



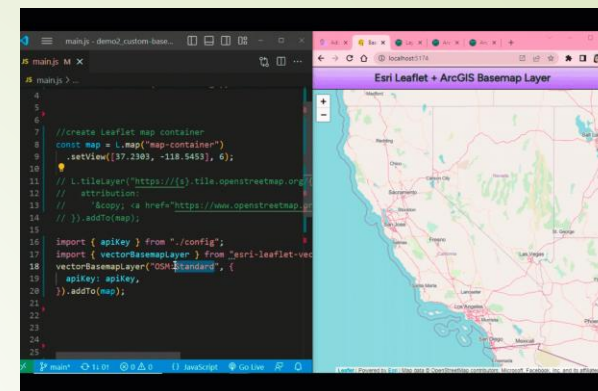
Interactive Mapping with JavaScript: Build Custom Web Maps from Scratch

Courtney Yatteau



Courtney Yatteau

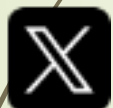
Developer Advocate, Esri



From Teaching to Tech



Courtney Yatteau



@c_yatteau



courtneyyatteau



@cyatteau.bsky.social



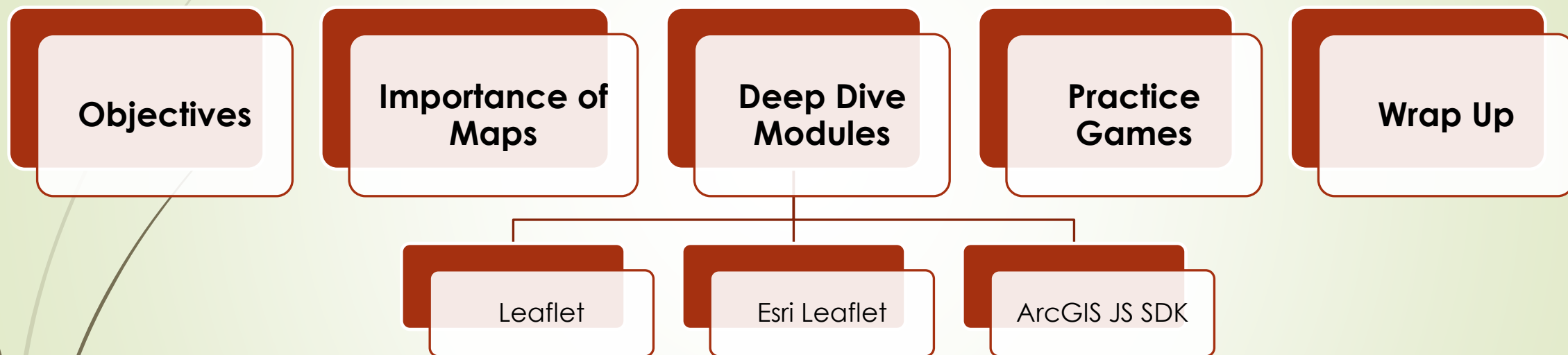
Description & Prerequisites

What to Expect

Unlock the potential of interactive web mapping in this engaging, hands-on workshop! Perfect for developers at any level, even those brand new to GIS, this session will guide you through the essentials of building custom web maps using powerful JavaScript libraries. We'll start with the basics of mapping concepts and data, then move into adding data layers, creating interactive features, and optimizing your maps for both performance and design. By the end, you'll be equipped to create dynamic, visually appealing maps that make data exploration intuitive and impactful in any web application.

