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Geog 778
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Trajectory Data Visualization

Executive Summary

Overview

I am always curious about the potential factors that may influence the car insurance price. I think the insurance company may consider the driving habits as one of the important factors to estimate the insurance price. As a result, I created a trajectory data visualization tool for users to plot trips of the vehicle on an interactive map and find the locations where risky driving behaviors happen. Users can plug in their own trajectory data in the Jupyter notebook, and select which variable in the dataset they want to visualize using the interactive map component embedded in this notebook.

Objectives

1. Visualize dangerous driving behaviors and help estimate the car insurance price; bring benefits for the company.
2. Alarm drivers to drive safely and ultimately save lives.

Users

The target users would be data scientists in the insurance company. They need to be familiar with the Jupyter Notebook development environment, and have experience in data collecting - data cleaning - data analysis - data visualization workflow. These data scientists may find my tool helpful if they need to visualize the trips of the vehicles on the map and locate the risky driving behaviors. After they visually assess the trips using my tool, they can then use their machine learning models to predict the car insurance price for each vehicle. This tool is programmed in Python and organized in the Jupyter Notebook, so it should be portable and easy for the data scientists to integrate in their own workflow on Google Cloud Platform for example.

Example Uses

The user firstly needs to make sure the original trajectory dataset contains these variables: vehicle_ID, longitude, latitude, timestamp, velocity, acceleration. Then, the user can upload this data in .csv file format in the Jupyter Notebook.

Then, the user can specify the headers and the number of rows for the dataframe. Next, the user can click “Runtime” and then “Run all” to execute all cells of this notebook. The notebook will generate an interactive map component at the very end of the notebook. This interactive map is powered by Leaflet and the basemap style is OpenStreetMap.

The user can pan around, zoom in/zoom out on the map. The user can also click the layers icon and select the variable that the user wants to inspect.

Case 1: Velocity

If the user selected velocity layer and toggled off other layers, the user would see a green color coded line that represents the instantaneous velocity of the vehicle along a trip. When hovering on the small gray circles on the green line, the user would see the velocity value at that specific point of location. (Figure 1)

Case 2: Acceleration

Acceleration is a vector quantity so it has both negative values (deceleration) and positive values (acceleration). As a result, the color coded line for acceleration is designed as a diverging blue to red line. The darker the blue, the larger the deceleration, and the vehicle would be moving slower; the darker the red, the larger the acceleration, the vehicle would be moving faster. When hovering on the small gray circles on the diverging color line, the user would see the acceleration/deceleration value at that specific point of location.

If the user checked the box for the “Speeding/hard-brake” layer, then the user would see red circles on the trip that inform the user there might be a speeding or hard brake at the specific point of location, because the acceleration/deceleration value is beyond the safe range. (Figure 2&3)

Case 3: Location

If the user just wanted to visualize the trip and knew the coordinates of the vehicle along the trip, the user would turn on the “marker” layer, and then some clusters of markers would appear along the trip. If clicking a cluster, the user would see red information markers that show the longitude and latitude values. The reason why I use the marker cluster feature is that too many markers would make the map overcrowded, especially when the user zoomed out. (Figure 4)

Data

The original trajectory dataset I used for this spatial data visualization tool is Next Generation Simulation (NGSIM) Peachtree Street dataset. This trajectory dataset was collected by the United States Department of Transportation (US DOT) Federal Highway Administration (FHA) on November 8, 2006, on Peachtree Street, Atlanta, GA. As the documentation of this dataset states, there is no accuracy assessment performed for the dataset. This may partially explain why some of the trips are not perfectly aligned with the centerline of the road network on the basemap.

The dataset can be accessed here:
https://datahub.transportation.gov/Automobiles/Next-Generation-Simulation-NGSIM-Vehicle-Trajector/8ect-6jqj

Improvement

One thing that can be improved in the future development is to better align the trip visualization with the centerline of the road network. OpenStreetMap may provide the street centerline vector layer for this request. I need some time to figure out how to plug this vector layer in the interactive map component.

The second thing is, it would be great if I could visualize how the vehicle changes lanes on the street. I believe this request depends on how close we can zoom in on the basemap, and how accurately the trip can be snapped to the street centerline. I think heading is another important variable for me to implement the lane changing feature, unfortunately, this NGSIM data does not include this variable.

Learning

This is the first time I go through a complete workflow of data analysis: from data searching to data preprocessing/cleaning to data analysis to data visualization. And this is also a new experience for me to use a non GIS platform to create a map. This mapping component nested in a Jypyter notebook would be more friendly for non GIS professionals to use and ingest into their own workflow. In addition, I also improved my programming skills, problem solving skills, and cartographic design skills.

