Transit Accessibility Explorer

A Web-based Visualization Tool

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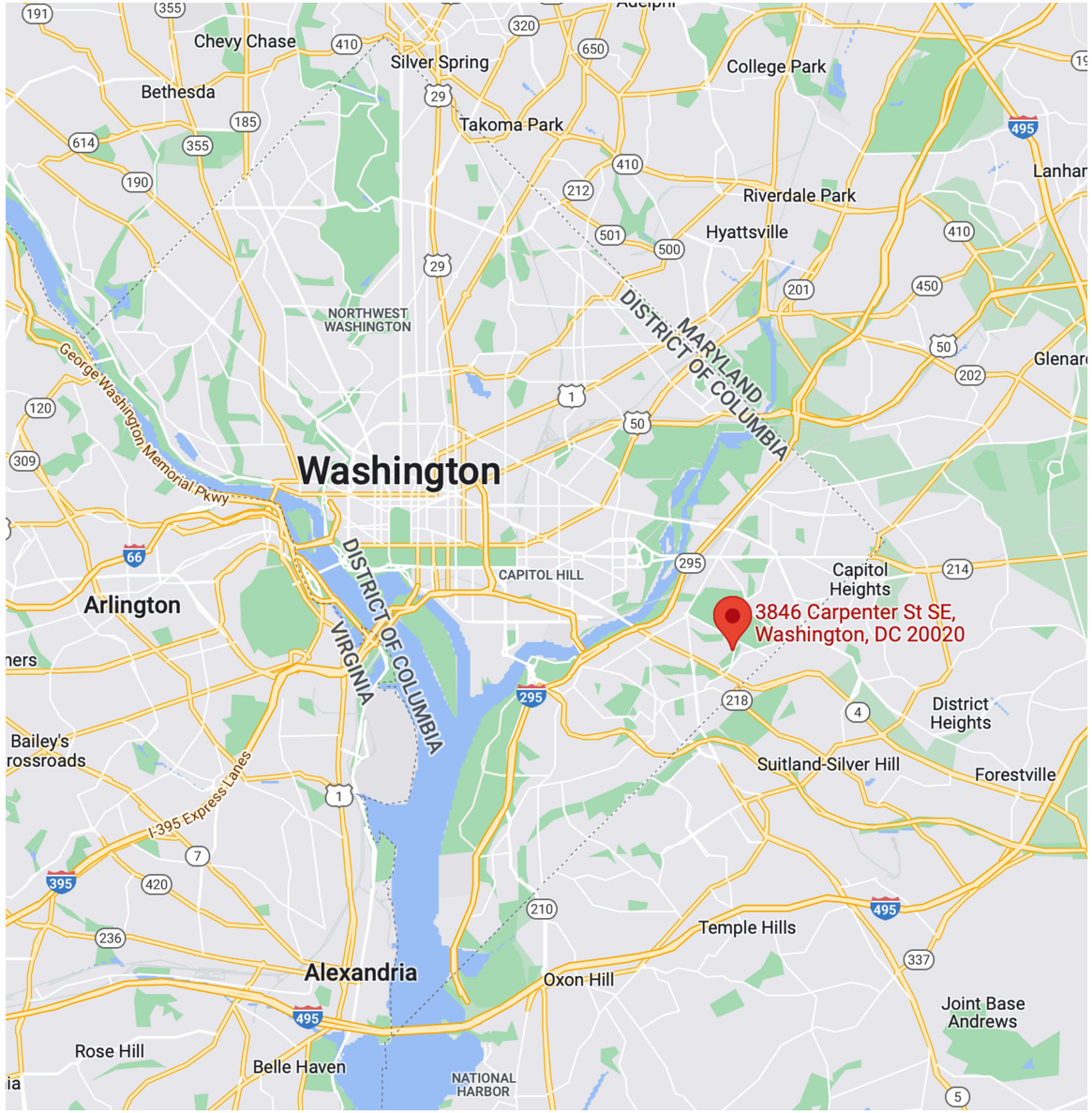
Overview

