Using GPS Location Data to Score Drivers' Safety

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ELECTRICAL & COMPUTER ENGINEERING

Introduction

Glympse, a small company that provides location sharing services to their industry partners and commercial consumers. They have a huge amount of traffic data collected from their app, and they want to know what we can do with it. After some brainstorming, we decided that we could implement a driver scoring algorithm for their industry partners.

During our design process, we researched ideas from insurance companies like progressive and several driving schools in order to gain a solid understanding of safe driving and inherently unsafe driving maneuvers. Then, we collected a large amount of data from Glympse's industry partners in order to build and implement a sample population. After which, we were able to score any single driver against that population.

Driver Scoring Algorithm Objectives

- Detecting various dangerous maneuvers from data like latitude, longitude, and heading to create a sample population.
- Scoring individual drivers against that population.

System Design

All the task data for a company is collected from Glympse's data base and then classified by agent ID. The data is preprocessed to fill out missing data, smooth noisy data, and pull out relevant information in order to detect maneuvers. We detected speeding, fast acceleration, hard braking, and fast turning using definitions gained from previous research on dangerous driving maneuvers. Then, we ran the detection algorithm on several thousand agents to create a sample population of counts for each maneuver. Individual drivers are scored by applying the detection algorithm on all their trips and comparing them to the population.
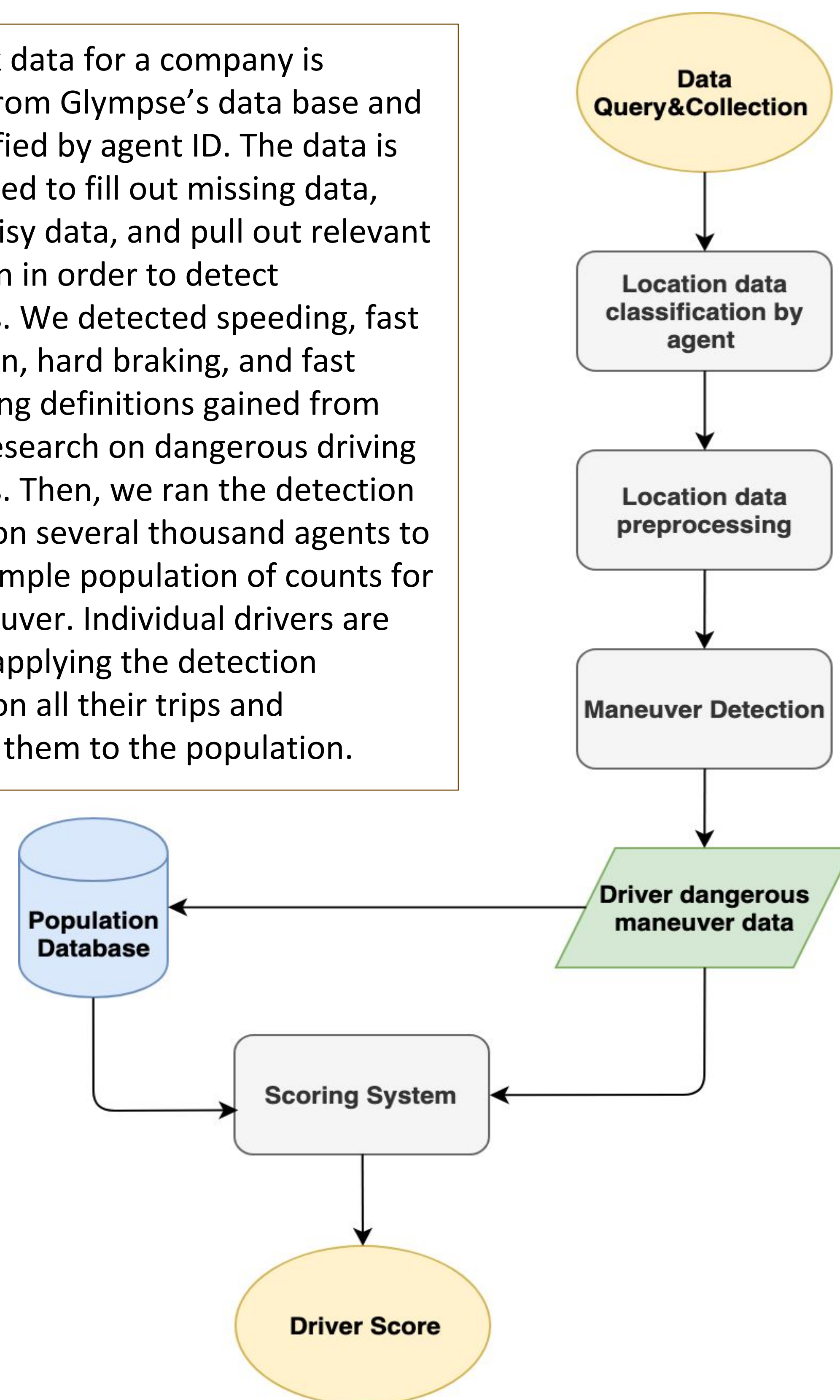

