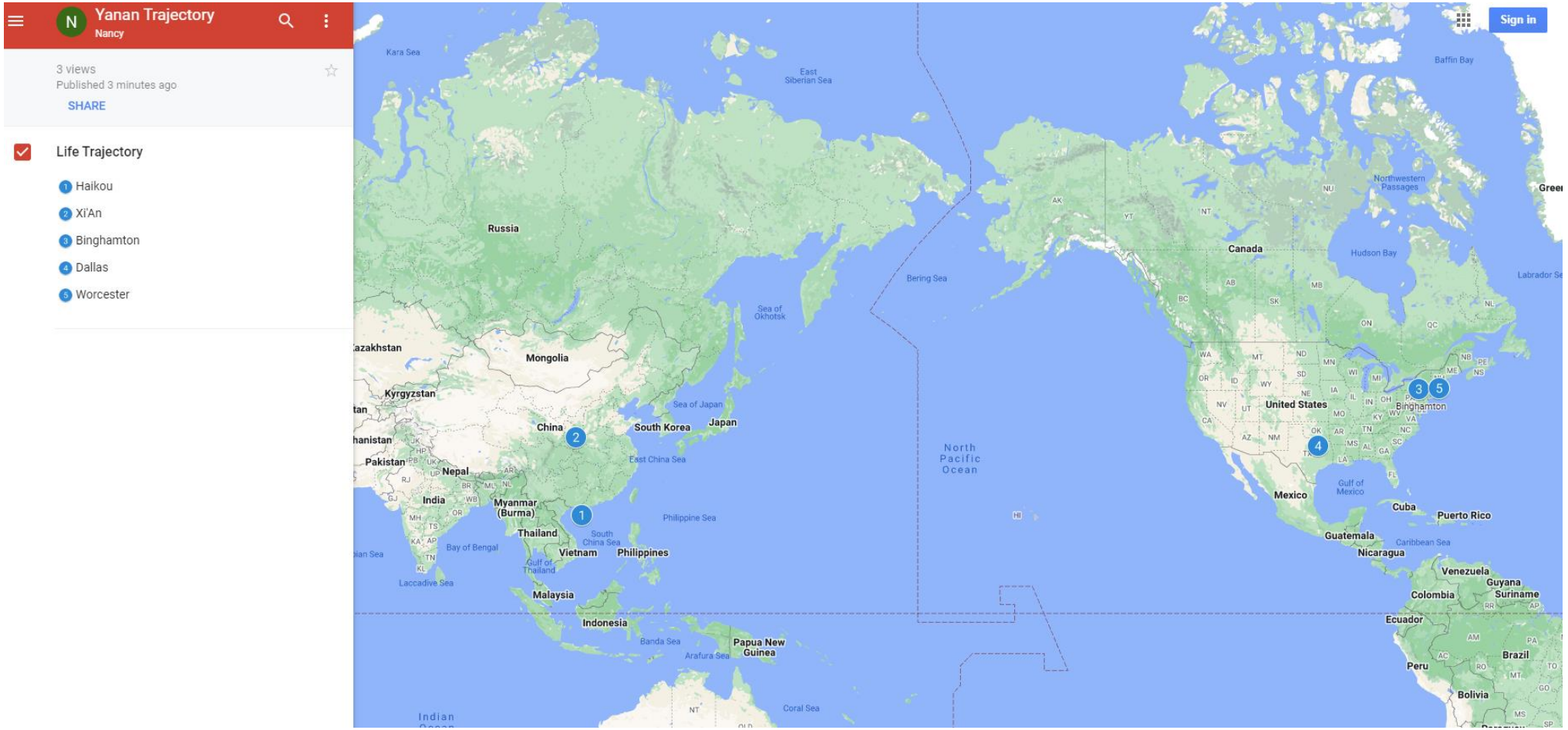
SSJ 30262 Web Mapping and Open-Source GIS

Instructor: Yanan Wu

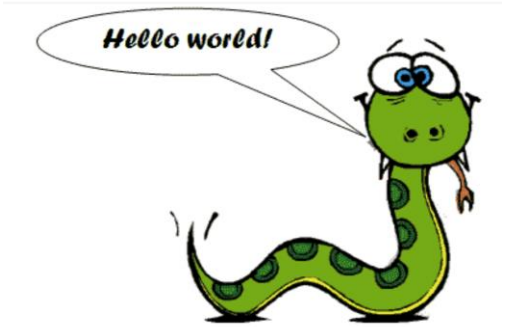
Yanan Wu – Visiting Assistant Professor

Education & Experience



Teaching

- **Python Programming & Computer PROG for GIS**



1. Manipulating Spatial Data
2. Web Mapping
3. Processing Raster
4. Data Analysis
5. Creating Custom Tool
6. Data Visualization
7. …

- **Web Mapping & Open Source GIS**

1. GitHub
2. HTML & CSS
3. JavaScript
4. Python
5. R
6. ArcGIS Online
7. …

How about you?

- Your background (e.g., name, major, where you come from)
- What is your funniest thing that happened during your summer break?
- What relevant experience do you have with python?
- What are your expectations for this course?