Agenda

Workshop Overview



Learning Objectives

What You Will Learn

Create maps for
JavaScript apps



Three different
libraries



Mapping & GIS
concepts



Use cases &
examples



Extending,
customizing, &
hosting



Integrated Development Environment

IDE Options

CodePen
Easy to use

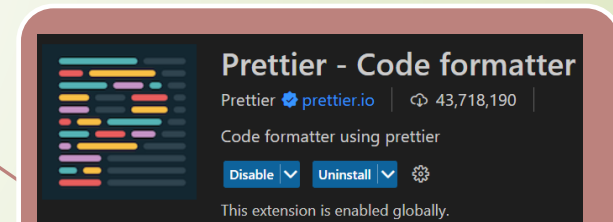
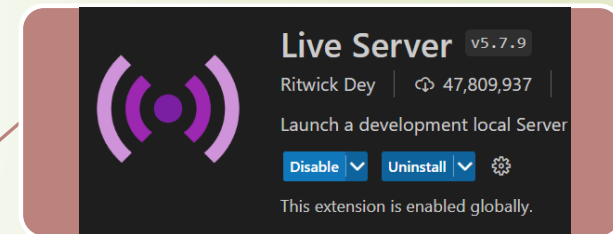
Create an account
at codepen.io
Shortcut: Shift + Tab

**Visual Studio
Code**
More Powerful

Download at
<https://code.visualstudio.com/download>

EXTENSIONS

View → Extensions



Shortcut
Alt/Option + Shift + F

Everyday Mapping

How we all use Maps

- Navigation/Directions
- Social Media
- Travel & Living
- Fitness Apps
- Public Transit
- Weather Radar
- Local Commerce



Maps in Action

Societal Vitality

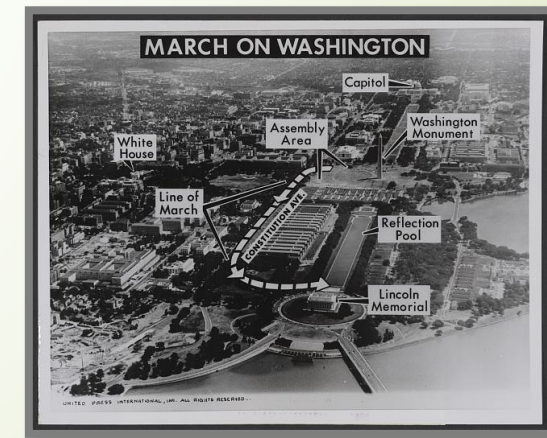
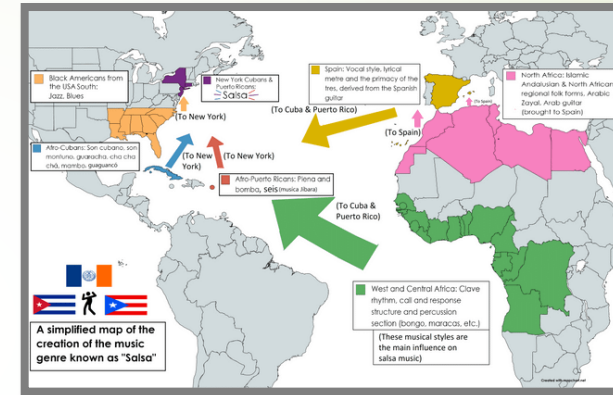
- Disaster Response
- Urban Planning
- Public Safety
- Route Optimization
- Wildlife Tracking



Storytelling with Maps

Visual Evidence

- Community Development
- Historical Events
- Cultural Impact
- Voting & Politics
- Outbreaks
- City Growth





