Development document

I started with simple logic - just "left-right" for steering and "accelerate-brake" for speed (without coast). At first few attempts, the car couldn't even confidently start the first lap. (without hitting the wall in the first seconds) After several iterations, I identified the middle of the track and updated the lidar logic it was only occasionally able to complete track 1 -it handled more complex tracks even worse.

In the first commit, I assembled a simple agent in ~25 lines of code. The simple lidar thresholds with the average values on the left and right edges were compared, and if the value was too low, the brakes were applied at the front. This simple approach only allowed the car to complete Track 1 with 100%, but on more complex or small tracks, the car crashed.

Oval 137.30942778228385

Spiral -46.19724886233493

Small_Circle -11.984489554987485

Large_Circle 138.13470023814565

Fast 136.81931780927331

Improvements after 1st commit:

The steering wheel now reacts to normalized displacement and expected curvature: the car moves to the center and prepares for turns in advance.

At the same time, I complicated the speed control. The agent now:

1. Calculates the base speed based on the front lidar and the lane width.

2. Add a lot of thresholds for better performance of the car on different tracks.

3. Additionally reduces the speed if the car goes far from the center.

With this logic, I had Track 8 average ~ 0.325, maximum 0.5(without collisions)(~120 score)

After succeeding on Track 8 without collisions, I wanted to improve results with fine-tuning thresholds. I increased acceleration to 0.55, which on Track 8 gave an average of ≈ 0.34 without losing stability. I was testing manually many thresholds to find the optimal one, and a lot of them were causing the car crash, so such edits were immediately rolled back.

Finally, I implemented dynamic acceleration along the average lidar for different range values, and their own speed thresholds are selected. This allowed acceleration even more aggressively on a straight distance

As a result, the rule-based agent on heuristics can pass all eight tracks without collisions, maintaining average speeds in the range of 0.30–0.55.