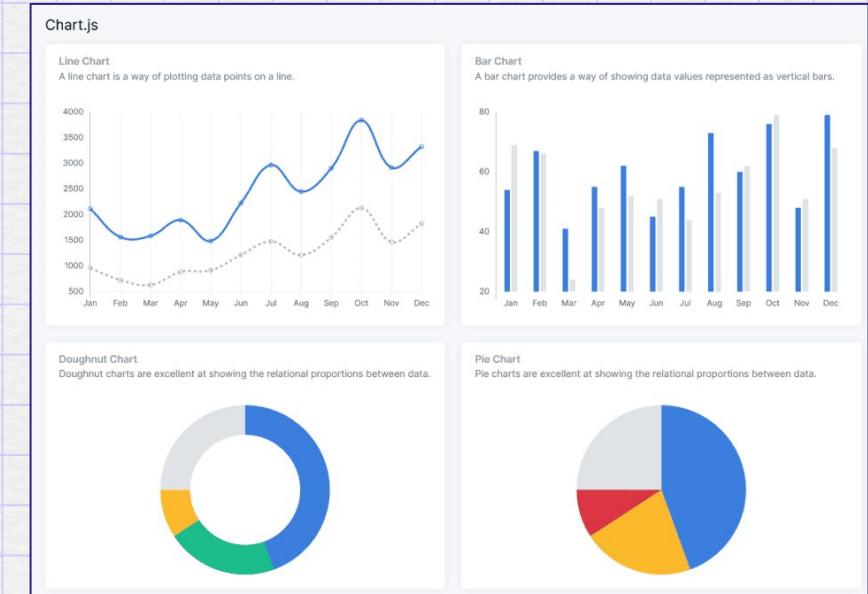


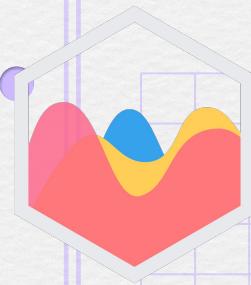
- Stepup: HTML file shortcut (! + Enter)
- Test out Extensions
  - Prettier
  - Live Server



# What is Chart.js

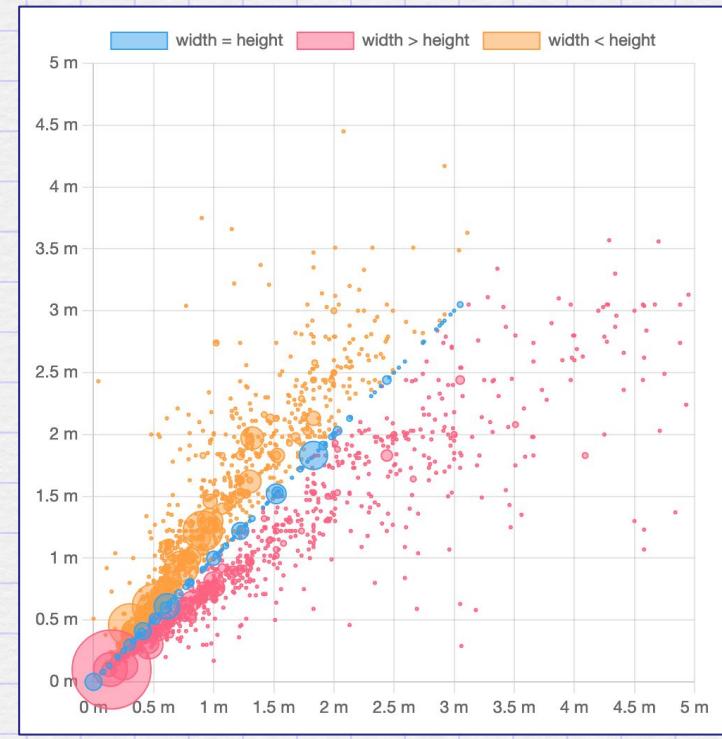
- **Chart.js:** A simple, easy-to-use JS library for interactive charts.
- **Supported Chart Types:** Area, Bar, Bubble, Doughnut and Pie, Line, Polar Area, Radar, Scatter.
- **Why Chart.js?:** Lightweight, beginner-friendly, great for basic charts with some interactive features.





# Chart.js - Rendering

- **Canvas Rendering:** Renders charts on an HTML5 canvas.
- **Performance:** Ideal for large datasets (no DOM nodes to manage).
- **Limitation:** No CSS styling—customization through built-in options or custom plugins.