The Libraries

Leaflet, Esri Leaflet, and ArcGIS REST JS



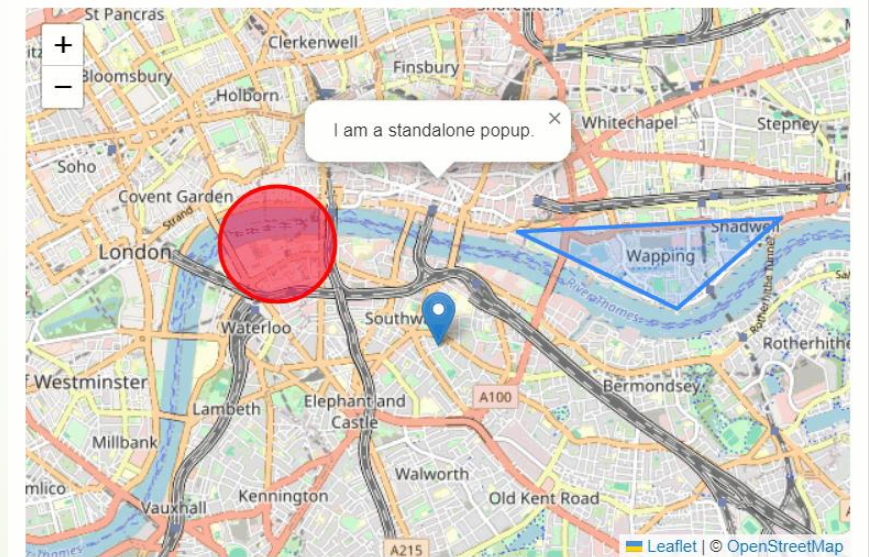
leaflet.com

What is Leaflet?

 leafletjs.com

 github.com/Leaflet

- Lightweight (~42 KB JS)
- Tons of plugins: leafletjs.com/plugins
- Focuses on simplicity and performance



Let's do our first module together!

We'll use Leaflet's Quick Start Guide to get started.

<https://leafletjs.com/examples/quick-start/>





Module 1.2 Overview

Goal: Enhance your map with interactive markers, popups, custom icons, and vector shapes, then organize everything into toggleable layer groups.

Topics:

- Basic Markers
- Popups & Tooltips
- Custom Icons
- Vector Primitives
- Layer Groups

Markers

- Map pins 📌
- `L.marker([lat, lng])`
- Clicks 🖱️
- `marker.on('click', ...)`



Popups & Tooltips

➤ Popups

➤ `marker.bindPopup('text').openPopup()`

➤ Tooltips

➤ `marker.bindTooltip('Hint')`



Custom Icons

➤ PNG icons

- `const icon = L.icon({ iconUrl:'pin.png' });`
- `L.marker([lat, lng], { icon })`

➤ Anchors & shadows

- `iconAnchor:[x,y]`
- `shadowUrl` and `shadowSize`

➤ HTML icons

- `L.marker([lat, lng], {icon: L.divIcon({ html:'😊 ' })})`



Vector Shapes

➤ Polylines

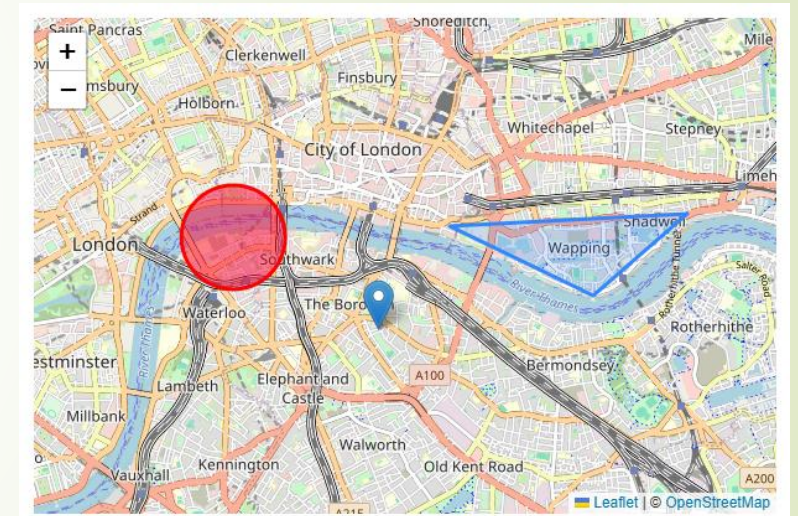
➤ `L.polyline([[lat, lng],[lat, lng], ...])`