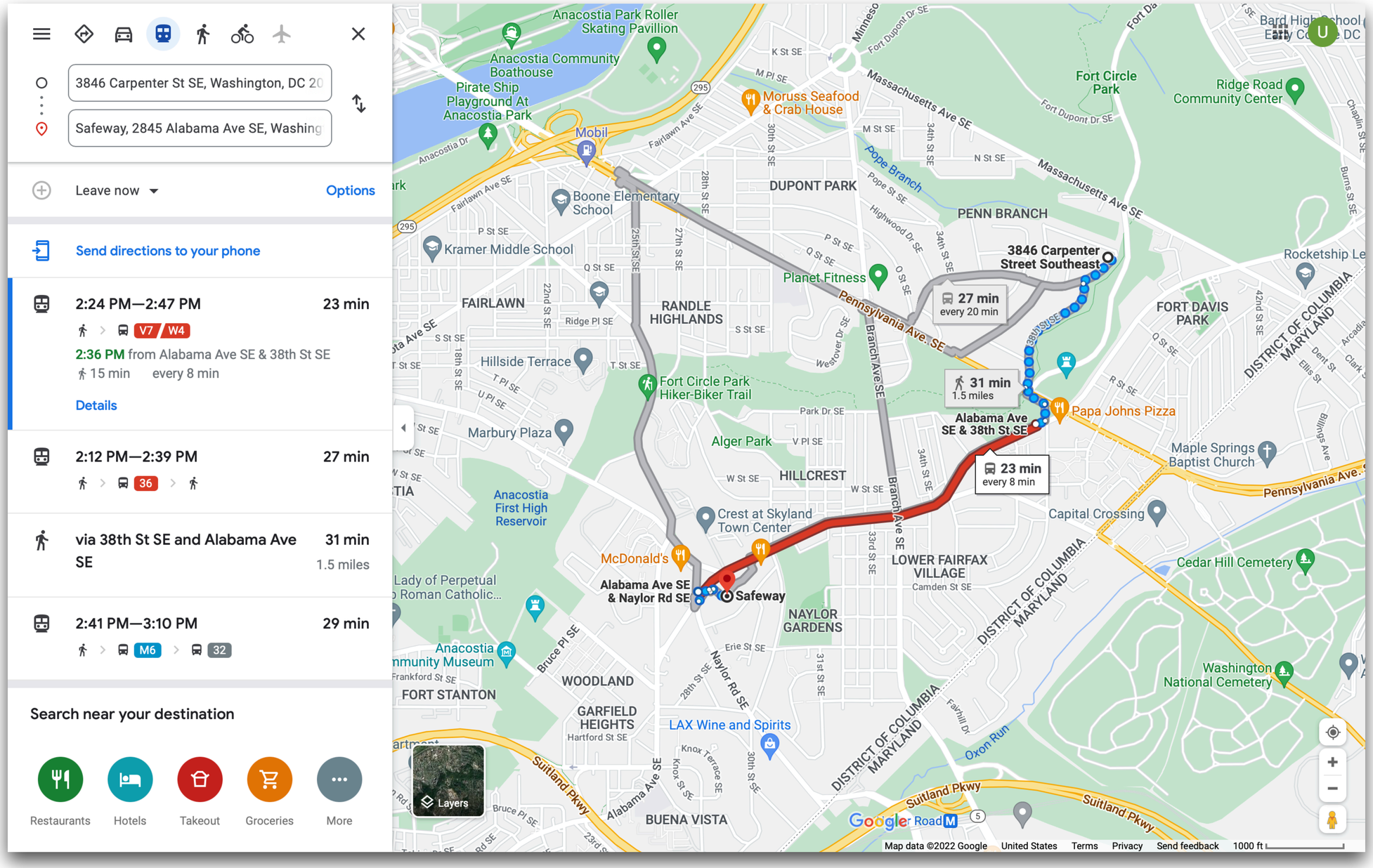
- **Part I: Introduction**
  - Context
  - The project
  - Accessibility metrics
- **Part II: Live Demo**
- **Part III: Data & Web Application**
  - Metric computation
  - Technology stack and application workflow
  - Future improvements

Part I:
Introduction

Accessibility characterizes the ease of reaching different destinations from a starting location

Say you live in NE Washington, DC at the red marker and you don't have a car, how easily can you get to a supermarket where you can buy fresh foods?




