PDX Metro Food Environment Map

Executive Summary

Tree Casiano | UW-Madison | GEOG 778 Practicum
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Introduction

The PDX Metro Food Environment Map (a.k.a. PDX Food Map) is an interactive web application designed to answer two related questions:

1) *Where are the sources of healthy food in Portland, Oregon and the surrounding metro area?*
2) *How difficult is it for people living in the area to access healthy food?*

These questions are hard to answer if you do not have access to a complete grocery store dataset or GIS software. Publicly available tools like Google Maps, for example, often label convenience stores as grocery stores, have limited filtering options, and are not designed to reveal spatial patterns in food access.

The PDX Food Map is a focused tool that provides a fuller picture of the food environment than one can obtain from a Google Maps search. The map displays *all* sources of fresh produce in the Portland-Vancouver-Hillsboro, OR-WA Metropolitan Statistical Area (MSA), including grocery stores, farmers markets, Community Supported Agriculture (CSA) Drop-off sites, and food pantries. Users can generate lists of these food resources within a search radius of their choosing and learn more about their hyperlocal food environment.

Food access indicators are complex and involve many different individual and community factors, such as proximity to stores, transportation access, and household income. The PDX Food Map displays public transportation layers and bike paths as well as detailed census tract profiles that display poverty rate, median household income, and population density in addition to the tract's rural/urban, food desert, and vehicle access status.

Project Goals

This project is an evolution of a prototype originally designed for GEOG 576 Geospatial Web and Mobile Programming. The prototype displayed grocery stores, farmers markets, and a choropleth map depicting census tract food desert and vehicle access classifications. The new production version adds the following map layers and application features:

1. Community Supported Agriculture Drop-off sites and food pantries

2. TriMet and C-TRAN bus stops and routes
3. Clark County, WA and Portland City bike paths
4. Improved point feature search and census tract exploration
5. An administrative interface and authentication service so that logged in admin users can edit the data for most of the point features
6. A production environment deployed using Amazon Web Services

Target Audience

The application is designed primarily for two target audiences:

1. Residents or potential residents of the MSA who wish to learn more about their local food environment and to locate sources of healthy food.
2. Community planners, organizers, and advocates interested in exploring food access indicators and resources in Portland Metro neighborhoods (with census tracts serving as proxy neighborhoods).

Website, Demo, and Project Repository Links

Production application: https://pdxfoodmap.info
Video demonstration: https://www.youtube.com/watch?v=xQSBhPvrmUw&feature=youtu.be
Code repository: https://github.com/treecasiano/pdx-food-map

System Design and Implementation

Data Collection and Preparation

The grocery store and farmers market tables were initially seeded with open data from the City of Portland. There are no publicly available grocery store or farmers market datasets that cover the entire region, so last year I added over 150 new records and vetted each as a legitimate source of fresh produce. Census tract data obtained from Oregon Metro's Regional Land Information System was joined to data from the United States Department of Agriculture Economic Research Service Food Access Research Atlas (2017).

For the new production version of the application, I secured shapefiles for the CSA Drop-off sites and bike trails from government open data web portals. Food pantry data was gathered from various lists found on government and community web sites and entered using the new administrative console. Public transportation data was available in both shapefile and GTFS format from TriMet and C-TRAN, respectively. The GTFS files for the C-TRAN data were

converted to shapefiles using the "Display GTFS in ArcGIS" plugin. All shapefiles were reprojected to Web Mercator and converted into SQL for import into a PostGIS-enabled PostgreSQL database. (See Appendix I for data sources.)

PostgreSQL was selected because I was already familiar with it and could easily restore a Postgres database in a Docker container for local development. The physical structure of the database and a subset of the production data used for testing are stored in a SQL dump file in the project repository: https://github.com/treecasiano/pdx-food-map/blob/master/db/docker-entrypoint-initdb.d/dump.sql

Because Docker makes it convenient to tear down and rebuild the database, I was able to make schema and test data changes quickly and fearlessly, knowing I always had a safe way to reset the local database. The dump file is kept in version control with the rest of the project, so another developer can reconstitute the database and run the application locally with the exact same test data. This a prerequisite for the automated unit, integration, and browser testing that I plan to add in the future.