➤ Polygons

➤ `L.polygon([[lat, lng], [lat, lng], [lat, lng], ...])`

➤ Circles

➤ `L.circle([lat, lng])`



Layer Groups

➤ Group

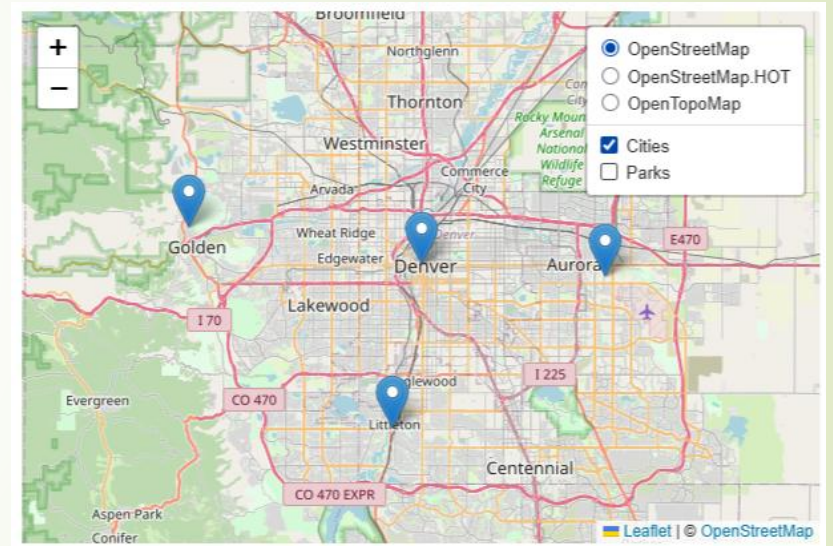
➤ `L.layerGroup([marker1, shapeA, ...])`

➤ Toggle visibility

➤ `map.removeLayer(group);`

➤ Control

➤ `L.control.layers`

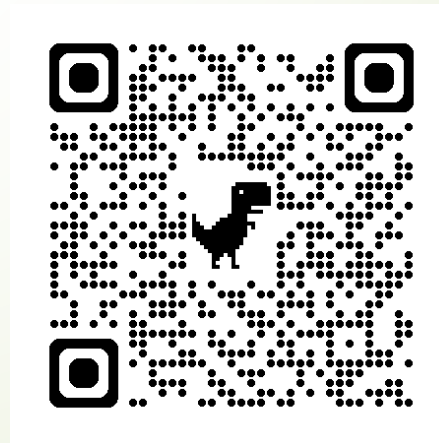


Work on Modules 1.1-1.2



Finished early?

Try out these CodePens!



<https://codepen.io/collection/kkbGGW>

Module 1.3 Overview

Goal: Load and inspect GeoJSON in Leaflet, style features with popups, add zoom controls, and benchmark & optimize map performance.

Topics:

- Load GeoJson
- fitBounds & Controls
- Performance

Load & Inspect GeoJSON



Fetch
remote
GeoJSON

Parse JSON

Add
L.geoJSON
layer

Inspect &
Count

fitBounds & Zoom Controls

Auto-fit full
extent

Click-to-
zoom
features

Performance Patterns

GeoJSON vs
Canvas

console.time
metrics

Low-fit
optimization

Work on Module 1.3

Finished early?

Try out these CodePens!



