

## Technical Manual

### Vehicle Routing Problem

- In the *Vehicle Routing Problem (VRP)*, the goal is to find optimal routes for multiple vehicles visiting a set of locations. (When there's only one vehicle, it reduces to the Traveling Salesman Problem.)
- For field progress map we modelled the problem as a Vehicle Routing problem with the volunteers as the vehicles and the voters as the locations where the products need to be delivered.
- Time travel matrix - The distance between points is refactored to use time taken to travel between voter locations from the Mapbox APIs.
- The time of conversation (10 minutes) per person is added to the time travel matrix.
- Hence, the Google OR tools library optimizes the total time required by the volunteers to cover the entire precinct and provides optimal routes (sequence of voters to visit) for each volunteer.
- The algorithm that OR tools internally uses is the Path Cheapest Arc algorithm which greedily finds the next voter to visit for each volunteer based on the remaining available time of the volunteer and the travel time matrix. Once, the availability of a volunteer is over then the algorithm stops adding more voters to the route of the volunteer.

### Algorithm

- Constructed pandas dataframes of voters
- Constructed dataframe of precincts from the precinct file.
- Filtered voter dataframe to include only the voters within the input precinct using geopandas
- Used the Mapbox APIs to construct travel time matrix
- Used OR tools to generate routes of volunteers
- Mapped the route indices to actual volunteers and added useful volunteer information such as next voter to visit to each voter
- Created geojson of voters with the volunteer information.