Course Format

- **Lectures:** Physics/Math, 3rd Floor, Room 310
  Monday: 9:00 – 10:50 PM
  Tuesday: 16:15 PM – 17:30 PM

- **Labs:** Physics/Math, 3rd Floor, Room 310
  Thursday: 16:15 PM – 17:30 PM

- **Office Hours**
  Monday & Wednesday: 3:00 – 4:00 PM (or by appointment)

- **Office Location:** Geography Main Office, Jeff 220

Course Requirements

- Labs: 11 in total

  For any graded assignment, if the you do not agree with the grade received, the instructor must be notified within one week after the assignment is graded.

- Late policy for lab (excluding midterm and final project)
- One midterm project & One Final Project (Oral presentation and paper report)

Extra Credit

- The instructor reserves **30 extra credit points** (**3% of total grade**) for those students who actively respond to the questions from other students posted on Discussion Forum.

Grade

- **11 lab (70%):** 700 points (70%)
- **Midterm exam (15%):** 150 points (15%)
- **Final Project (15%)** 150 points (15%)

1000 points total (100%)

Extra point (3%) 30 points

Letter Grade	% of Points
A	(above 93.0%)
A-	(90.0 to 92.9%)
B+	(87.0 to 89.9%)
B	(83.0 to 86.9%)
B-	(80.0 to 82.9%)
C+	(77.0 to 77.9%)
C	(73.0 to 76.9%)
C-	(70.0 to 72.9%)
D+	(67.0 to 69.9%)
D	(63.0 to 66.9%)
D-	(60.0 to 62.9%)
F	(0.0 to 59.9%)

Free Online learning source for Course Materials

- Haverbeke, M. (2024). Eloquent javascript: A modern introduction to programming.
- W. N. Venables, D. M. Smith and the R Core Team (An Introduction to R)
- Introduction to leaflet
- ArcGIS API for Python
- ArcGIS Maps SDK for JavaScript
- ArcGIS StoryMaps | ArcGIS Dashboards | ArcGIS Experience Builder
- geemap – A Python package for interactive mapping with Google Earth Engine

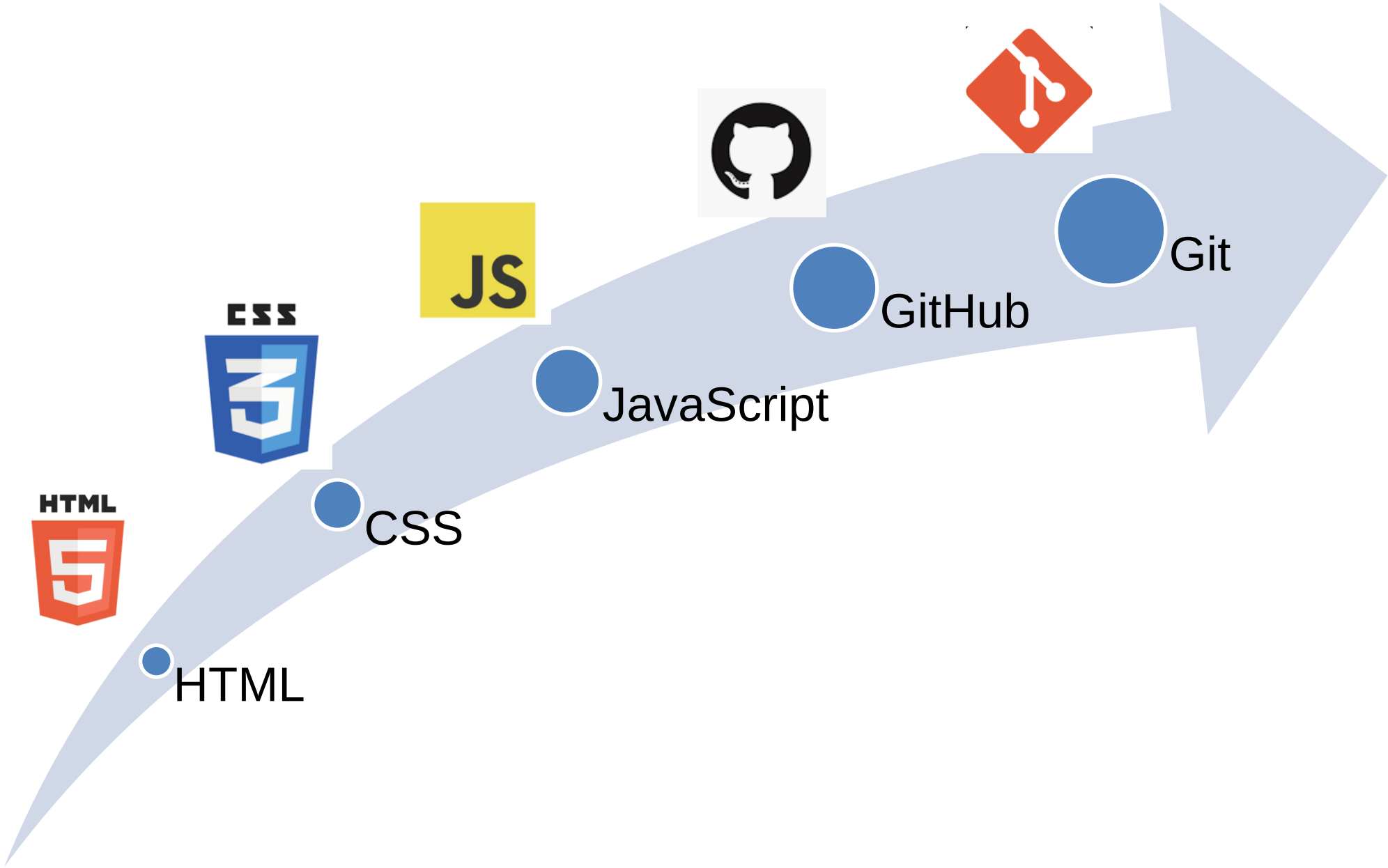
Emailing Instructor

- Use “SSJ-Web mapping” as the subject of the email
- I will strive to respond to questions within two business days, i.e., 48 hours excluding weekends.