Back End Services and API Design

The back-end web server and API routes are built with Node and Express. I implemented an "API First" strategy and used the Open API Specification and the Swagger UI tool to develop and test the new API routes independent of the UI. The models I developed with these tools function as a kind of data contract and facilitate rapid development of CRUD (Create, Read, Update, Delete) routes that map to operations performed on each database entity.

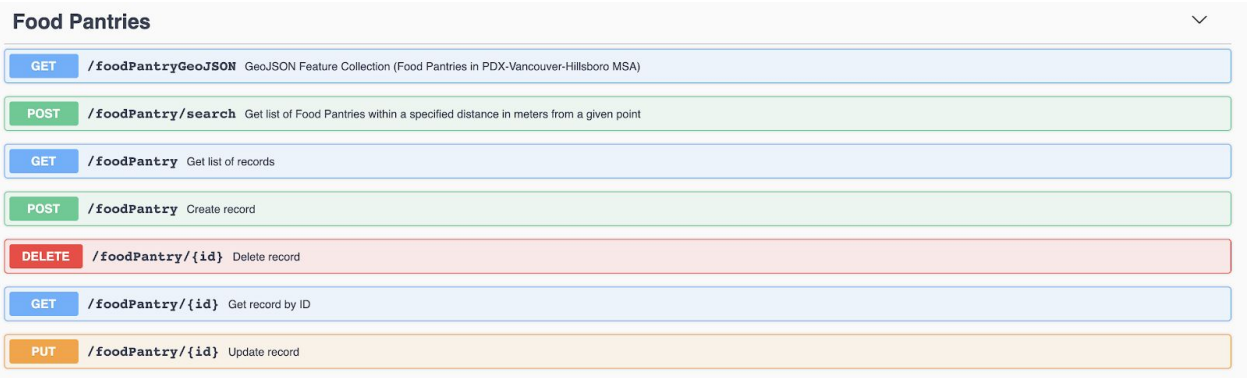

Figure 1: API routes associated with the Food Pantry entity that can be tested via the Swagger UI

Front End Framework and UI/UX Design

The front end is built with Vue.js, a modern JavaScript framework. Specifically, I used the Vue 2 Leaflet library, a Vue.js wrapper around the mapping library Leaflet. Every GeoJSON map layer

functions as a modular, reactive Vue component. The Vue CLI and Node.js handle front-end package management. The Vuex and Vue Router libraries were used for state management and front-end routing, respectively. The Vuetify Material Design library was chosen because it provides a Google-inspired aesthetic, exceptional documentation, active maintenance, long-term support, and a suite of full-featured, responsive, accessible, and versatile web components.

Deployment

The production database was provisioned using the Amazon Web Services Relational Database Service (RDS). The Node application was deployed using AWS Elastic Beanstalk and Elastic Container services. The Elastic Beanstalk Command Line Interface (EB-CLI) makes deployment virtually effortless. For user testing, I took a snapshot of my production database and used that to create a testing RDS instance. I launched a separate application instance to connect to the testing database. Users could thus log in with temporary admin credentials and add or edit records using the administrative interface without harming the production data. Once user testing was over, I simply terminated these instances.

With AWS, I was also able to secure the domain name and SSL certificate, create Security Groups that restrict inbound traffic to the database(s) in my Virtual Private Cloud, and set up Identity and Access Management roles.

Example Uses

Census Tract Profiles

To examine spatial patterns in food access, the census tracts are visualized by both food desert and vehicle access status (see Figure 2) as well as by poverty rate (Figure 3). Clicking on a tract displays a Census Tract Profile. Figures 2 and 3 show a cluster of food deserts in Southeast Portland. Most of these tracts are also classified as having low-vehicle access. Every map layer (grocery stores, farmers markets, public transportation, etc.) provides additional context that facilitates the identification of neighborhoods likely to have financial and geographic barriers to food access.