APPENDIX: SCREENSHOTS

Figure 1:

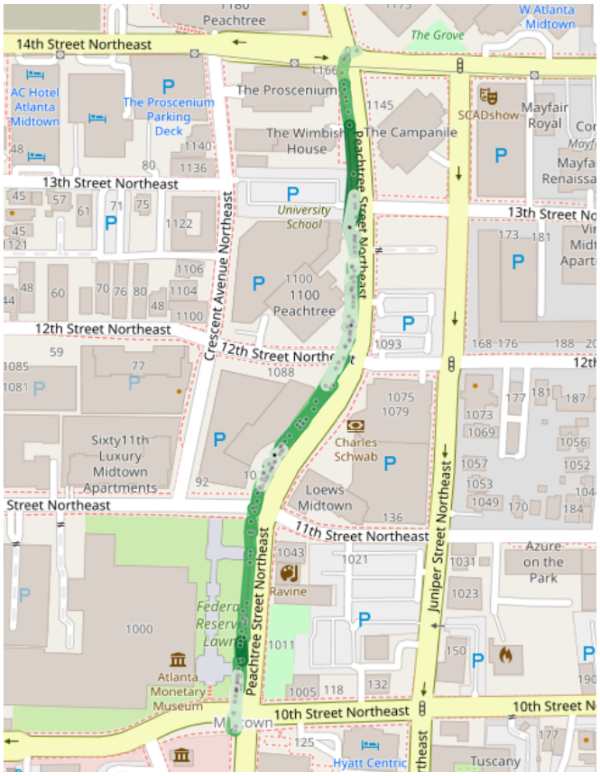


Figure 2:

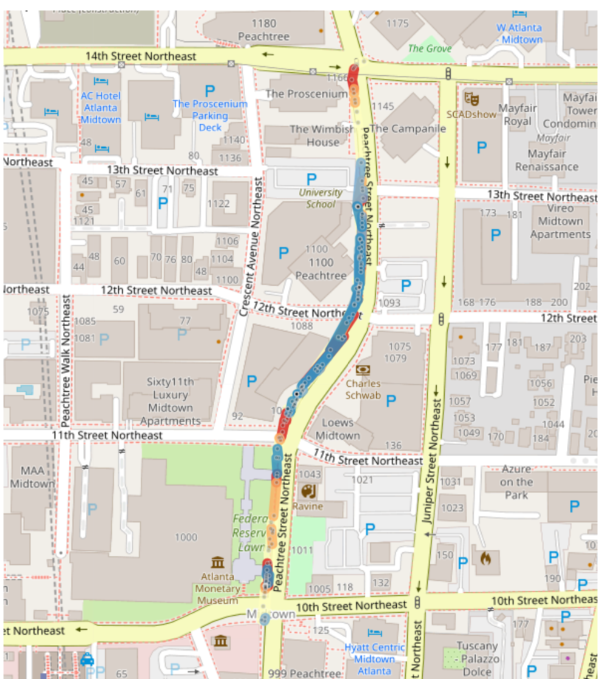
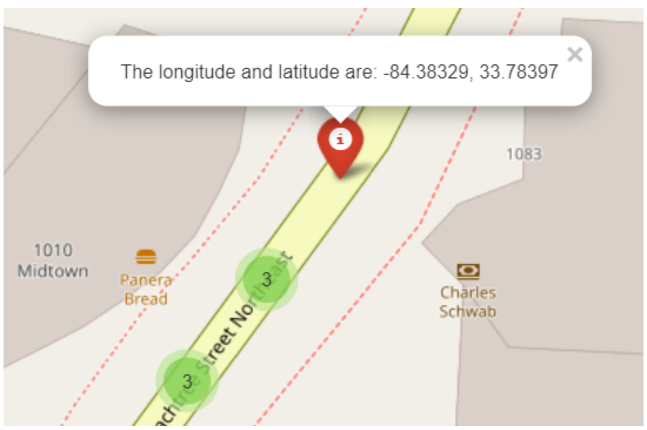


Figure 3:


Federal
Reserve
Lawn
Peachtree
1011
10th Street
Park
Atlanta
Monetary
Museum
1005
10th Street Northeast
Midtown
125

Figure 4:


The longitude and latitude are: -84.38329, 33.78397
1083
1010
Midtown
Panera
Bread
Charles
Schwab
3
3