<https://codepen.io/collection/qBePPV>

Module 1.4 Overview

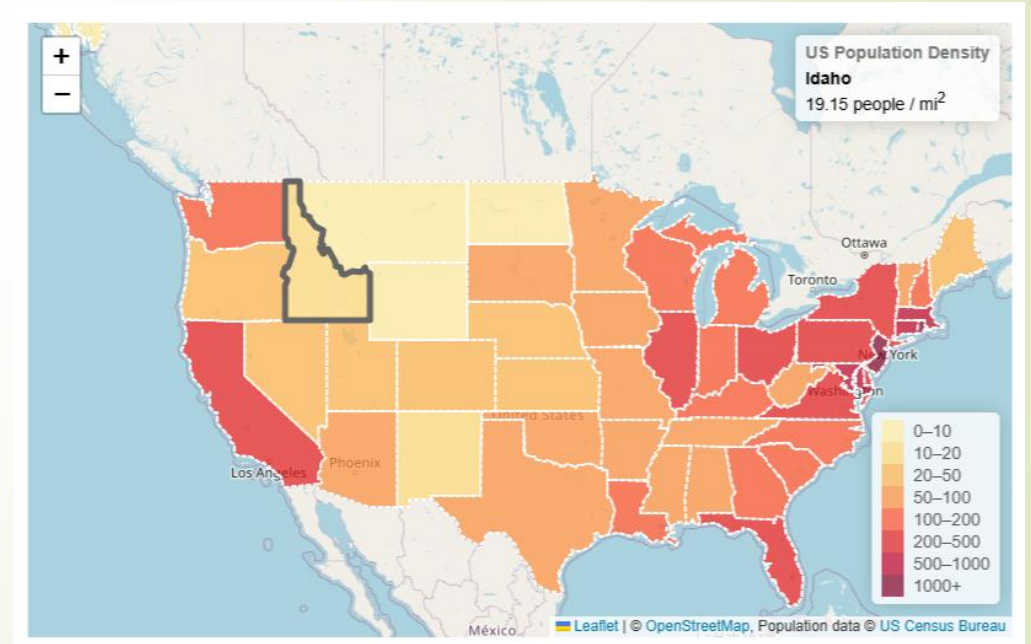
Goal: I will be able to turn raw numeric data into a styled choropleth layer, add a legend, let users switch metrics, and make the map responsive and print-ready.

Topics:

- Classify numbers
→ map colors
- Legends
- Switch metrics
- Export & print


Choropleth

- Load & extract data
- Compute breaks
- Apply style





Legend, Interactivity, & Responsiveness

- Color ramp and legend
 - Metric selector
 - Responsive & print-ready
- 

Module 1.5 Overview

Goal: You'll learn to add custom map controls, enable shape drawing and editing, and implement one-click and continuous user location tracking.

Topics:

- Custom controls
- Shape drawing & editing
- One-click geolocation
- Live tracking

Interactive Map Tools

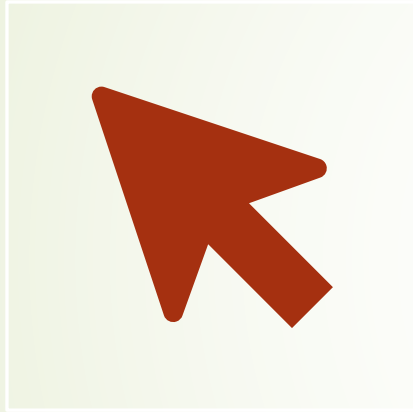


Reusable controls



Shape drawing & editing

Location & Tracking



One-click user locate

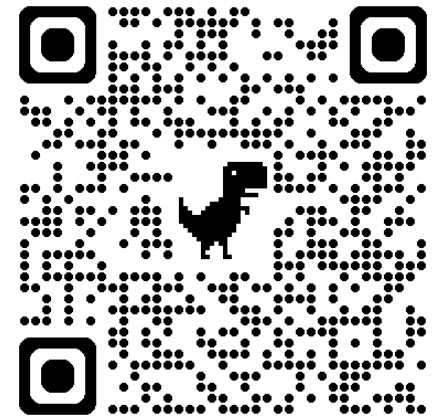


Live follow-me mode

Work on Modules 1.4 & 1.5

Finished early?

Try out these CodePens!



<https://codepen.io/collection/Gpekkw>

Host Your App with



Share your app with a URL



What is Netlify?

A platform with hosting & backend services for web apps.



Why use it?

Easy to deploy your HTML, CSS, & JS sites.



Step-by-Step Guide

Sign up at netlify.com

Go to the 'Sites' tab and click 'Add new site'.