# Chart.js - History and Community

- **Popularity:**
  - **GitHub Stars:** ~60,000
  - **npm Downloads:** ~2.4 million weekly
- **History:** Created in 2013, open-source, MIT license.
- **Community:** Actively maintained by an open-source community with lots of plugins.

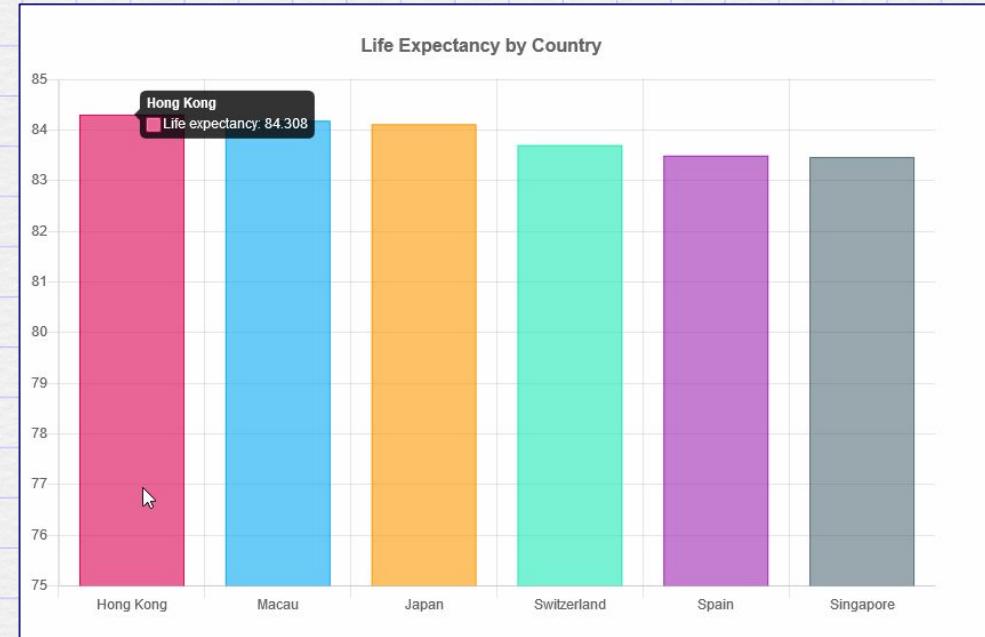
The screenshot shows the GitHub repository page for Chart.js. At the top, it displays the repository name "Chart.js", a description "Simple, clean and engaging charts for designers and developers", and a "Follow" button. Below this, it shows "684 followers" and a link to the website "http://www.chartjs.org/". The "Pinned" section lists several projects:

- Chart.js (Public) - Simple HTML 5 Charts using the <canvas> tag. (JavaScript, 65.1k stars, 11.9k forks)
- chartjs-plugin-datalabels (Public) - Chart.js plugin to display labels on data elements. (JavaScript, 888 stars, 489 forks)
- chartjs-chart-financial (Public) - Chart.js module for charting financial securities. (JavaScript, 789 stars, 200 forks)
- chartjs-plugin-zoom (Public) - Zoom and pan plugin for Chart.js. (JavaScript, 603 stars, 329 forks)
- chartjs-plugin-annotation (Public) - Annotation plugin for Chart.js. (JavaScript, 11 stars, 0 forks)
- chartjs-plugin-deferred (Public) - Deferred plugin for Chart.js. (JavaScript, 1 star, 0 forks)

On the right side, there are sections for "People" (showing profile icons of contributors), "Top languages" (JavaScript and HTML), and "Most used topics" (chart, plugin, canvas, html5).

# Bar Charts

- **What is a Bar Chart?** A bar chart visualizes comparisons across different categories, where each bar's height indicates its value or frequency.
- **When to Use Bar Charts:** They are perfect for comparing distinct categories and highlighting specific comparisons.