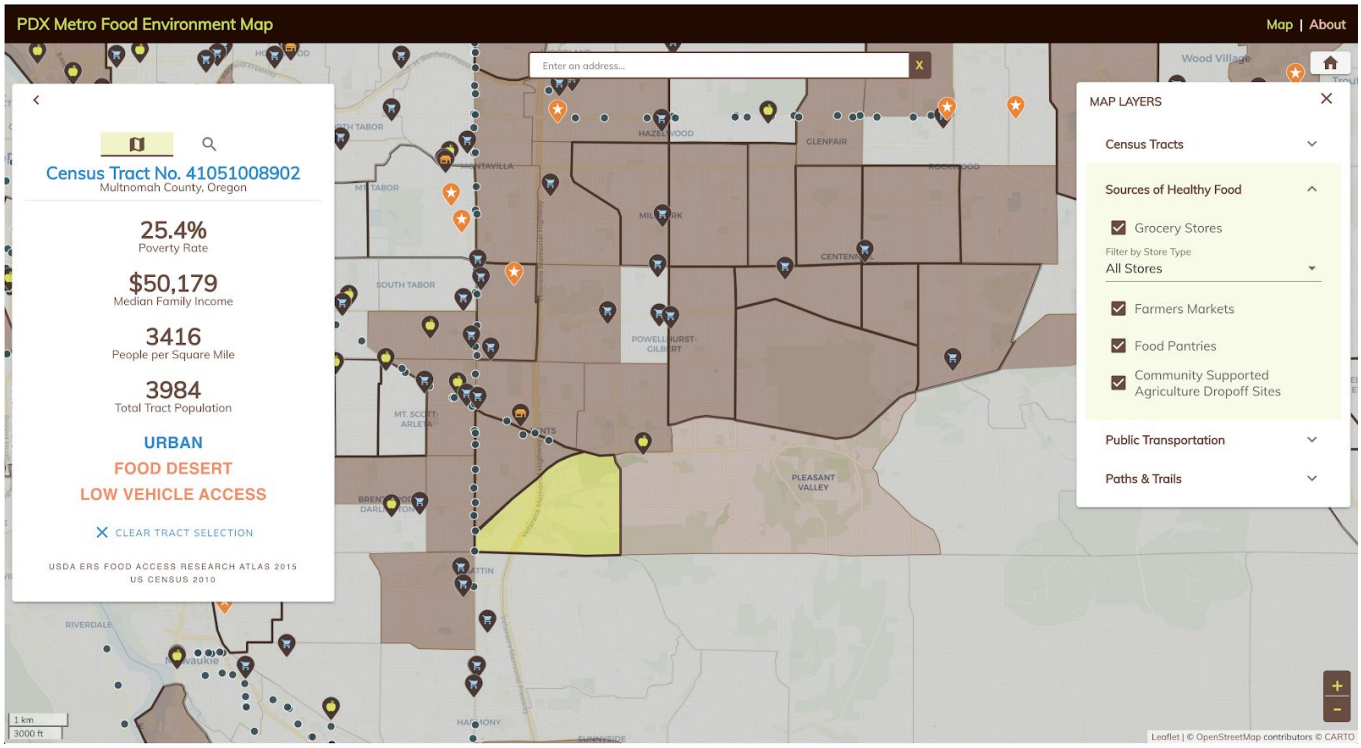

Figure 2: Census Tracts classified by food desert status and vehicle access, with selected tract highlighted.