Select 'Deploy manually'

Drag & drop your folder

Your site is live, & the domain can be customized!



Esri Leaflet

Esri Leaflet

developers.arcgis.com/esri-leaflet

➡ **Esri Leaflet:** Set of tools to use ArcGIS services in Leaflet



GitHub Repo

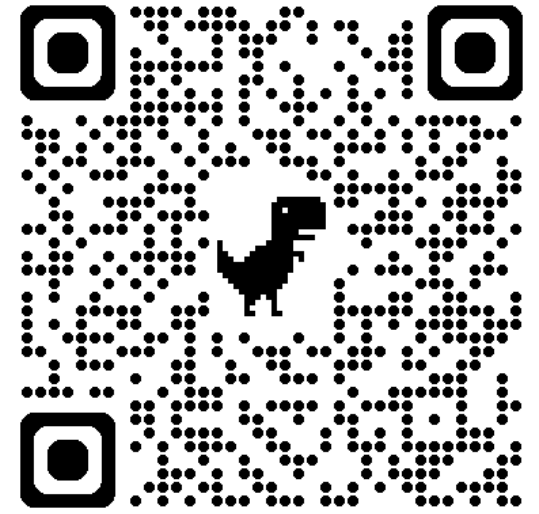


Documentation

ArcGIS Location Platform

<https://location.arcgis.com/>

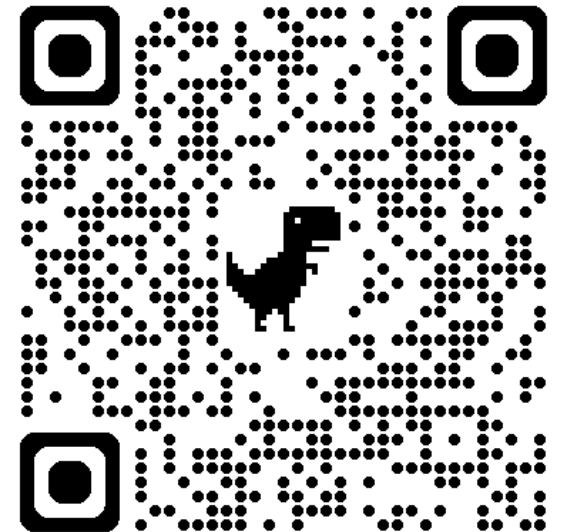
► Create API keys, data layers, and more



Let's do our first Esri Leaflet module together!

We'll use Esri Leaflet's documentation to get started

developers.arcgis.com/esri-leaflet



Module 2.2 Overview

Goal: I will load and style feature layers, add popups, and create an interactive SQL-powered filter.

Topics:

- Feature layers
- Styling & popups
- Querying

Layers & Styling

- Add point, line and polygon feature layers
- Apply simple styles (color, weight, fill, opacity)

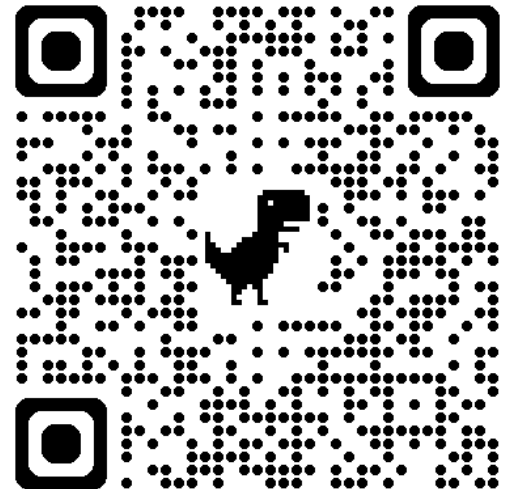
Popups & Interactive Queries

- ➡ Bind popups to display feature attributes
- ➡ Build a SQL filter control and call `setWhere()`