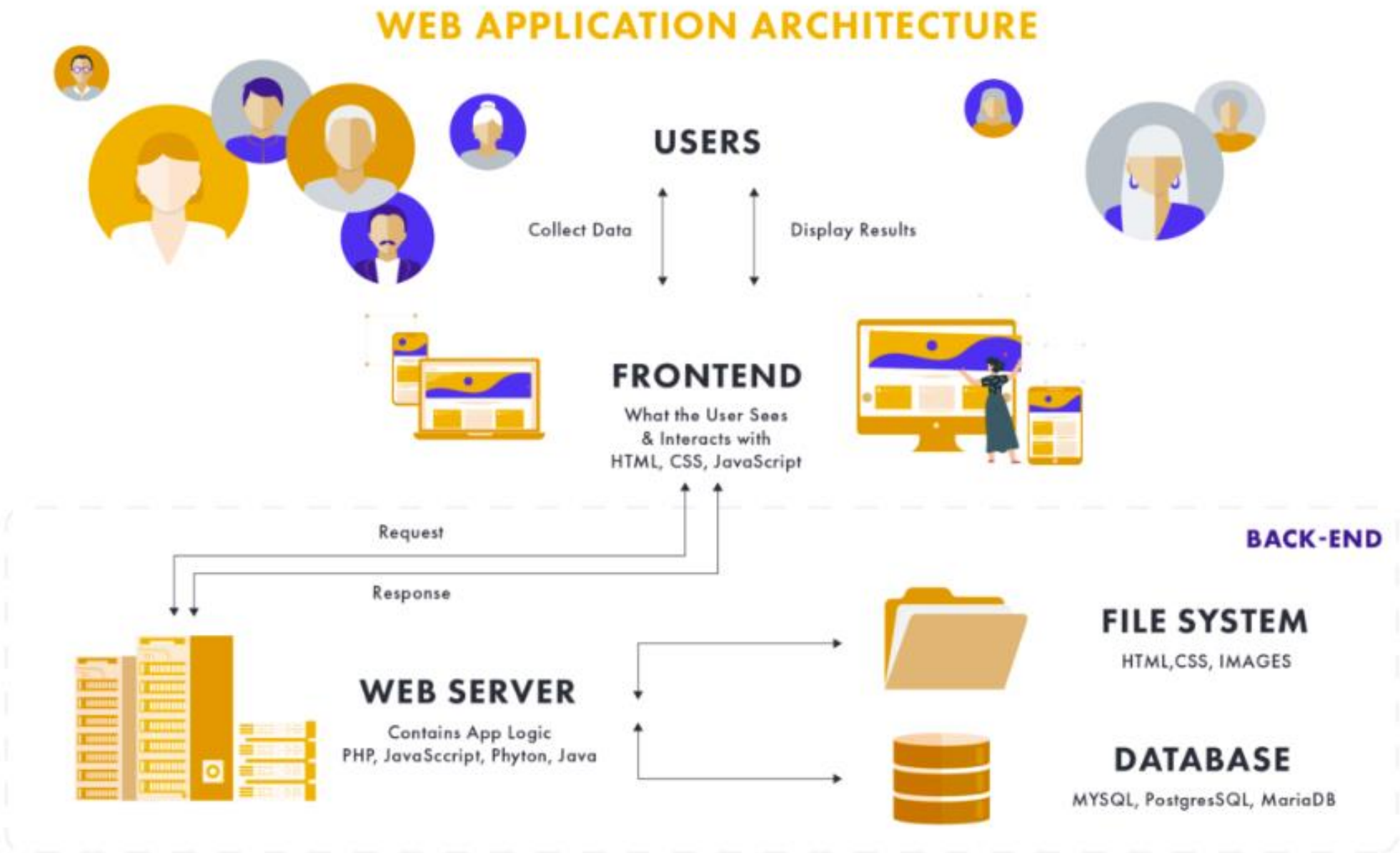
Course Schedule

- Week 1 – 2 – Introduction to GitHub
- Week 3 – 4 – HTML and CSS
- Week 5 – 6 – Introduction to R
- Week 7 – Dynamic Web
- Week 8 – Midterm (Submit a report of your personal website)
- Week 9 – 11 Application of APIs (ArcGIS JavaScript API, Google Maps API, Leaflet etc.)
- Week 12 – Web mapping (no need of programming)
- Week 13 – geemap: A Python package for interactive mapping with GEE
- Week 14 – 16 Final project wrap up and presentations

Way to create a website?