3846 Carpenter St SE, Washington, DC 20
Safeway, 2845 Alabama Ave SE, Washing
Leave now
Options
Send directions to your phone
2:24 PM—2:47 PM
23 min
V7 W4
2:36 PM from Alabama Ave SE & 38th St SE
15 min every 8 min
Details
2:12 PM—2:39 PM
27 min
36
via 38th St SE and Alabama Ave SE
31 min
1.5 miles
2:41 PM—3:10 PM
29 min
M6 32
Search near your destination
Restaurants
Hotels
Takeout
Groceries
More
Layers
Anacostia Park Roller Skating Pavillion
Anacostia Community Boathouse
Pirate Ship Playground At Anacostia Park
Moruss Seafood & Crab House
Mobil
Boone Elementary School
Kramer Middle School
DUPONT PARK
PENN BRANCH
FAIRLAWN
RANDLE HIGHLANDS
Planet Fitness
Pennsylvania Ave. SE
3846 Carpenter Street Southeast
27 min
every 20 min
31 min
1.5 miles
Alabama Ave SE & 38th St SE
Papa Johns Pizza
23 min
every 8 min
Fort Circle Park
Fort Circle Park Hiker-Biker Trail
Hillside Terrace
Marbury Plaza
Alger Park
HILLCREST
Crest at Skyland Town Center
Anacostia First High Reservoir
McDonald's
Alabama Ave SE & Naylor Rd SE
Safeway
NAYLOR GARDENS
LOWER FAIRFAX VILLAGE
Capital Crossing
Maple Springs Baptist Church
Cedar Hill Cemetery
Washington National Cemetery
Ridge Road Community Center
Rocketship Le
FORT DAVIS PARK
DISTRICT OF COLUMBIA MARYLAND
Lady of Perpetual Roman Catholic...
Anacostia Community Museum
WOODLAND
FORT STANTON
GARFIELD HEIGHTS
LAX Wine and Spirits
BUENA VIEW
Suitland Pkwy
Oxon Run
Google Road M
Map data ©2022 Google
United States
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Send feedback
1000 ft

Why is this important?

- Low accessibility could mean lower quality of life, especially without cars
  - Food deserts => fast food instead of fresh food
  - Lack of green space access => poorer health outcomes?
  - Need to take more time off work to make a trip to preventative health care facilities => fewer incentives to go
  - Spatial mismatch of jobs and job seekers
- Often related to spatial inequities
- Mobility != accessibility

Transit Accessibility Explorer

- Even though highly critical, accessibility is not widely adopted by practitioners/citizens
- Transit Accessibility Explorer is a web-based visualization tool aimed at increasing public awareness
  - Stakeholders can explore accessibility levels in their cities

3 objectives of the tool

- Introduce accessibility as a concept
- Do the heavy lifting needed to calculate metrics of accessibility and visualize them
- Allow users to explore relationships between accessibility and socioeconomic indicators as well as potential spatial inequities

But wait…

Accessibility as a concept alone is not enough.
We need to define some metrics to measure it!

(In this project, we focus on transit accessibility.)

2 metrics of accessibility

(for this prototype of Transit Accessibility Explorer)

- **Metric 1: Avg. time to reach the closest community asset of some type (e.g., a supermarket) starting from a census tract**
- **Metric 2: The number of community assets reachable from a census tract via public transit within a given time threshold (e.g., 20 minutes)**
- Accessibility metrics can be computed for many types of community assets
  - Supermarkets, parks, preventative health care services, libraries
  - Even jobs! (Accessibility and job spatial mismatch are closely related)

Part II:

Let’s look at the app (+ UI/UX design)

(It’ll make more sense when we come back to discuss technical things.)