# Line Charts

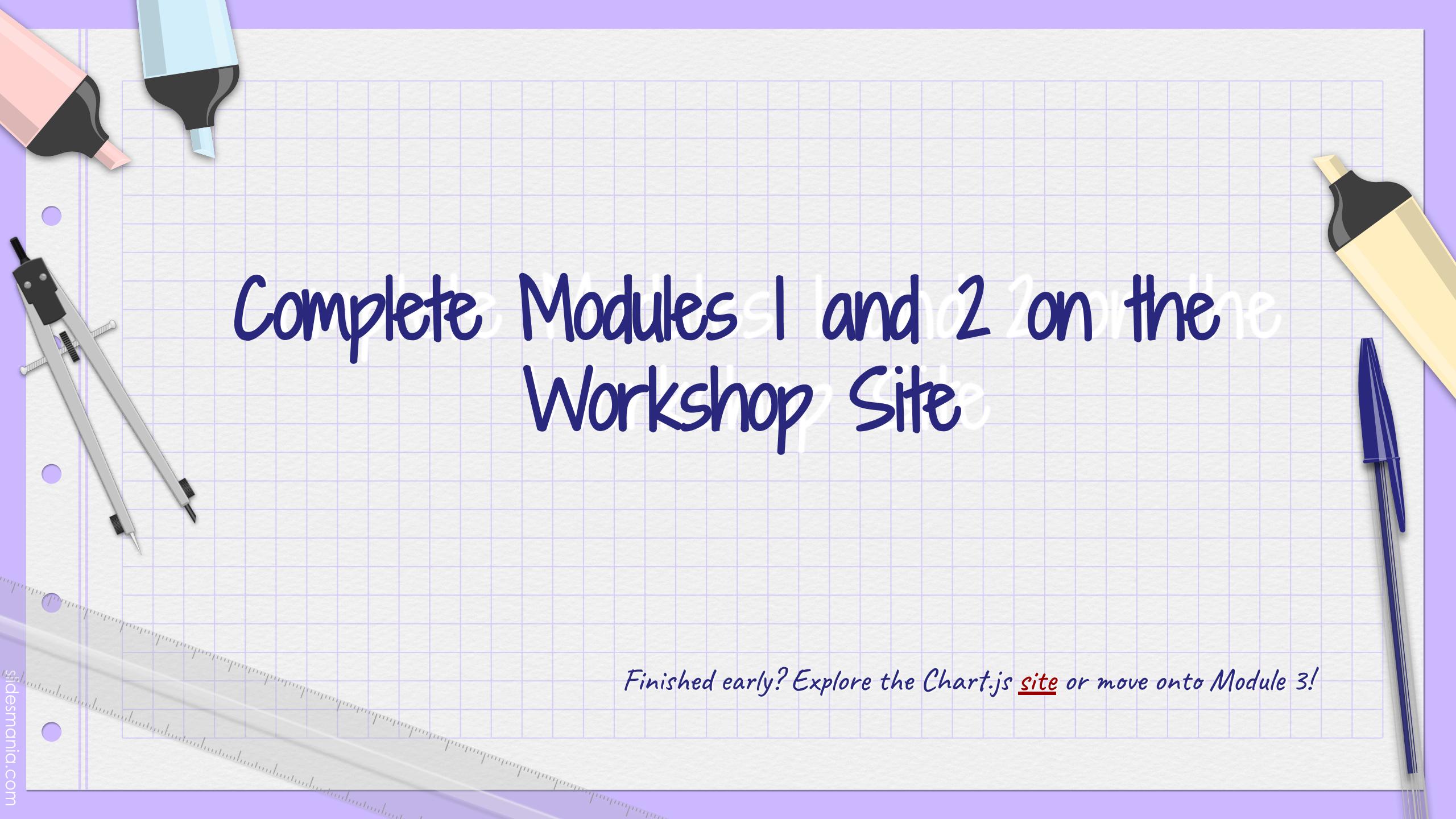
## What is a Line Chart?

- A line chart displays data points connected by lines.

## When to Use Line Charts:

- Ideal for visualizing trends and changes over time, especially when comparing data continuously.





# Complete Modules 1 and 2 on the Workshop Site

Finished early? Explore the Chart.js [site](#) or move onto Module 3!