Web Application Architecture



[Source]

Front-end

HTML Hypertext Markup Language

- Decide the structure

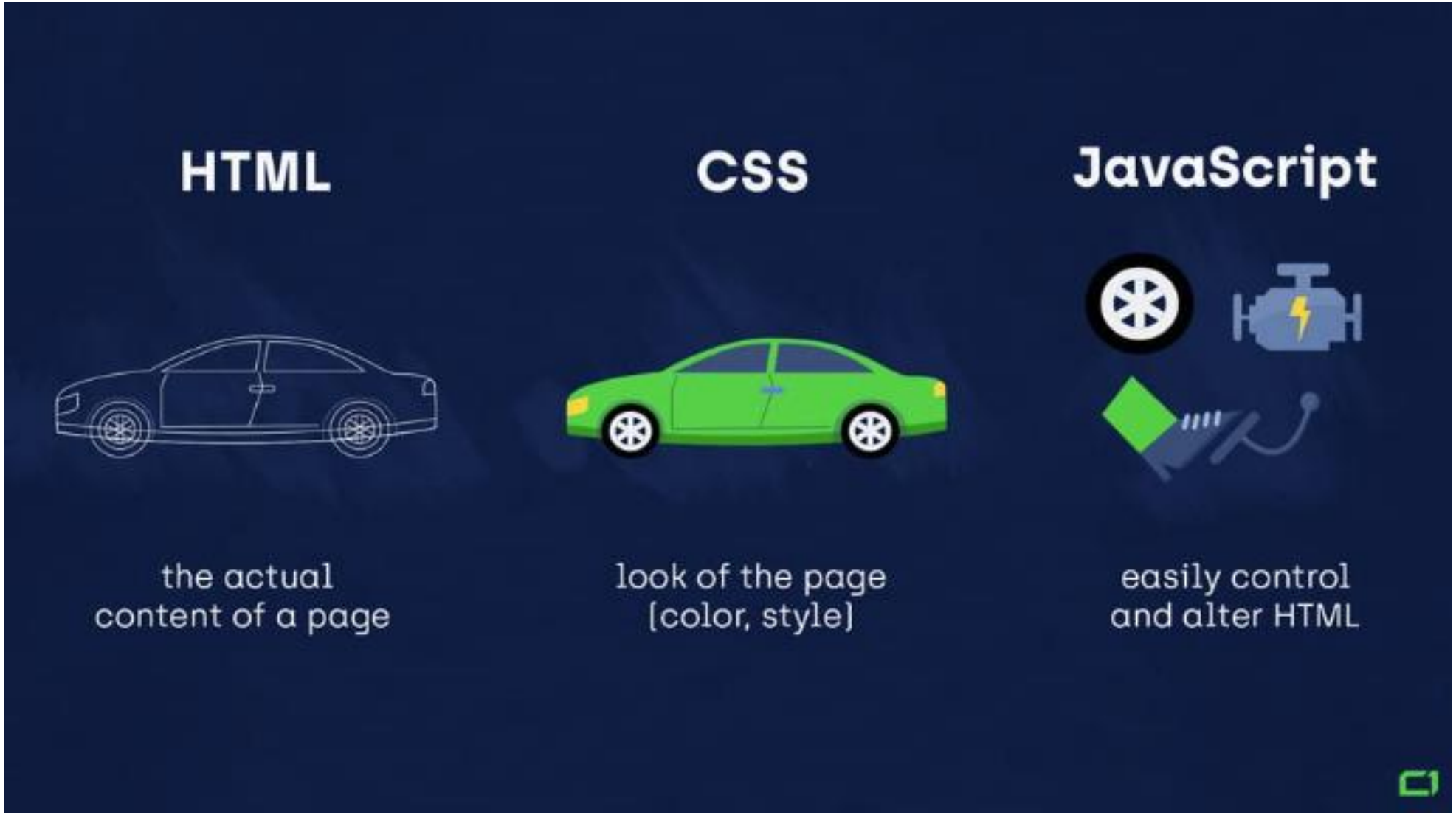
CSS Cascading Stylesheet

- Styling Language
- Visual styling

JavaScript Programming Language

- Adding Functionality

HTML / CSS / JavaScript



Source

Web Development & Web Maps

- **HTML**

  - Hypertext Markup Language
  - Standard markup language used to create web pages
  - Written in the form of HTML elements consisting of tags enclosed in angle brackets (e.g., <html></html>)
  - Browsers (like Firefox, Chrome, Safari) can read these HTML tags and convert them into visual (or audio) web pages
  - HTML elements are the building blocks of all web sites
  - Select **'Inspect'** on any web page accessible via the internet and you will see HTML.

HTML

- HyperText Markup Language

```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.0 Transitional//EN">
<HTML>
   <HEAD>
        <TITLE> My Title </TITLE>
   </HEAD>

   <BODY>
      This is the main body of this HTML.
   </BODY>
</HTML>
```

- Predefined HTML elements in red: **HTML , HEAD , TITLE , BODY**

The very first web page!

