Saving Time and Life: A Model of Self-Driving Vehicles

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Problem: Every day, an average of over 3,000 people dies due to world-wide vehicle-related accidents. Throughout a person's life, we can estimate that approximately five years of real time will be spent waiting in line, with 6 months of that due to red traffic lights. The advent of more sophisticated vehicle safety features has led to the development of completely autonomous driving systems and this has positive implications for our lives in the future. Our team is looking to model a small system of paved road (without obstruction) filled with self-driving cars. We will measure how well the system's behavior, governed by basic rules, is able to perform while increasing traffic density and introducing more complex behavioral and boundary conditions.

Approach: To solve the problem of modeling self-driving cars, we are first going to establish a baseline of performance with our unidirectional cars progressing in one of two directions (North or East) and looping when at the end of their path (the grid's boundary). We will measure the performance of the system by comparing the ability of our cars to continue without creating traffic jams/stopping as traffic density is increased. We will also be looking to model the effect of equalizing proportions of North cars with East cars, because as their percentages approach 50%, we expect they will be less likely to succeed. Following that baseline, our stretch goals will be two-fold. Firstly, we want to experiment with different rules and exceptions to our autonomous cars' original AI to see if we can achieve a more robust system of behavior. Our success will be measured in terms of total traffic jam avoidance while 1) being able to increase the model's capacity for total cars, or 2) more closely approaching car-type proportionality. Comparing these results to our model's established baseline will be the measure of our success. Our second stretch goal will be to give our cars the ability to move in multiple directions other than just North or East. Next, we will assign the cars unique destinations and ensure our simulation is able to direct the cars to the end of their path without collision. The measure of success will be to test if our model is able to withstand the introduction of 'bad drivers.' These bad drivers will not share their AI counterparts' aversion to wrecks or desire for destination.

Objectives:

1. Create rules for vehicles that self-govern behavior on a small grid of virtual road with cars either progressing North or East and not colliding.
2. Measure this system in terms of overall traffic density to total traffic jam avoidance.
3. Measure this system in terms of the proportion of North cars versus East cars (given a certain traffic density) to total traffic jam avoidance as the proportion approaches 50/50.
4. (Stretch-1) Attempt to improve upon the established baseline performance by creating more robust rules and exceptions to vehicle behavior. "Make the AI smarter"
5. (Stretch-2) Attempt to expand vehicle abilities to include multi-directional travel and destination parameters while still maintaining collision avoidance. "Make system more realistic"
6. (Stretch-2.2) Introduce 'bad drivers' which are not concerned with vehicle collision and test resilience of existing system.