Note: I designed the tool with the 3 objectives in mind.

localhost:3000

Part III:
Data (Metric Calculation) & Web Application

Data: Accessibility Metrics

Main ingredients needed for calculation

- Destination locations
  - data from OpenStreetMap via Overpass
- Transit stops, routes, stop times
  - General Transit Feed Specification (GTFS) data via WMATA API
- Graph routing algorithm — the bulk of time was spent here
  - GTFSpy

Accessibility Metric Calculation

- **Metric 1** (focus on supermarkets and buses as the mode of transit)
  - Recall definition: Avg. time to reach the closest community asset of some type
  - Idea: find the closest supermarket *by bus* from each bus stop in a census tract and average travel times to these supermarkets over all origin bus stops in the tract
- Large number of origin-destination stop pairs — use parallel computing to reduce computation time

Algorithm Outline

- For each bus stop in each census tract in Washington, DC
  - Calculate travel times to all other bus stops within walking distance of a supermarket (e.g., within a 500m buffer) using a routing algorithm
  - Record the fastest time
- Average all the fastest times over all bus stops in a census tract to get a value for Metric 1 for that tract
- Repeat procedure for all census tracts in DC

Web Application

Technology Stack

Backend	▸ JavaScript ▸ NodeJS	▸ Express ▸ PugJS
Frontend	▸ JavaScript ▸ HTML	▸ CSS ▸ Bootstrap
Mapping	▸ Mapbox GL JS	
Database	▸ N/A (GeoJSON stored on server)	

Web Application

Logic & Workflow

user visits url → Routes to app page; loads and parses GeoJSON as a string object and passes it to client side while rendering the page

Server-side application

↓

Creates HTML containers; parses data string as GeoJSON; creates 2 Mapbox objects and adds GeoJSON data as source.

Client-side application

→ Adds data layers with manually-defined discrete value stops for colors

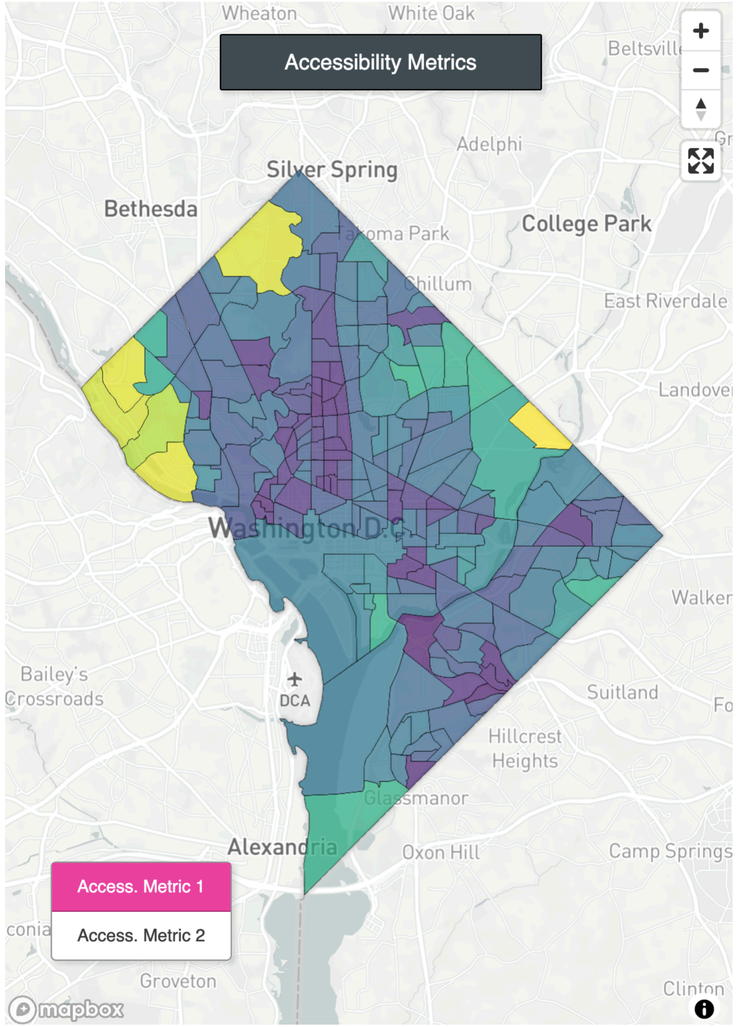
→ Adds mouse-hover event listener to each map for showing popup box