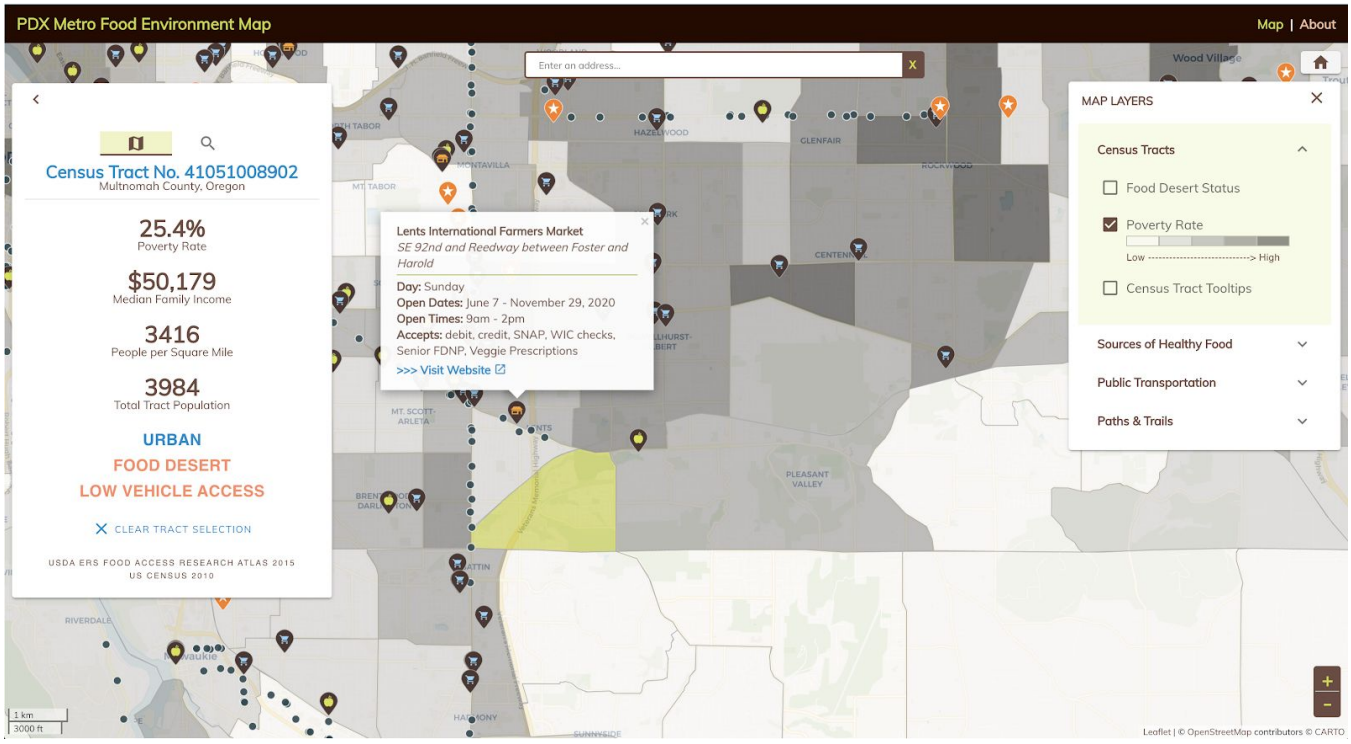

Figure 3: Census Tracts classified by poverty rate.

Search Feature

Figures 4 and 5 show the results of searches for healthy food resources in downtown Vancouver, WA and downtown Beaverton, OR. Each item in the search result list is linked to a map marker. Clicking on the orange icon for any given search result will open the associated map marker's popup and adjust the map view to include that location. While the poverty rates and median household incomes are comparable and both areas have many tracts in the vicinity classified as food deserts, there are many more food resources in downtown Beaverton.