Figure 1. Flow chart of driver scoring system

The Data

Glympse collect location point data at a default frequency of 1 location point per second. These location points are stored as ordered data in an array as shown below in Table 1. Glympse organizes only the data from their industry partners and organizes them in a hierarchy consisting of company, stores, agents, and their tasks.

Table 1. Location point organization

| Name	Description	Type	Encoding
timestamp	Timestamp of the location event	number	UTC ms
latitude	Location Latitude	number	latitude * 10e6
longitude	Location longitude	number	longitude * 10e6
speed	(optional) Speed at the time the location was captured	number	cm/s
heading	(optional) Heading at the time the location was captured	number	degrees
elevation	(optional) Elevation at the time the location was captured	number	meters
horizontal_accuracy	(optional) Horizontal Accuracy	number	meters
vertical_accuracy	(optional) Vertical Accuracy	number	meters
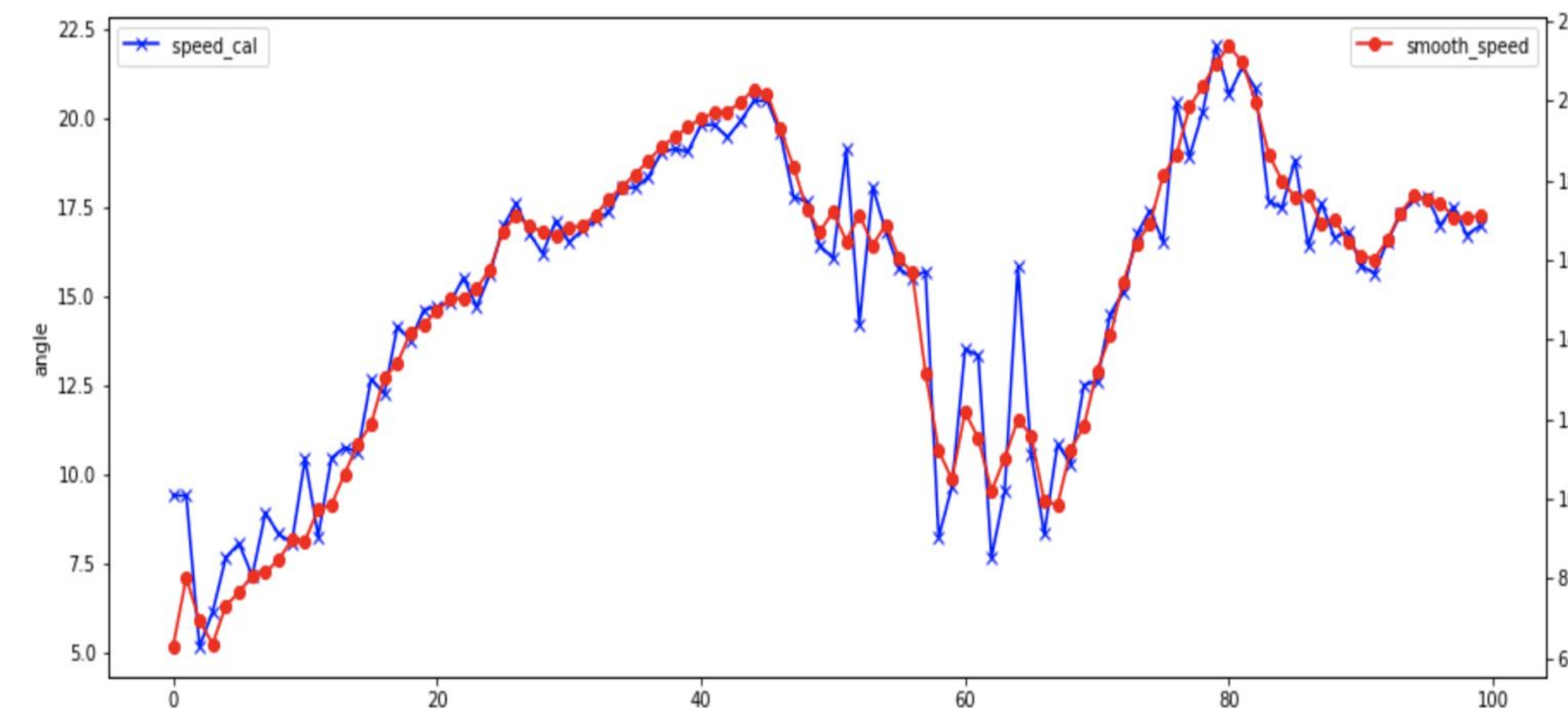
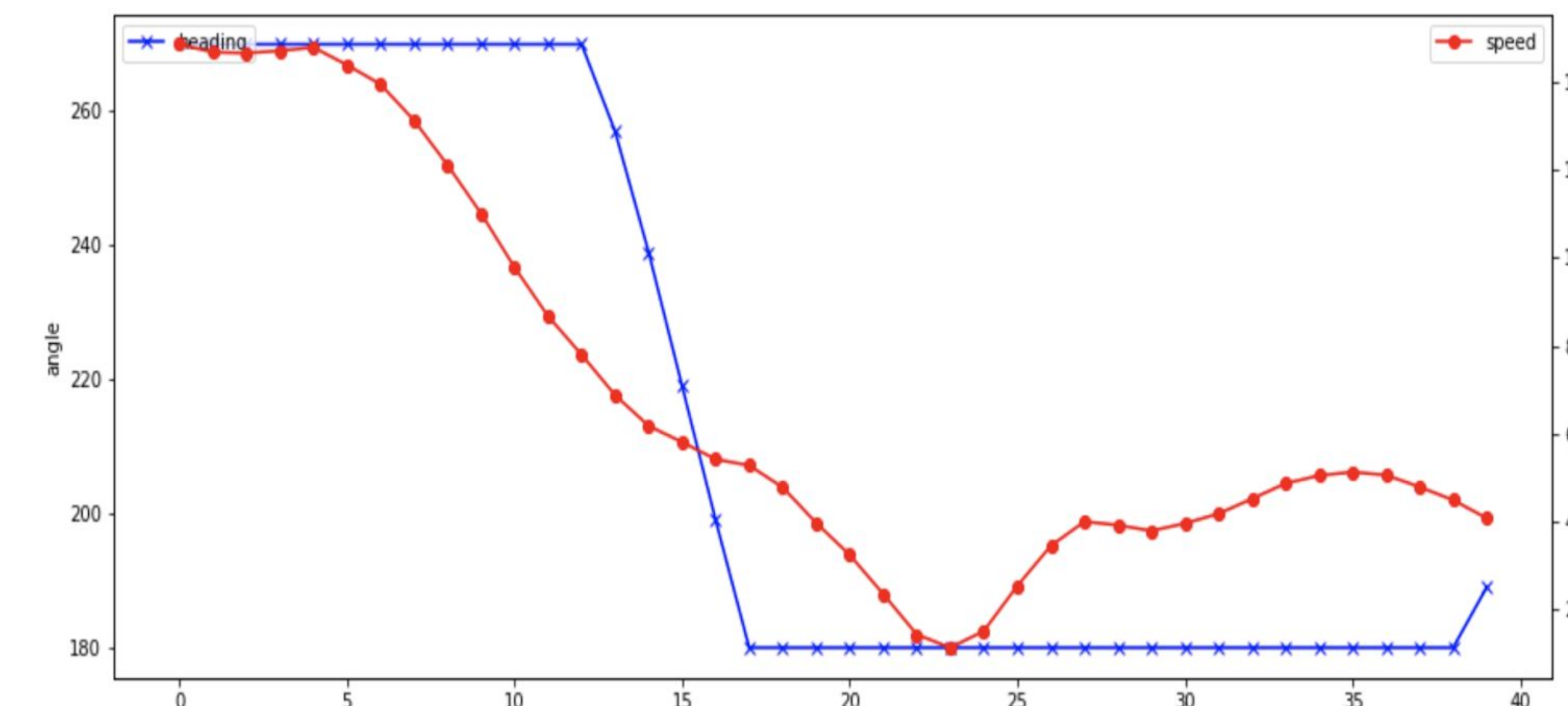Figure 2. Graph of calculated speed and smoothed speed
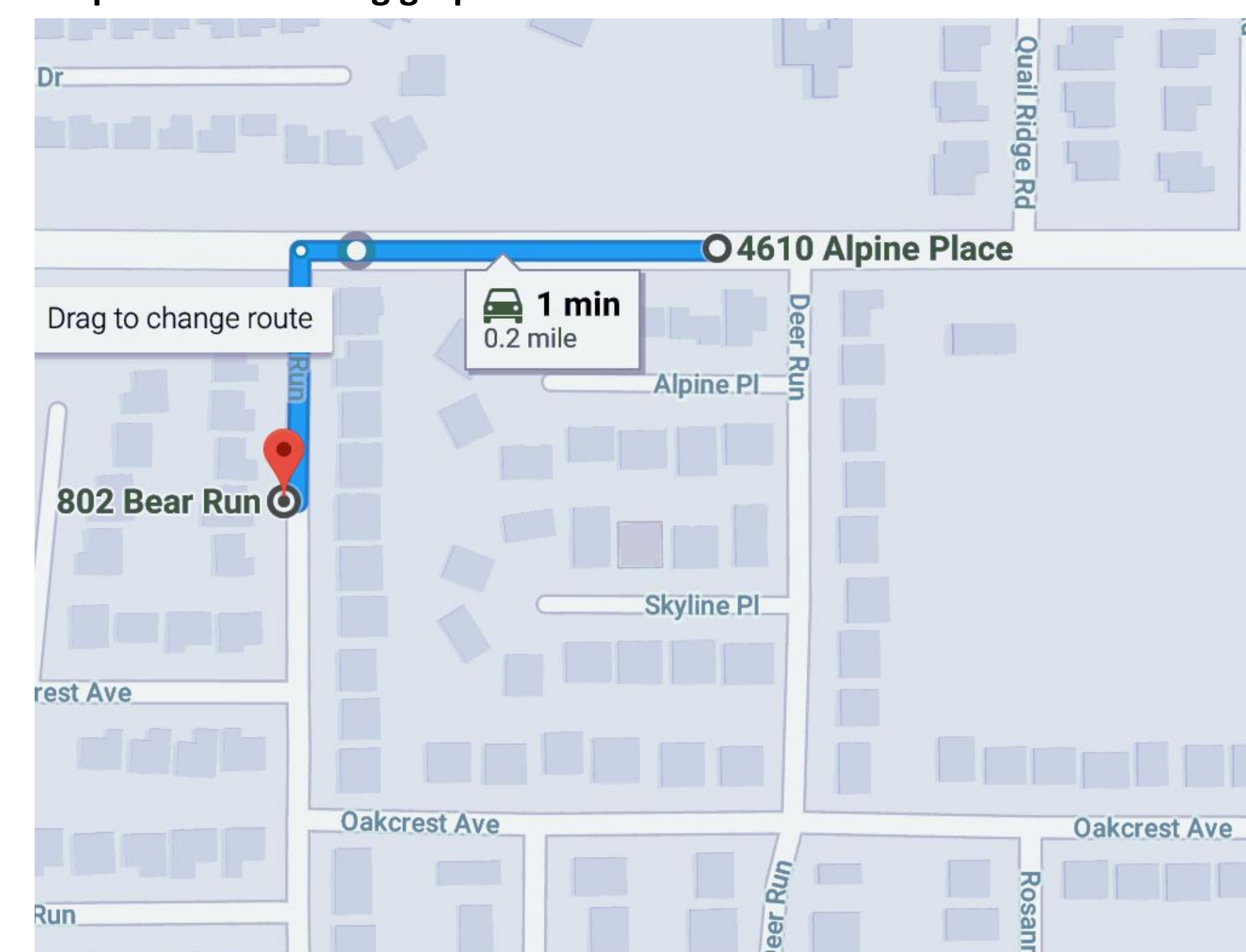