- HTML
  - **Following is the first page of the internet:**

    http://info.cern.ch/hypertext/WWW/TheProject.html

Web Development & Web Maps

```
h1 { color: white;
  background: orange;
  border: 1px solid bl
  padding: 0 0 0 0;
  font-weight: bold;
}
/* begin: seaside-theme */

body {
  background-color:white;
  color:black;
  font-family:Arial,sans-serif;
  margin: 0 4px 0 0;
  border: 12px solid;
}
```

CSS

- **CSS**
  - **Cascading Style Sheets**
  - Used for describing the look and formatting of a document written in a markup language.
  - Goal is to separate document content from document presentation
  - Things like *Layout, Colors, Fonts, etc.*

With CSS

Without CSS

Web Development & Web Maps

- **JavaScript (JS)**
  - First developed by Netscape in 1995
  - **Goal is to make web documents interactive / dynamic**
  - Example: http://www.w3schools.com/js/
  - The primary client-side language for interactivity (sometimes used on the server)
  - Has nothing to do with the language *Java* (which is more powerful)
  - Lots of “Libraries” available for making programming easier.

Let’s create our fist web page

Let's look at a simple example

http://www.w3schools.com/js/tryit.asp?filename=tryjs_lo_op_for_ex

A little bit complex example generated from chatGPT

https://github.com/gisynw/TEST.git

Web-based Platform - Microsoft

Web-based

Free / Open Source

Source: Iris Network Systems

Unlimited Repository (Repo)

File size limit:

- > 50 MiB: get warning
- > 100 MiB: need to use Git Large File Storage (Git LFS)

Version Control System (VCS)

Version?

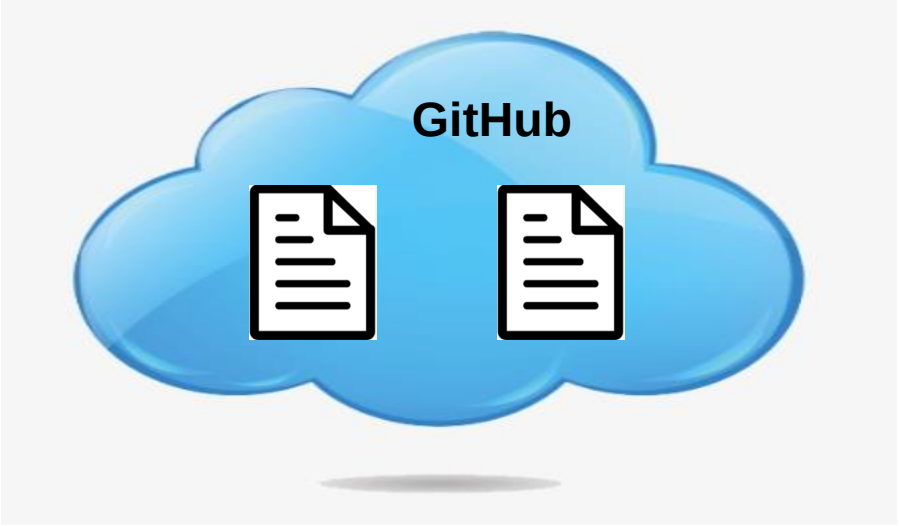
- Make Change
- View History
- Roll back changes