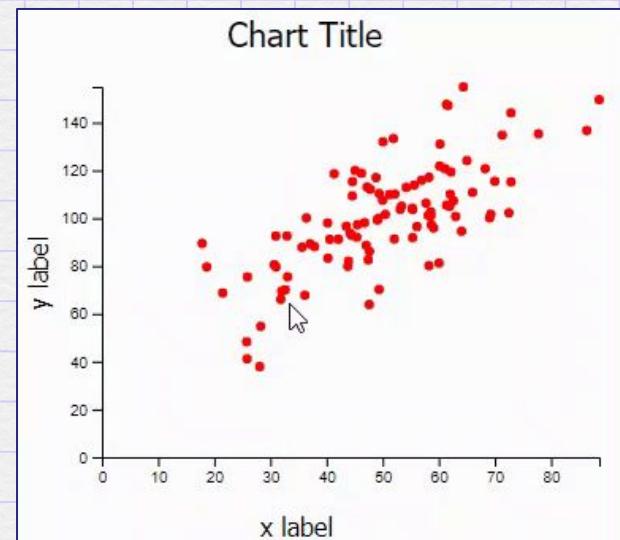
# Scatterplot

- **What is a Scatter Plot?**

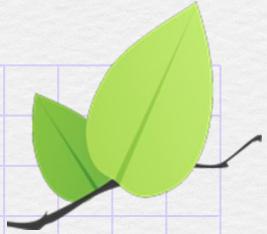
- A scatter plot is used to visualize the relationship between two numeric variables.
- Each point represents a pair of values, plotted on the X and Y axes.

- **When to Use Scatter Plots:**

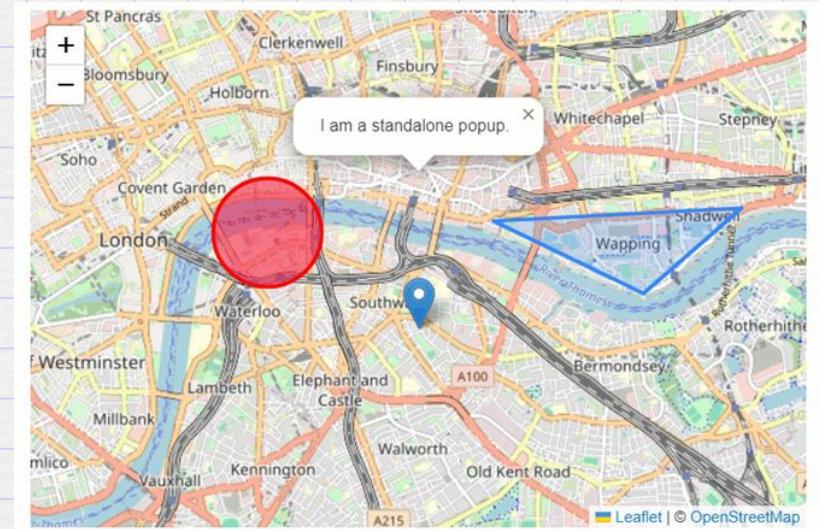
- Best for **correlation analysis**: Shows how two variables are related.
- Ideal for visualizing **clusters** or outliers.
- Useful for **regression analysis**, identifying patterns, or comparing distributions.