ArcGIS Hub

- ➡ Find feature layers

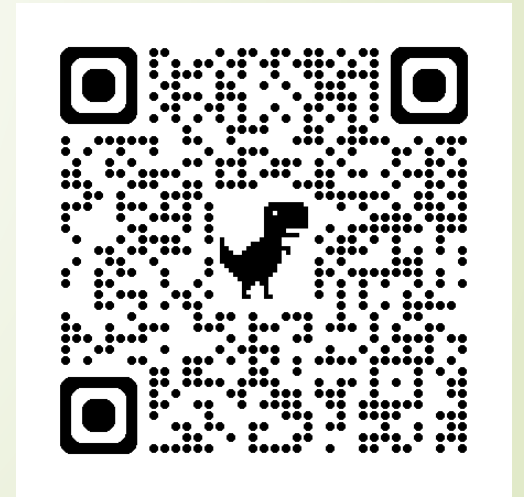
<https://hub.arcgis.com/>



ArcGIS VTSE

<https://vtse.arcgis.com/>

- ➡ Design your own basemaps

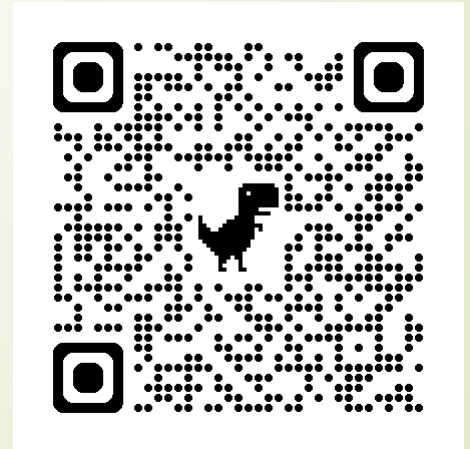


<https://vtse.arcgis.com/>

Work on Module 2.2

Finished early?

Try out these CodePens!



<https://codepen.io/collection/BaKwdb>

Module 2.3 Overview

Goal: I will learn how to visualize and style dense point data on a map.

Topics:

- Heatmaps
- Clustering
- Symbol styling

Show Dense Data Clearly

- Heatmaps show *where* points are concentrated
- Clusters reduce visual clutter
- Both improve readability at different zoom levels

Customize for Clarity & Style

- Restyle clusters with custom icons
- Override feature layer symbols
- Add popups for interactivity



Work on Module 2.3

Module 2.4 – 2.5 Overview

Goal: I will be able to add search & geocoding, calculate routes, and show service areas.

Topics:

- Geocoding
- Routing

Searching & Geocoding



Find locations by
name, address, etc.
or click.



Learn what
geocoding really
means.

Routing & Service Areas



Calculate routes
between places.



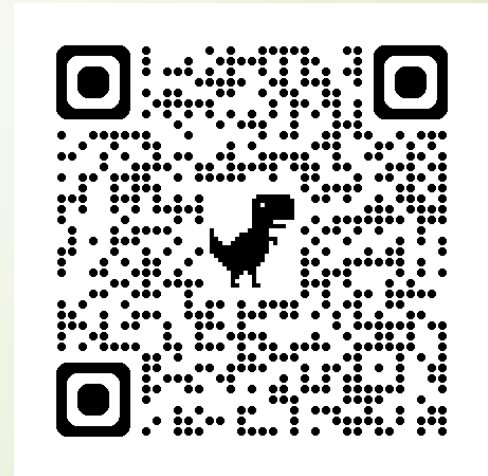
Explore drive-time
zones on the map.

Work on Modules 2.4 – 2.5



Finished early?

Try out these CodePens!



<https://codepen.io/collection/GpekvY>



ArcGIS JS SDK Examples

What are Components?