Figure 3. Speed and heading graph for a left turn

Figure 4. Mapping of a left turn

Maneuver Definitions

Fast Acceleration: +3 m/s2
Hard Braking: -3 m/s2
Speeding: % over speed limit
Fast Turning: 20+ mph for left turn, 15+ for right turn

Scoring

Drivers are scored on a normal curve against the sample population and the driver is assigned a score from 1-5 for each maneuver. These scores are weighted based of previous research into dangerous driving and combined into an overall safety score from 1-5.
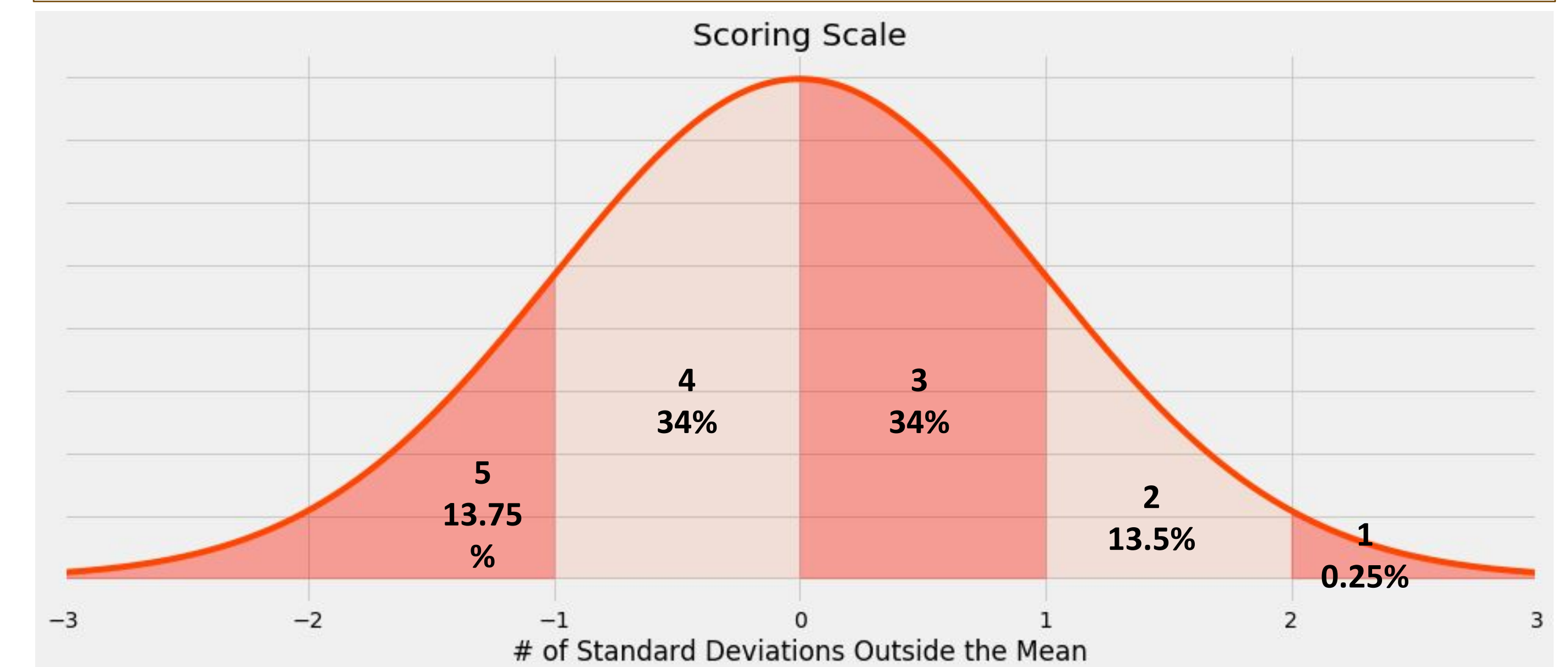

Figure 5. Graph of the scoring distribution

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Overall driver safety score out of 5:  3.05

Scoring break down by maneuver:
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Hard braking score:              4
Fast acceleration score:         3
Fast turning score:              4
Speeding score:                  2

Driver statistics:
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Total hard brake count:          37
Total fast acceleration count:   31
Total fast turning count:        2
Total speeding count:            1044
Total drive time:                1 day, 12:49:12
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Figure 6. Example score report

Future Development

- Adding safe maneuver detection to improve safety scoring
- Automatically detecting accidents
- Scoring efficiency of the drivers using route data
- Implement for commercial use as a phone app

Acknowledgments