# Leaflet

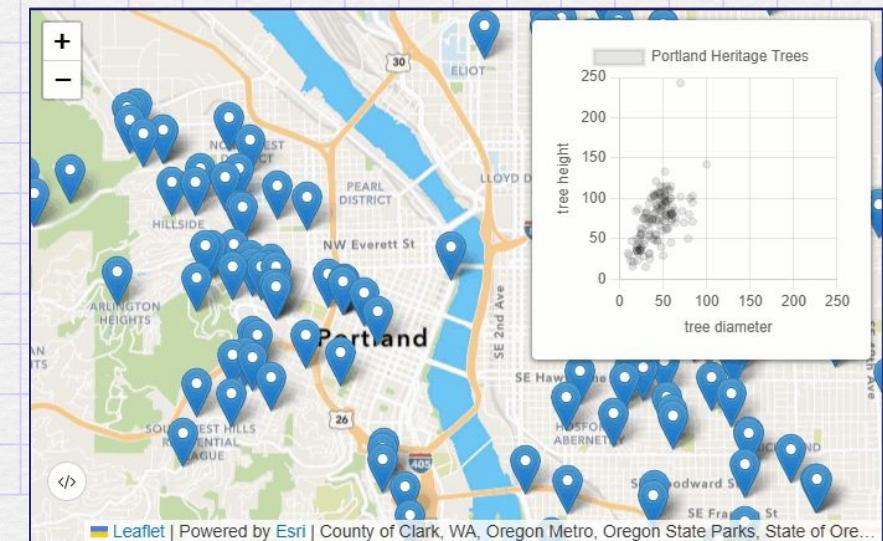


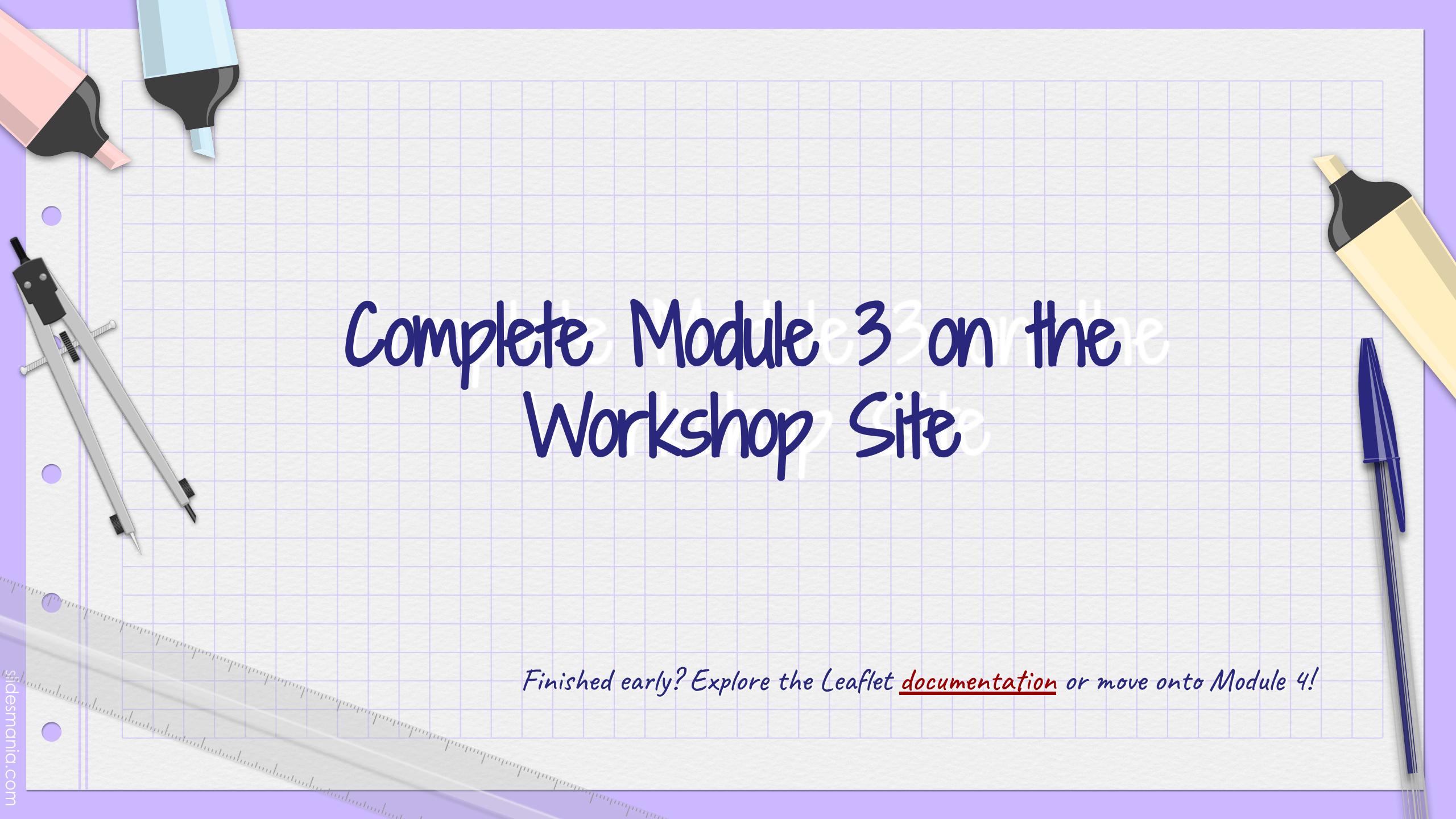
- **Leaflet:** JavaScript library for interactive maps.
- **Lightweight:** Only about 42 KB of JS and it's easy to integrate with charts.
- **Use Case:** Perfect for embedding maps in web applications.
  - a. Note: View is set with an initial latitude and longitude. You can use this geocoding [search tool](#) for finding locations.