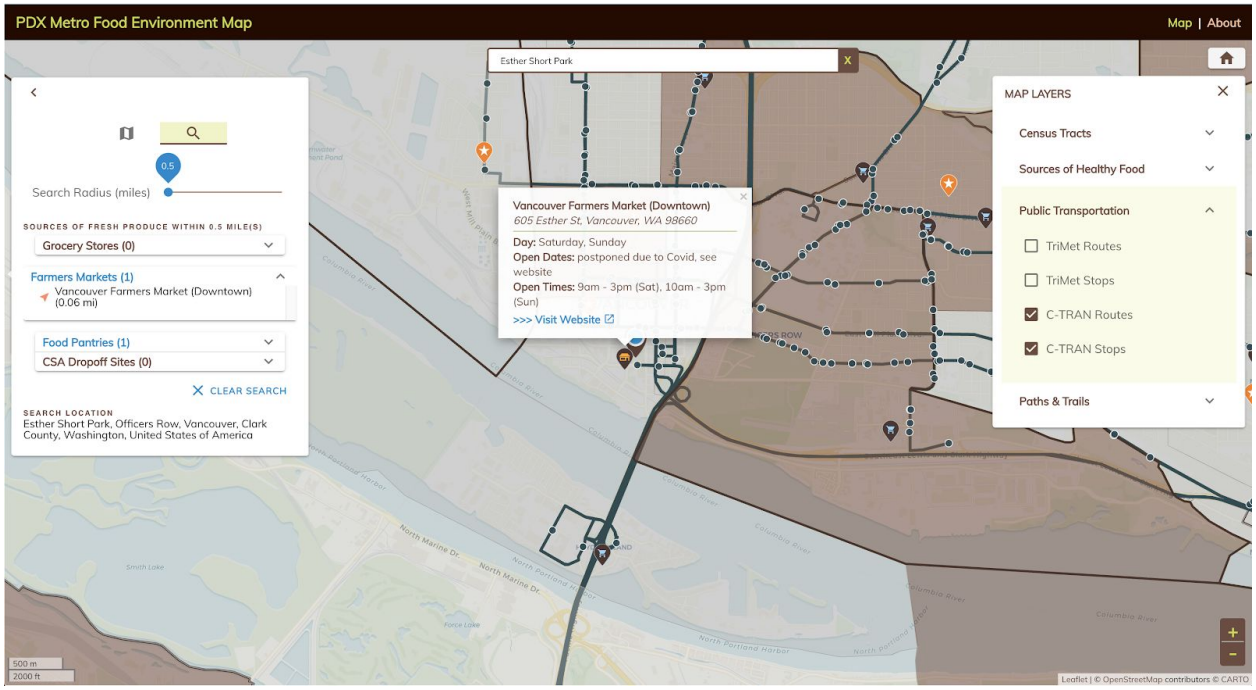

Figure 4: Sources of healthy food within 0.5 miles of downtown Vancouver, WA.

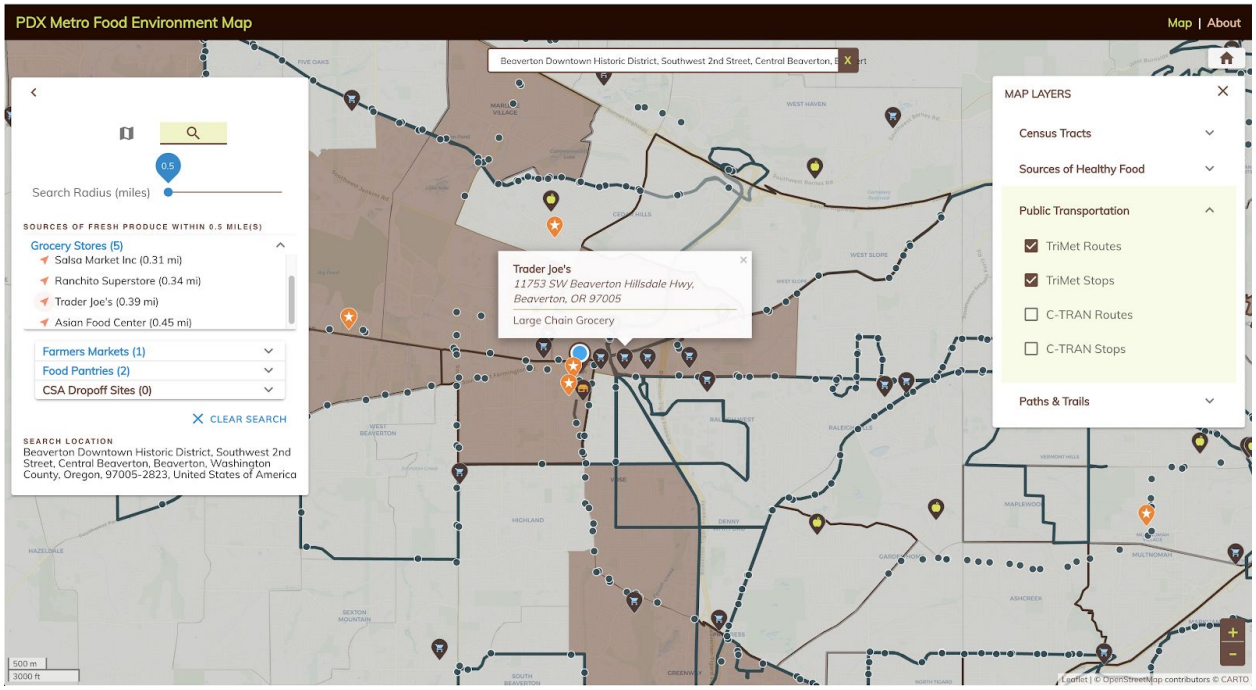

Figure 5: Sources of healthy food within 0.5 miles of downtown Beaverton, OR.

Admin Console

To make it easy to create the food pantry dataset and update the seasonal information for all 41 farmers markets, I created an administrative interface. The “Admin Console” is a responsive interface that displays all grocery store, farmers market, and food pantry database records in a searchable, sortable table (Figure 6). Form field validation and keyboard-navigability facilitate rapid and accurate data entry (Figure7) .