Similar To

But different

- Syncing is done manually
- Programming

How Git Works



1. Clone Repo

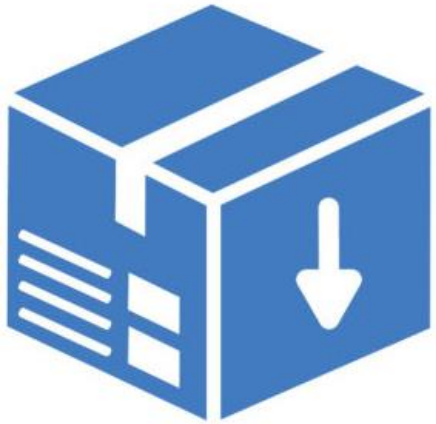
2. Make Change

- Edit
- Add
- Delete

3. Push change to Repo on Web

Leaflet Package in R

- Leaflet.js is a Javascript library
- Wrapped in R environment

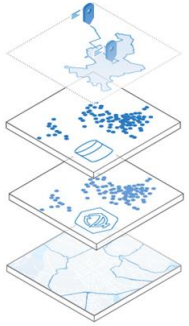


- No need of HTML or JavaScript

- Example of Interactive map

Example

Web maps using the ArcGIS API for Python

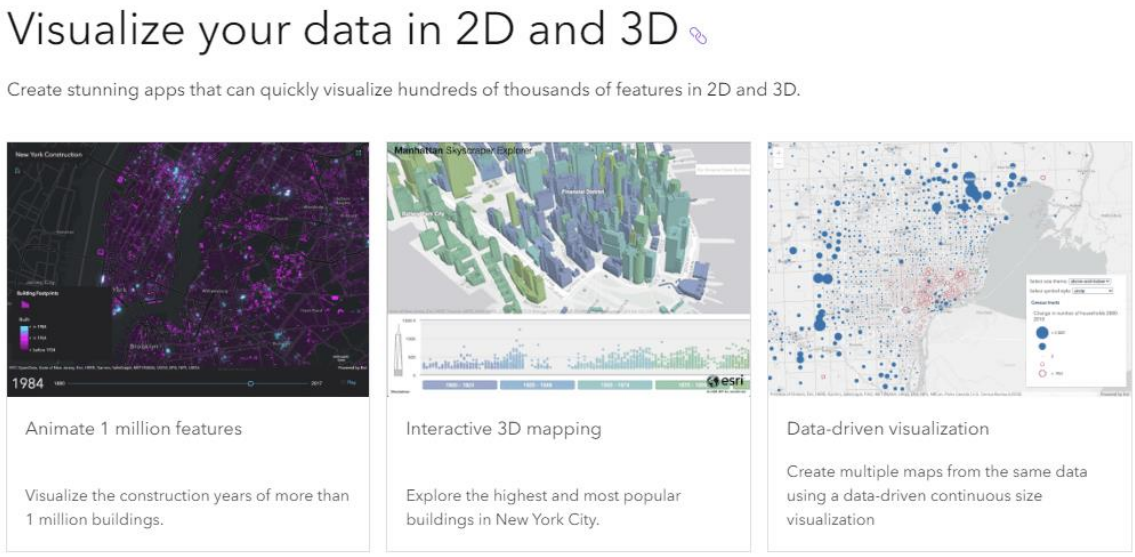


- GIS Organization (e.g., ArcGIS Online)
- Content Management
  - Layers, web maps, services
- Spatial analysis
- Data science

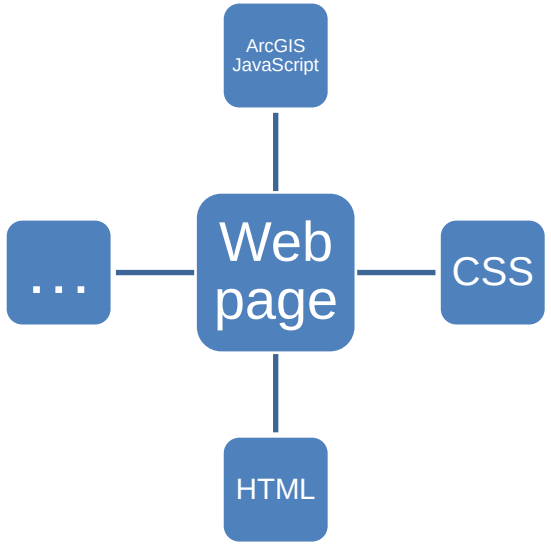
Web maps using the ArcGIS API for Python

1. Esri User Document
2. Esri official Repo on GitHub

Web maps using the ArcGIS Maps SDK for JavaScript



ArcGIS Maps SDK for JavaScript



- Web-based GIS Applications
- Use Javascript

- Can be integrated with other web technologies (e.g., HTML, CSS)

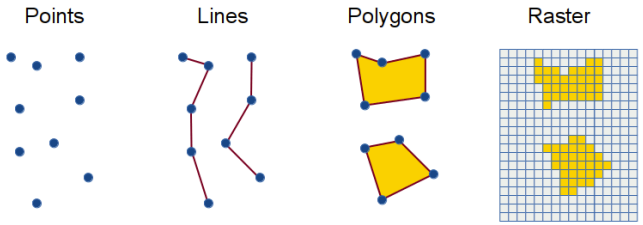
- Data Visualization

Web maps using the ArcGIS Maps SDK for JavaScript

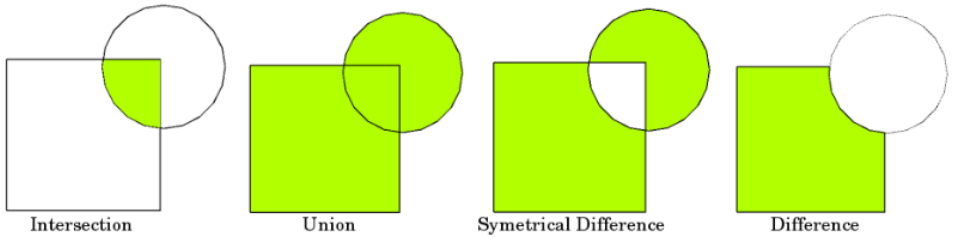
1. Esri User Document
2. Esri official Repo on GitHub