# Esri Leaflet

- **Esri Leaflet:** Adds Esri's mapping capabilities to Leaflet.
- **Features:** Access to Esri basemaps, feature layers (e.g. ArcGIS Hub and Living Atlas), and geospatial services.
- **Combining with Charts:** Use map features to dynamically update charts with relevant data.





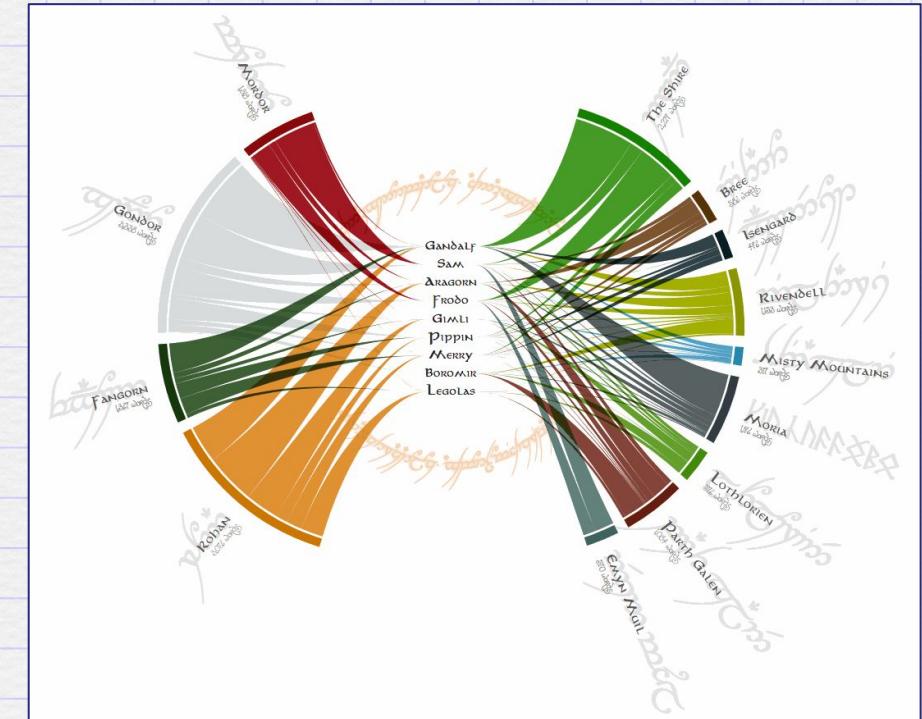
# Complete Module 3 on the Workshop Site

Finished early? Explore the Leaflet [documentation](#) or move onto Module 4!



# D3.js

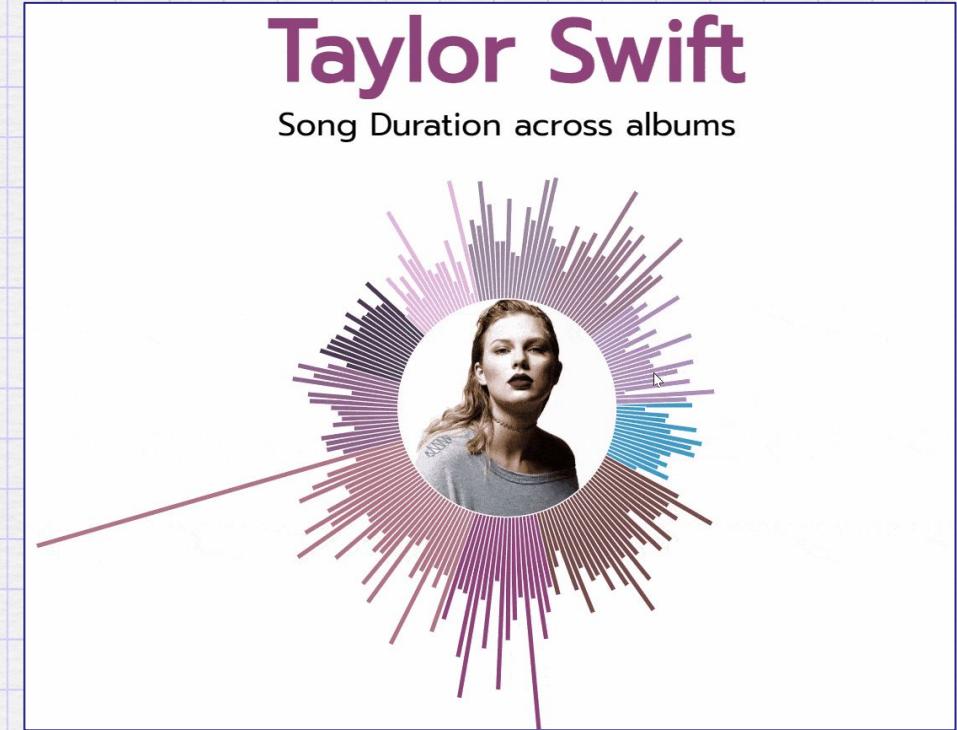
- **D3.js:** JS library for creating complex, data-driven visualizations.
- **Key Feature:** Manipulates the DOM based on data.
- **Why Use D3?:** More flexibility and customization than Chart.js.