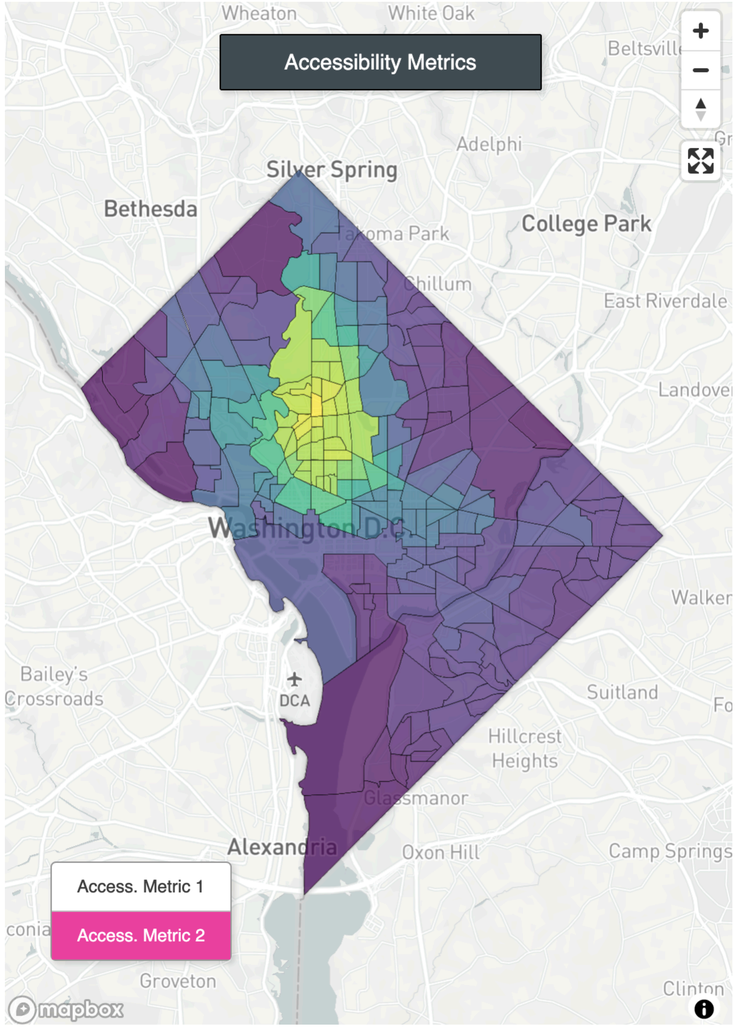
→ Adds toggleable menu buttons for switching between different data layers