Web maps using the Open Source Spatial Libraries

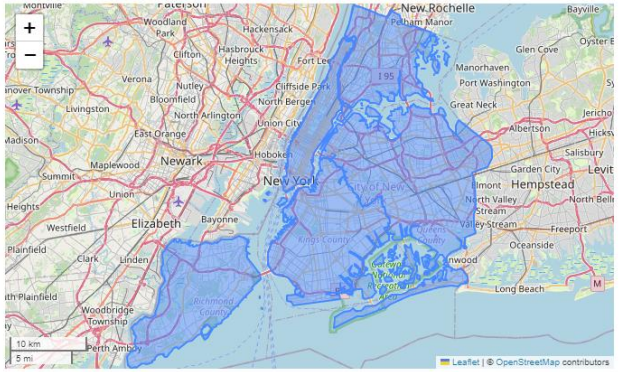
Spatial Data Structure



Geometric Operation



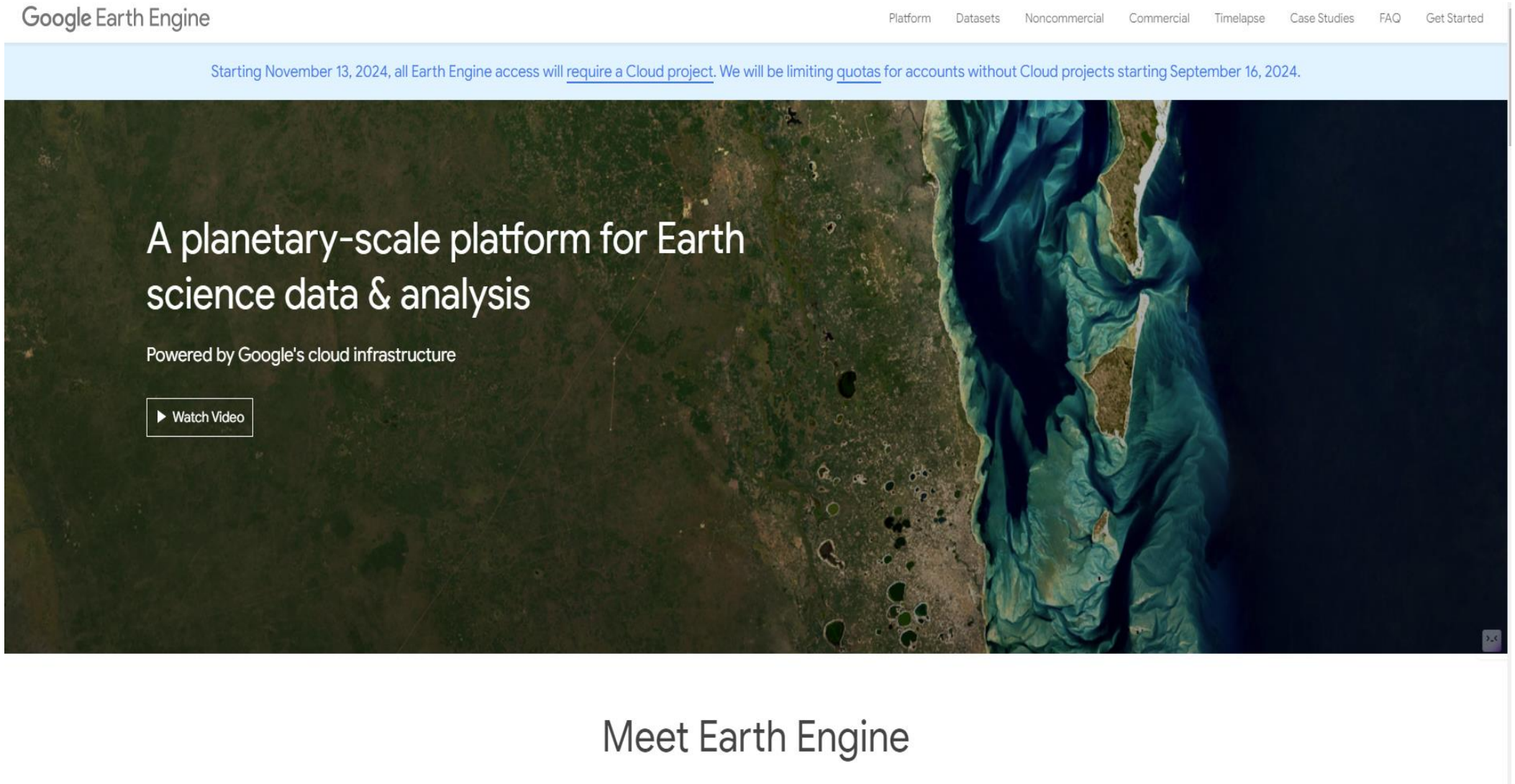
Interactive map



Open Source

- Installing with Anaconda/conda

geemap – Google Earth Engine Python API



geemap – Google Earth Engine Python API

giswqs

Type / to search

Overview | Repositories 282 | Projects | Packages | Stars 1.1k

Qiusheng Wu

giswqs

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Associate Professor at the University of Tennessee, Knoxville | Amazon Visiting Academic | Google Developer Expert (GDE) for Earth Engine

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University of Tennessee
Knoxville, TN
15:50 - same time
qwu18@utk.edu
https://gishub.org
https://orcid.org/0000-0001-5437-4073

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Dr. Qiusheng Wu is an Associate Professor and the Director of Graduate Studies in the Department of Geography & Sustainability at the University of Tennessee, Knoxville. He also serves as an Amazon Visiting Academic. Dr. Wu specializes in geospatial data science and open-source software development, with a research focus on utilizing big geospatial data and cloud computing to study environmental changes, particularly in surface water and wetland inundation dynamics. He is the creator of several widely used open-source Python packages, including geemap, leafmap, and segment-geospatial, which are designed for advanced geospatial analysis and visualization. Explore his open-source contributions on GitHub at https://github.com/opengeos.