# D3.js and SVGs

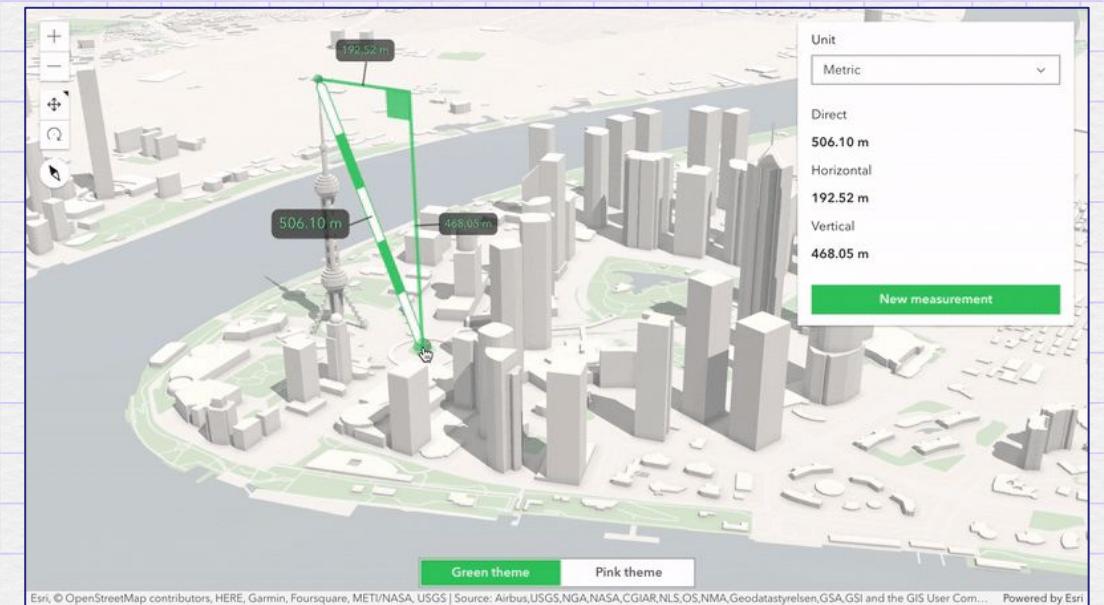
- **SVGs:** Uses Scalable Vector Graphics (SVG) for browser rendering.
- **Complex Visualizations:** Create radial charts, bubble charts, force-directed graphs, and more.
- **Benefits:** Ideal for responsive, interactive, and customizable visuals.