- Pre-built <arcgis-map>, <arcgis-scene>, <arcgis-chart>
- Declarative HTML → minimal boilerplate JS
- Can leverage ArcGIS Online items by ID
- Framework-agnostic & instant 2D → 3D

CSS & JS Libraries (CDN) + API Key

```
<script>esriConfig={apiKey:"YOUR_KEY"};</script>  
<link href="https://js.arcgis.com/4.33/esri/themes/light/main.css"  
rel="stylesheet"/>  
<script src="https://js.arcgis.com/4.33/"></script>  
<script type="module" src="https://js.arcgis.com/4.33/map-  
components/"></script>
```

Embed a 2D Map

```
<arcgis-map basemap="style" center="lng, lat" zoom="#"> </arcgis-map>
```

Embed a 3D Map

```
<arcgis-scene basemap="style" ground="world-elevation"  
  camera-position="lng, lat, z" camera-tilt="#">  
</arcgis-scene>
```

Embed a 2D Web Map

```
<arcgis-map item-id="YOUR_WEBMAP_ID"></arcgis-map>
```

Instant 3D Web Scene

```
<arcgis-scene item-id="YOUR_WEBSCENE_ID"></arcgis-scene>
```

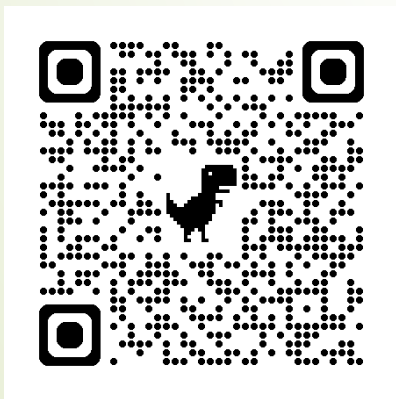

Key Advantages & Next Steps

- **Zero boilerplate:** maps and widgets in 5 lines of HTML
- **Built-in UI:** legend, search, zoom, compass, etc.
- **2D/3D:** one framework for both
- **ArcGIS Location Platform:** reuse your existing web maps/scenes

ArcGIS JS SDK – CodePen Practice

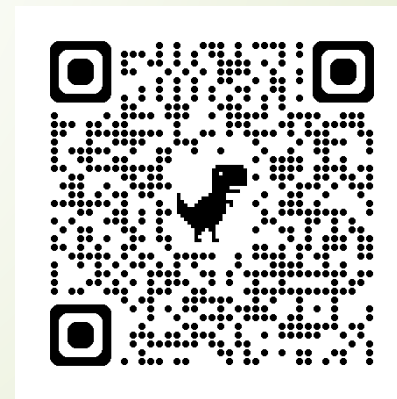
- Uncomment out the steps
- Modify the code to see how it changes
- Use the doc to try test out more things!

CodePens



<https://codepen.io/collection/dGkVJm>

ArcGIS JS SDK Doc



<https://developers.arcgis.com/java/script/latest/components/>



Custom Projects

Individual or group activity

Host Your App with



Share your app with a URL



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Go to the 'Sites' tab and click 'Add new site'.

Select 'Deploy manually'

Drag & drop your folder

Your site is live, & the domain can be customized!

Create and Share your Own Maps!

Ideas, Code to Play with, and more

Documentation & Practice

- [Leaflet examples](#)
- [Esri Leaflet tutorials](#)
- ArcGIS JS SDK tutorials

Project Ideas

- Create custom styles with VTSE – See my blogs ([article 1](#), [article 2](#))
- Add your own feature layer to a map ([example](#))
- Create a local area map guide ([example](#))
- Create a historical weather events map
- Create a tourist attraction audio tour

YouTube Videos

- [MapTiler Channel](#)
 - [Leaflet tutorials](#)
- [GeoDev Channel](#)
 - [Leaflet Crash Course](#)
- [My Channel \(@c_yatteau\)](#)
 - [Esri Leaflet Playlist](#)
 - [ArcGIS Developer Playlist](#)
 - [AI-Powered Mapping Playlist](#)

Other

- [Raul's geospatial resources](#)
- [Tons of free & open data](#)