Mapping Your Transit:

Using publicly available GTFS data to automate production of interactive transit maps of your community

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Spring 2025

Background:

Public transportation is an important tool that supports communities all over the world. It makes travel and social engagement more accessible, it creates jobs, eases traffic congestion, and is a greener alternative to driving. Mapping Your Transit is a project that celebrates your local transit network with fun and interactive maps. Leveraging the power of an open standard format for transit data, the General Transit Feed Specification (GTFS), this project allows users to upload data from any transit network to view an interactive map and download a custom poster of their favorite bus or subway system.

GTFS data is widely available for almost any regional transit organization in the United States, and a simple google search of “GTFS” and a city name will usually find a link to download the text files that make up a GTFS database. While transit maps are widely available for navigational purposes from regional agencies themselves, stylized “fun” transit maps can be hard to find. Using this standardized data, users can make cohesive, aesthetically pleasing maps for unique places with the click of a button.

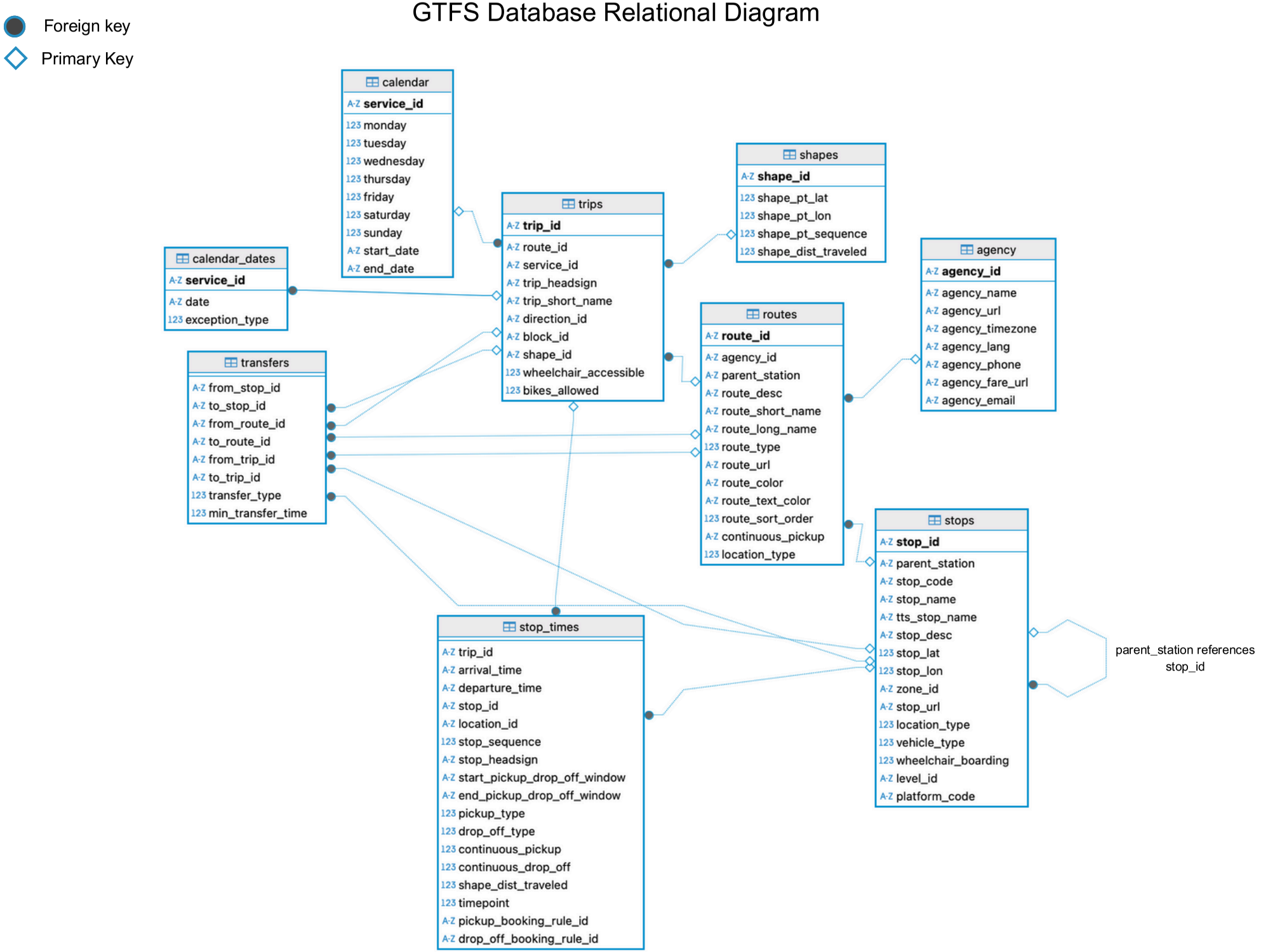
Data:

