BDA PROJECT CHECKPOINT 2

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AIM:

Propose a cost function to minimize on your project.

COST FUNCTION:

Cost = (Trip Time (mins) / 30 (mins)) + (1/10) (The time spent stopped in traffic, at stop signs, or at stop lights. / Time (mins)).

The idea behind the below cost function is that we reduce Professor Kinsman's travel time from house to work place. As we know the time is approximately 30 minutes, we are reducing it one way, from home to work primarily because reaching to work on time is important. Also, we could assume that the travel back would be the same route and even if not, reaching late from work is not that bad as compared to reaching late to work.

The total cost function is composed of two parts:

- Objective function
- Regularization

The objective, in this case, is to reduce the trip time from work to home or the other way round. The usual travel times are 30 minutes, so the travel time is normalized by 30 (as mentioned in the write up).

For the regularization part, we have decided to consider to reduce the time spent on stop signs or traffic lights. So, for calculating the total time stopped, we will compare the latitude/longitude with the corresponding time, and check if the coordinates have changed or not and in the process add the time in minutes wherever the coordinates remain the same or in other words, do not change. The numerator is the actual time spent on while on a trip from home to work and overall time stopped in that trip. The denominator is the approximate average time Professor Kinsman stops at all red lights and stop signs. This data will be fetched and calculated from the GPS file provided to us. This will be coded when implemented. Then the factor of 1/10 assures that the regularization does not dominate the objective function (as in write up). The final computed cost has no units on it.

Causes of Noise:

Sometimes the data obtained by the GPS, that is the track of the vehicle appears to be in motion even though when it has been parked. This can be considered as noise which is caused because of the device's inefficiency to see enough satellites at a given time. Here, there is an occurrence of noise because the GPS sensors may not be able to fix on at least four satellites. The orbits of the GPS satellites used by the Garmin Global Positioning System

receivers are arranged in a manner that at a given time at least four satellites are visible to these receivers. The user's location is later determined or triangulated by the process known as trilateration by picking up the signals from the satellite. The four satellite are used for specific tasks as mentioned below:

- **First satellite**: The initial localization on the Earth.
- **Second satellite**: Narrows down the user's location. This is done by considering the circle formed where two spheres of the satellite intersect.
- **Third satellite**: Further narrows down the choice to two probable points on the Earth's surface.
- **Forth satellite**: Selects one point among the two probable points as the user's location. This is done by calculating the location and time corrections.

The GPS file comprises of two types of data: **GGA and RMC**.

How we can measure noise?

In order to check the number of satellites, the user can check the seventh data attribute from the GGA data field. It tells us a maximum of 12 satellites that can be connected to the device. If there are less than 3 satellites, then we will have inaccurate data. The way we can get rid is that just remove that data point where satellites count is less than 3. If satellites are 3 or more, retain the data points.

Measures to reduce or avoid this noise:

- Initial acquirement from the satellites by the device is time-consuming. If this is for the first time and can take around a few minutes to establish the user's position.
- For better signals, the antenna of the device must be flipped up and should be parallel to the Earth's surface.
- When the device is placed indoors, the chances of it acquiring the satellites are very low as the process of locating the satellite and locking it will be hindered by the walls and windows of the house.
- For better satellite acquisition, try mounting the device on the windshield or dashboard of the vehicle.
- Sometimes the signals from the satellite are interfered with due to the electronic devices or any protective coating on the windshields. In this case, the user can place the device under the clear sky for a few minutes to obtain satellite acquisition.

REFERENCES:

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- https://www.techwalla.com/articles/how-does-a-garmin-gps-system-work
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