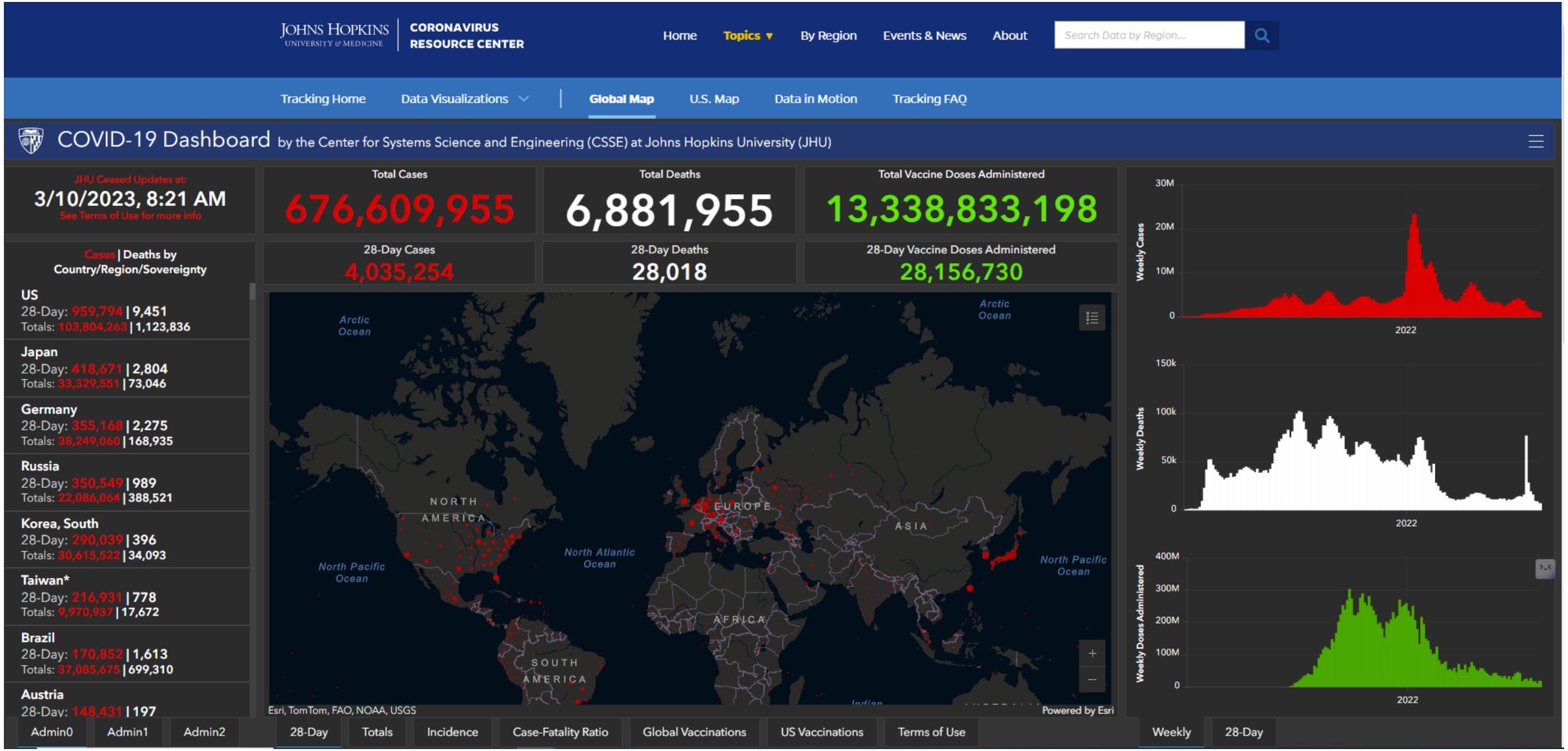
Open-source Projects

- **Linux:** manjaro-linux
- **R packages:** whiteboxR
- **Python packages:** geemap | leafmap | eefolium | geehydro | lidar | whitebox | whiteboxgui | geospatial | pygis | pypackage
- **ArcGIS Toolboxes:** WhiteboxTools-ArcGIS | Depression Analysis Toolbox | Wetland Hydrology Analyst
- **Google Earth Engine:** Awesome-GEE | earthengine-py-notebooks | qgis-earthengine-examples | earthengine-apps

Latest Blog Posts

- Visualizing satellite image time series interactively
- Segment-geospatial presentation at SERVIR
- Segmenting remote sensing imagery with box prompts
- New book release: Earth Engine and Geemap
- Creating satellite timelapse with Streamlit and Earth Engine

Web maps – No programming needed



Midterm Presentation & Final Presentation

- Create a Personal Website:
  - Design the structure of your website using HTML for content and layout.
  - Enhance the visual appearance with CSS, making it attractive and responsive.
  - Add interactivity with JavaScript to engage visitors (e.g., dynamic content, animations).

- Beautify Your Website:
  - Implement custom styles for a unique, personalized aesthetic.
  - Ensure your site is responsive and accessible across various devices.

- Enrich Your Website with a Portfolio Section:
  - Programming Skills:

    Showcase the programming languages and technologies you've learned (e.g., Python, JavaScript, R).

    Include code snippets, project descriptions, and links to your GitHub repositories.
  - Web Maps:

    Display interactive web maps you've created using the ArcGIS JavaScript API, Leaflet, Python.

    Provide descriptions of the data sources, the purpose of each map, and how they were created.

Next Class

- Sign Up for a GitHub Account (recommend use the University Account)
- Setting up a profile.
- Explore GitHub:
  - Familiarize yourselves with the GitHub interface.
  - Explore repositories, issues, pull requests, and GitHub Pages.
- Install Git
  - Provide instructions for installing Git on their local machines.
  - Explain the basic configuration steps, such as setting up their name and email.
  - Ensure they understand how to use Git commands like git init, git clone, and git commit.