Tesla's Race Towards Level 5 Autonomy

Traffic prediction is a quite well-known topic with research stemming back to more than 50 years prior to today. Now, machine learning has allowed us to be able to predict the short term or long-term nature of traffic, i.e. what the traffic will be like in the next 10-15 or the next day or next week. We can also try and predict the traffic congestion i.e. the number of cars driving through a given broad segment, the travel times i.e. for example how the Google Map app tells you the best route to take when trying to find the fastest route. To do this, Google uses machine learning to not only analyzes current traffic data and historical traffic data but also tries to forecast short-term and travel times. Good tools to make such predictions are ARIMA, Random forest and LSTMs.

We can also use machine learning to help prevent car accidents the same way Tesla does. The Tesla's model learns how to autopilot from humans. Elon Musk referred to each Model S owner as an expert trainer that feeds a collective AI network by simply just driving the vehicle on autopilot. In other words, each Tesla driver trains their car when they drive on autopilot mode. By doing this they reinforce wanted driving behaviors from the car and discourage unwanted driving behaviors. The best thing about this model is that all Teslas are part of a fleet. So, when one car learns, it teaches all other Teslas over its network so they can all learn together. This makes for the perfect combination of machine learning and independence. Given there are tens of thousands of humans driving the cars and all the cars learn together, it makes for a lot of instructional data so that all the cars should get very precise at driving in a short time span. Elon Musk said that the system should improve everyday by updating the driving algorithm and that the Model S owners could add approximately a million miles of new data every single day.

A few weeks after the release of the Model S, owners of the model have already left reviews on websites, such as the Tesla Motors club, about the autopilot is improving all by itself. One review described how a person tested the autopilot on roads with sharp curves which Tesla does not recommend. The user said that the first time he used autopilot while making a curve at full speed, the car didn't stay in its lane and promptly issued the take control alert. But, after a few times more turns on this curve with strong pressure on the steering wheel, the car started to learn that it has to slow down first before making a curve at the corner. Today the car has no issue taking the curve so it turns out the system is definitely learning and doing so pretty.

According to Elon, there are four pillars for autonomous driving with the first one being a long-distance radar system that can see through virtually anything minuscule that human might not be able to see through like sand, snow, dust, etc. The second enabling technology are cameras with image recognition software that can be able to identify and differentiate between animals, cars and traffic signs. The third are ultrasonic sensors and the fourth is satellite imagery with real time traffic. Upon integration of all these systems, we have an incredibly robust overall system that almost acts like a digital extended safety cushion of technology for your vehicle.

While Tesla's autopilot has done plenty of upgrades over the past few years, the current version definitely isn't ready for full self-driving just quite yet, however, Tesla is planning on a massive software update coming during the fall of 2020 which Elon Musk believes will be the key to full self-driving by the end of the year. The current version of the Tesla's autopilot doesn't allow the vehicles to achieve full self-driving within a short period. This is because there are significant foundational issues that make it difficult to improve the safety of the autopilot. The senior director of artificial intelligence at Tesla explained how the company's new update will focus more on the artificial intelligence aspect rather than the explicit decision making. Typically, when the autopilot sees a stop sign, it stops at the sign. However, this isn't going to work out because there's always certain outliers that might make it impossible to

achieve level 5 autonomy. So instead of this simplistic approach, the company is utilizing its data set to monitor actual human reactions and copy those reactions for each scenario. This is change in Tesla's approach is called software 2.0 and it's slowly taking over the software 1.0.

In the upcoming software update, the company will be or almost be done with the software 2.0, completely getting rid of the previous foundation of autopilot. This re-write can be explained using the term Neural Network. Neural Network refers to the ability to understand what an object or sign is, regardless of the differences in angles, lighting and degradations. In our brain, we all have the ability to tell the difference between a dog and a cat, despite the breed, color or size. This is what the neural network is trained to accomplish. So, because Tesla has a lot of data with people driving cars, the company can replicate a driver's field movement while on autopilot. For instance, if there's a worn-out stop sign that Tesla's cameras don't seem to be catching onto, autopilot will be able to use the fact that other drivers have stopped at that area in the past so it will replicate that action in real life. According to Elon Musk, this is the kind of revolutionary update that's coming during the fall of 2020.

With the expansion of software 2.0 in Tesla's autopilot, Teslas are becoming better at identifying 3D objects. These updates will allow Tesla to better understand the environment and react to it appropriately. For example, the Tesla autopilot is now able to drive through green lights knowingly. In the past, Teslas wouldn't react to green lights and when they, autopilot was just following the lead of a car in front of it or staying in its Lane. If a Tesla on autopilot was the first car in its lane and the light turned green, the driver would have to step on the accelerator but with the improvements in software 2.0, the autopilot will now be able to drive through green lights while actively knowing it's passing a green light.

Essentially, what we will see in the upcoming autopilot update is a foundational rewrite that is heavily reliant on neural networks, human reactions and a lot of minuscule issues being fixed. This upcoming update is the reason Elon Musk believes that level 5 autonomy would be attained at lease by the end of the year. According to Elon musk, a lot of functionality will happen all at once when we transition to the new software stack. Then the question to be asked post-release would be; what functionality is proven safe enough to enable for owners?

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