This project is built using GTFS Data, which is a well documented open standard data format used internationally to make transit data widely available to the public. Initially designed by Google engineers and known as Google Transit Feed Specification, it is a widely used standard that makes it possible for third party navigation apps to include transit modes of transportation in their trip planning. It is made up of several tables holding data on routes, stops, schedules, and geospatial features. For more background on the GTFS format, visit gtfs.org.

There are two main types of GTFS Data: static and real time. GTFS realtime data includes live updates of vehicle locations and departures. This project uses GTFS static or “GTFS - Schedule” data, which is made up of fixed schedule, route, and stop information. There are seven essential text files that make up a GTFS feed: stops, stop times, routes, agency, calendar, calendar dates, and trips. This project requires at least one inessential file, shapes, which contains necessary geospatial data. This file is included in most GTFS feeds.

The following diagram shows the general structure of the GTFS data format, and the structure recreated in the database generated by Mapping Your Transit.

GTFS Database Relational Diagram



This project uses 5 of the essential GTFS Files and the shapes.txt files. All of these files must be present in the uploaded zip folder to use the app.

- **stops.txt** – Contains information about individual transit stops, including names, locations (latitude and longitude), and IDs.
- **stop_times.txt** – Details the scheduled arrival and departure times for each stop along a trip.
- **routes.txt** – Defines the transit routes, including route names and types (e.g., bus, subway).
- **agency.txt** – Provides information about the transit agency operating the service, such as name, URL, and timezone.
- **trips.txt** – Lists the individual trips for each route and service, linking routes, service calendars, and stop sequences.
- **shapes.txt** – Contains a list of coordinates associated with the shape of a trip. This is the only innessential file necessary for using Mapping Your Transit

Process:

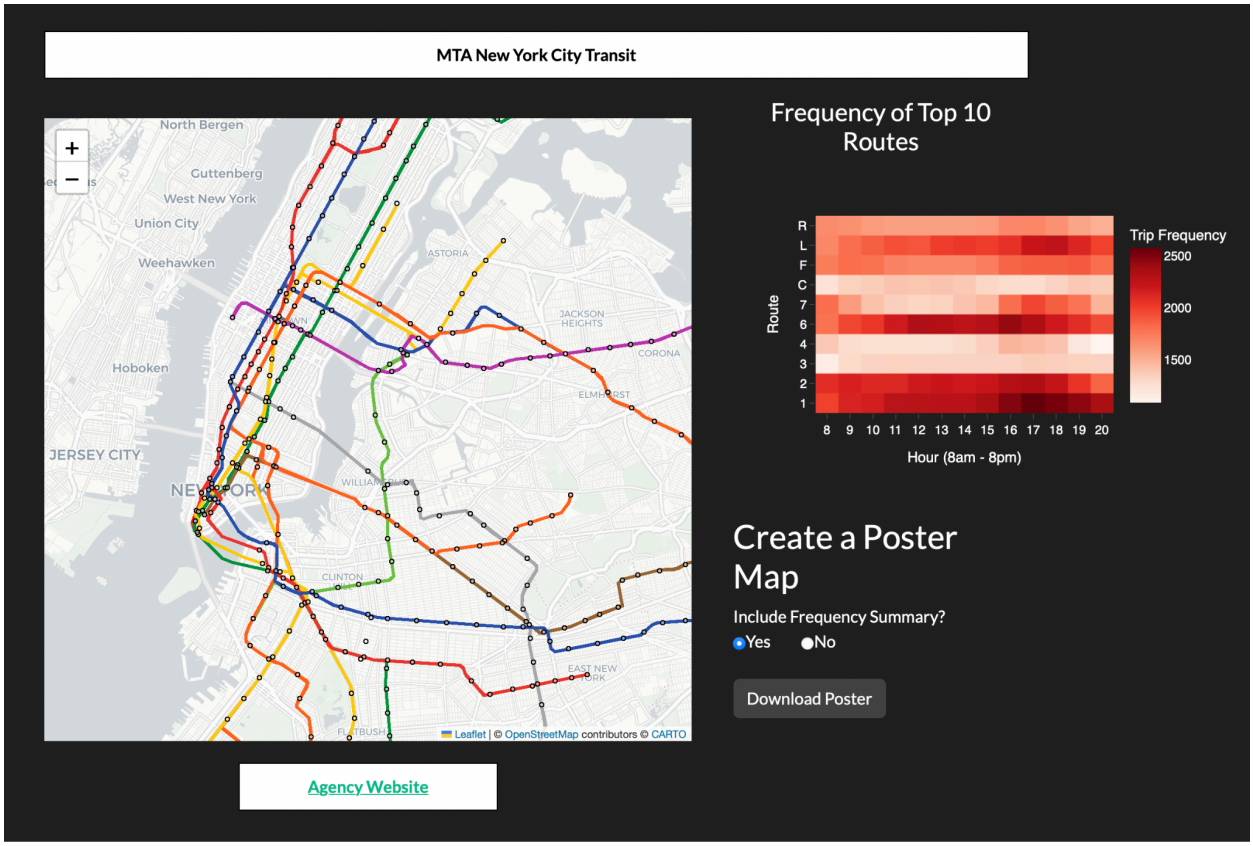
When using Mapping Your Transit, users can upload data or choose from an existing selection of cities. The compressed files uploaded to the user interface are then inserted into a database when an instance of the class “Feed” is created. This class streamlines access to GTFS tables and simplifies internal processing. Many components of this class were inspired by the gtfs_functions GitHub library, which was created to simplify working with GTFS data in python. When processing the geospatial data stored in the GTFS feeds, I use the Geopandas library, which extends the functionality of the pandas library to make operations on spatial data easier.

A primary focus of this project that is very prevalent in the data processing stage is making sure that all legitimate GTFS feeds are compatible with the way data is handled and transformed, so that users are limited as little as possible when using the system to create and explore maps. In order to prioritize compatibility with any GTFS feeds, I check for and try to correct for unexpected files and columns, missing data, and other common errors. Testing for the project was done using a diverse set of feeds in an attempt to anticipate these errors.

Interactive maps are created using Folium, which integrates with the Leaflet.js library to display geospatial data directly in the user interface These maps are color-coded by route and feature clickable popups displaying route names, stops, frequencies, and service days. Static poster maps are generated using Matplotlib, using the Shapely library to streamline access of geospatial components. The entire user interface is built using Dash, a Python framework for interactive web apps.

Using the Mapping Your Transit Project:

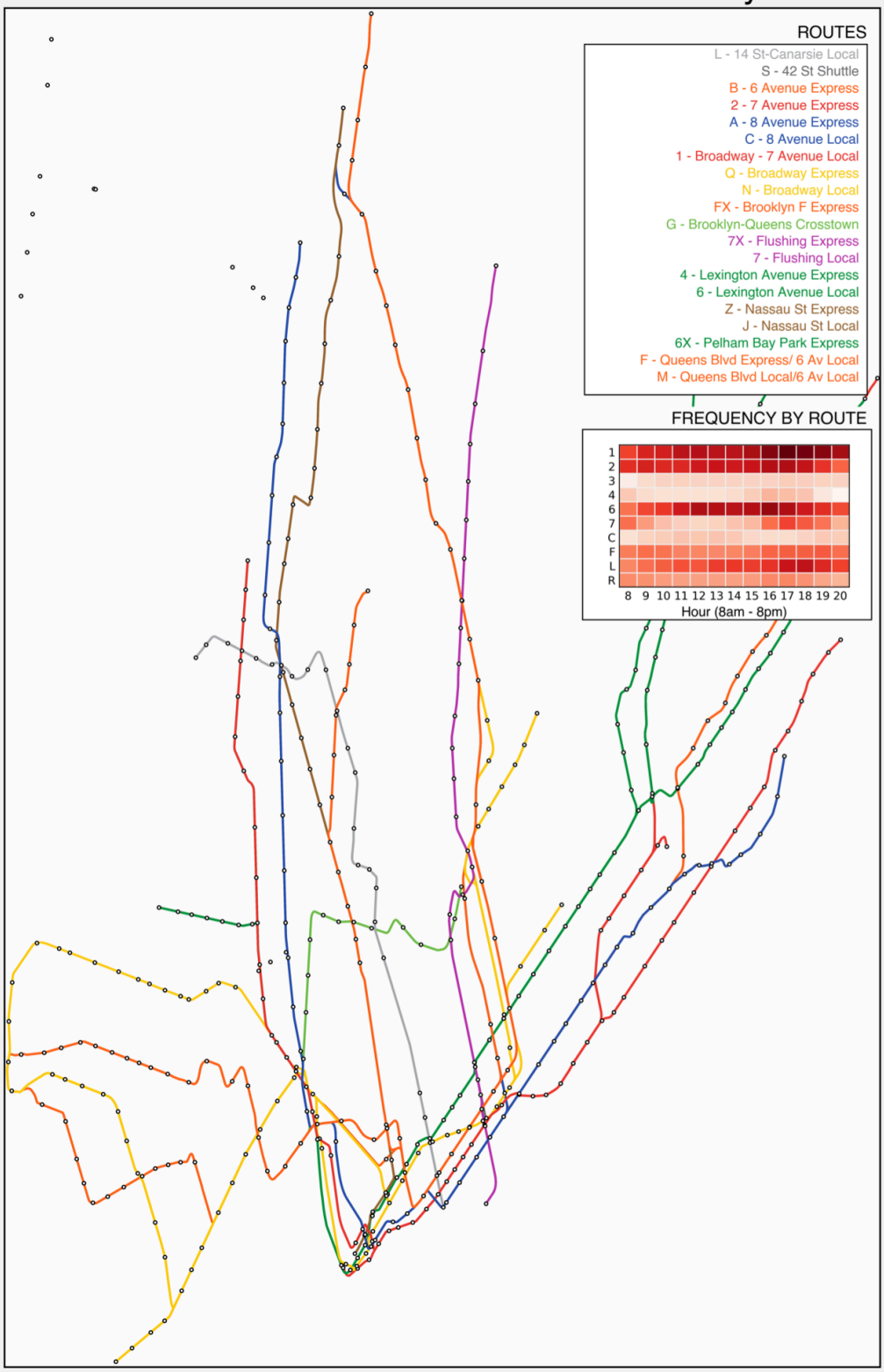
Users can interact with Mapping Your Transit via its user interface, where they can upload GTFS data, interact with the transit map, and download a poster.



After data is selected or uploaded, an interactive map window appears showing the folium map. Users can click on each route or stop to explore the features of the transit network. This interactive map allows users to see what routes would be useful for their daily commutes and to see the times and dates these routes run.

An interactive frequency table is also created showing the total number of trips per hour of the top 10 routes. Users will also be able to click a download poster button, which generates and saves a static 11 x 17 transit map poster. Users have the option to download the poster with or without a frequency table included. The given example shows a preliminary version of the posters.

MTA New York City Transit



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With a minimalistic and simplified aesthetic, these posters are primarily designed for decor and not for use as a navigational tool. The user interface will also provide a link to the transit agencies webpage if users want to learn more or find navigational maps.

This project offers a creative way to explore the structure of local transit systems and share them in a visually compelling format. By using open source data, Mapping Your Transit helps users appreciate the complexity and beauty of the transit networks that keep their communities moving.

Potential Future Developments:

This project is functional with many GTFS feeds, but it does struggle with very large feeds, limiting its usability. When adapting a project to accept user submitted data, there is a tradeoff between limiting what users can submit and limiting what the app can accomplish. As it is impossible to fully predict what users will submit, more extended testing could reveal unexpected errors and allow for more robust preparation for user submissions. There could also be more strenuous validation of GTFS Feeds when first submitted. Implementation of a validation system such as GitHub repository gtfs_validator.

Major future developments may include enhanced customization options for the poster maps, such as implementing basemaps, which is a continuing goal of mine, and allowing for the choice of a light or dark mode poster.

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