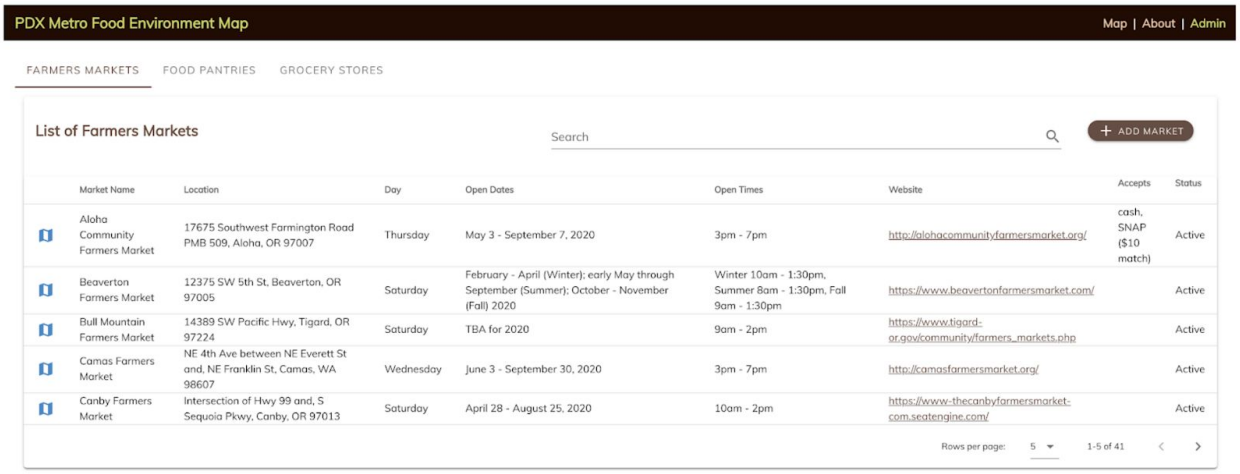

Figure 6: Admin Console, table view

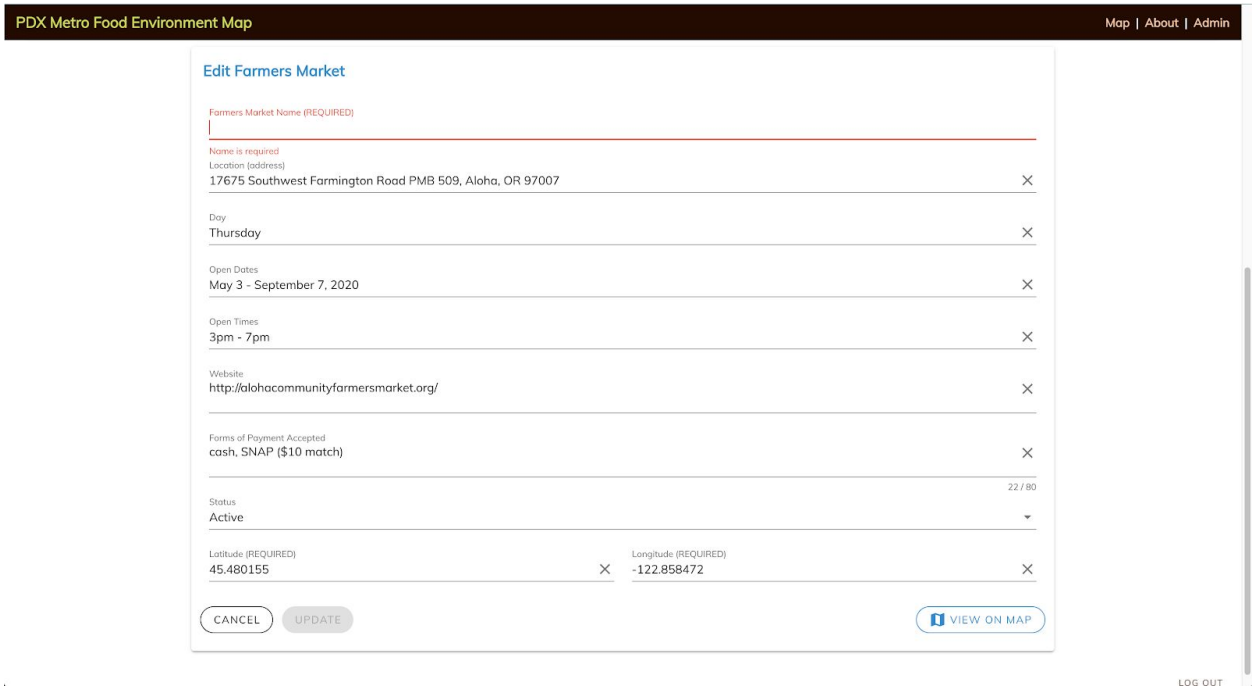

Figure 7: Admin Console, edit form showing validation of a required field

Limitations

The most significant limitation to this application is that the data is not updated in real time. Grocery store data will seldom change. Stores opening and closing are infrequent events. Farmers markets, however, do update seasonally, and now with the COVID-19 pandemic, hours of operation for the season are not yet known.

There were more sources of emergency food than I anticipated, so the records are not yet truly comprehensive for the entire statistical area. I focused on the free food markets where you can get fresh produce and other healthy food. More resources will be added in the future. I made sure that each location has a website link and/or a phone number so that users have a convenient way to get the most up to date information.

Lastly, there are some omissions in the data from TriMet, so not every stop appears to be connected to a TriMet route and not every route has associated stops. An opportunity for future development would be to retrieve this data directly through TriMet's web services so that updates are immediately available in the application.

Another possibility for future development would be to include an export feature. As far as I am aware, I have the most comprehensive database of grocery stores in the area and would be happy to share it with others. I am also considering adding a form available to the public that would let them inform me of incorrect or missing stores, markets, or food pantries.

Conclusion

I thoroughly enjoyed building the PDX Food Map. It was satisfying to work across the entire stack, from data modeling and API design to the final polishing of the user interface and everything in between. My success with completing my deliverables well in advance of deadlines and the achievement of all of my stretch goals can be attributed to careful planning (a course requirement) and my ability to leverage the significant client-server communication, software development, web mapping, and JavaScript skills learned over the past four years. I started my job as an application developer around the same time I started the GIS graduate program and have found that one endeavor has continually informed the other. My hope is that this project not only showcases my skills but also serves as a useful tool for other people.