Web Application

Logic & Workflow

→ Add toggleable menu buttons for switching between different data layers …



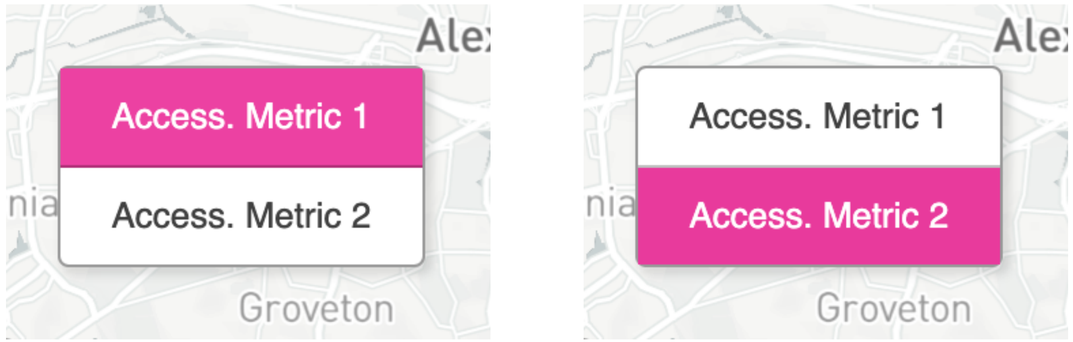


Web Application

Logic & Workflow

→ Add toggleable menu buttons for switching between different data layers

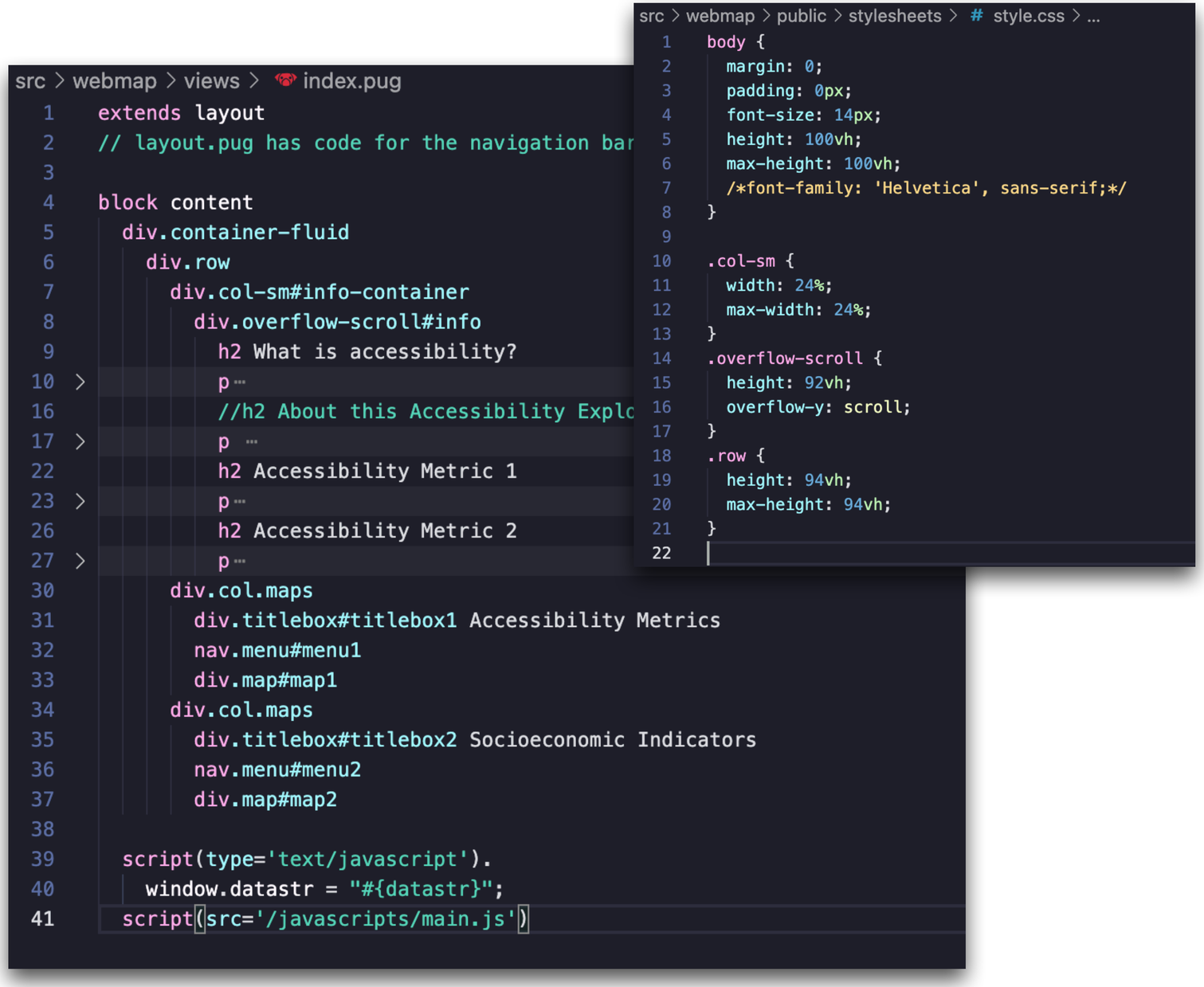
...



- When a button is clicked, the visibility property of the corresponding data layer is set to ‘visible’; rest of the layers set to ‘none’
- The HTML class of clicked button is set to ‘active’; rest of the buttons are reset to default (i.e., not active)
  - Toggle visual effects on buttons are achieved using CSS

Other good learning opportunities

PugJS + HTML/CSS + Bootstrap



Future Improvements

- More consideration in the calculation of the metrics
  - Travel times by foot using pedestrian street networks
- Compute metrics for other types of community assets
- Add legends to the maps
- Eventually:
  - Deploy as a live web app
  - Expand to other cities
- **Your inputs**

Get in touch

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