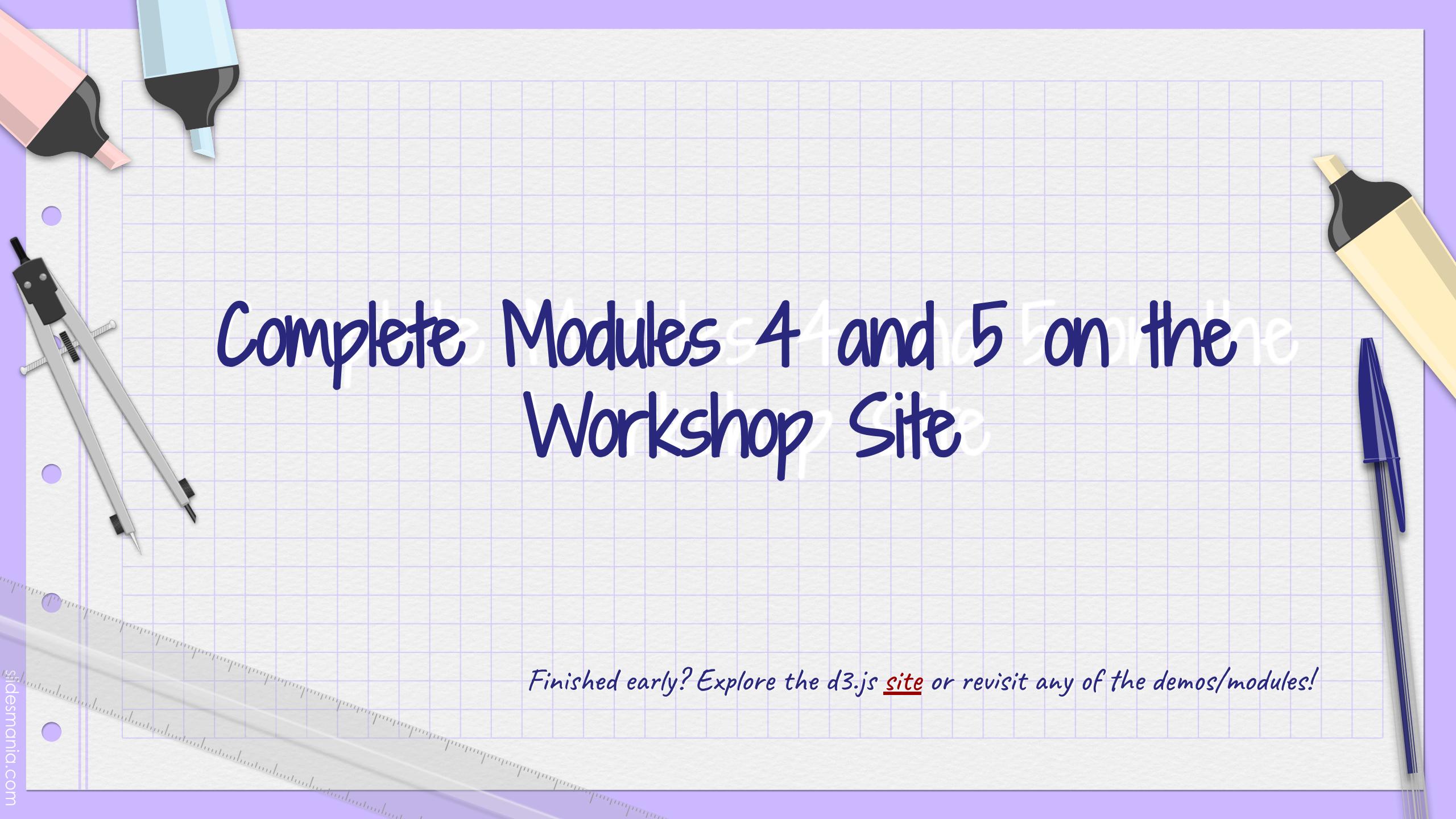
# ArcGIS Maps SDK for JavaScript

- Advanced GIS Capabilities
- Integrated with Esri Services
- Robust Data Visualization



# How does the ArcGIS Maps SDK for JS Compare to Leaflet/Esri Leaflet?

Feature	ArcGIS Maps SDK for JS	Leaflet/Esri Leaflet
Complexity	More features and capabilities	Simpler, lightweight setup
Data Handling	Efficient with large datasets	Best for smaller datasets
3D & Real-Time	Extensive 3D and real-time support	Limited to basic capabilities
Graphics Rendering	Uses WebGL for complex visuals	Primarily uses DOM rendering



# Complete Modules 4 and 5 on the Workshop Site

Finished early? Explore the d3.js [site](#) or revisit any of the demos/modules!

# Conclusions

- **Key Techniques:** Explored D3.js, Chart.js, Leaflet, Esri Leaflet, and ArcGIS for dynamic visual storytelling.
- **Workshop Goals:** Improved skills in creating interactive and engaging visualizations.
- **Next Steps:**
  - a. Apply skills to new projects.
  - b. Share work on platforms like GitHub.
  - c. Join and participate in related online communities.

# Resources

- **Chart.js Github Repo**
- **Chart.js Github Awesome list** - curated list of Chart.js resources and libraries
- **Chart.js Site**
- **D3.js Github Repo**
- **D3.js Site**
- **Leaflet Site**
- **ArcGIS Maps SDK for JavaScript Documentation**