Links to Tools and Technologies

Simple Statistics: https://simplestatistics.org/
Swagger and Open API: https://swagger.io/docs/specification/about/
Vue2Leaflet Library: https://korigan.github.io/Vue2Leaflet/
VueJS JavaScript Framework: https://vuejs.org/
Vuetify Material Design Component Framework: https://vuetifyjs.com/en/

Appendix I

Census Tracts 2010 shapefile from Oregon Metro
Retrieved from http://rlisdiscovery.oregonmetro.gov/?action=viewDetail&layerID=2588.

Community Supported Agriculture (CSA) Farm Dropoff Sites
Retrieved from http://gis-pdx.opendata.arcgis.com/datasets/csa-farm-dropoff-locations on 2/1/2020.
Data last updated on 1/29/2019.

C-TRAN Public Transit
Retrieved from https://www.c-tran.com/about-c-tran/business/c-tran-gtfs-data on 2/1/2020.

Farmers Markets, City of Portland
Retrieved originally from https://gis-pdx.opendata.arcgis.com/datasets/farmers-markets) in April 2019.
Dataset was extended by the project developer who will update the data with 2020 information prior to project deployment.

Food Pantries in Portland, OR
Retrieved from https://www.foodpantries.org/ci/or-portland on 2/1/2020.
Updates to be made quarterly by the developer.

Grocery Stores, City of Portland
Retrieved originally from https://gis-pdx.opendata.arcgis.com/datasets/grocery-stores/data in April, 2019 and will be updated annually by the developer.

Pedestrian and Bike Trails for Clark County, WA
Retrieved from https://gis.clark.wa.gov/gishome/metadata/#/layer/306 on 2/1/2020.

Portland Recommended Bicycle Routes
Retrieved from http://gis-pdx.opendata.arcgis.com/datasets/recommended-bicycle-routes on 2/1/2020.

TriMet Geospatial Data (Route Stops)
Retrieved from https://developer.trimet.org/gis/ on 2/1/2020.
Data last updated by TriMet on 1/15/2020.

USDA ERS Food Access Research Atlas (2017 data)
Retrieved from https://www.ers.usda.gov/data-products/food-access-research-atlas/.