End-to-End self driving with CNN

INTRODUCTION

DeltaX is a self-driving competition which is held in the University of Tartu. The competition is arranged to choose the best solution from various teams in two tasks inspired by real-world self-driving challenges.

- **Task 1:** This task is about testing generalization for various track layouts and collision avoidance. The track's layout and obstacle location are undisclosed. The contestants are eliminated depending on the number of collisions their cars experienced. If there is a tie, the drivable area will be reduced during the following round, and this will continue until the team with the fewest collisions is identified.

- **Task 2:** The track layout is fixed and known in advance. However, the main purpose is to reach the destination by a predetermined undisclosed path(figure 1). Contestants are eliminated if they are unable to follow the exact path. The path becomes more complex if there is a tie.

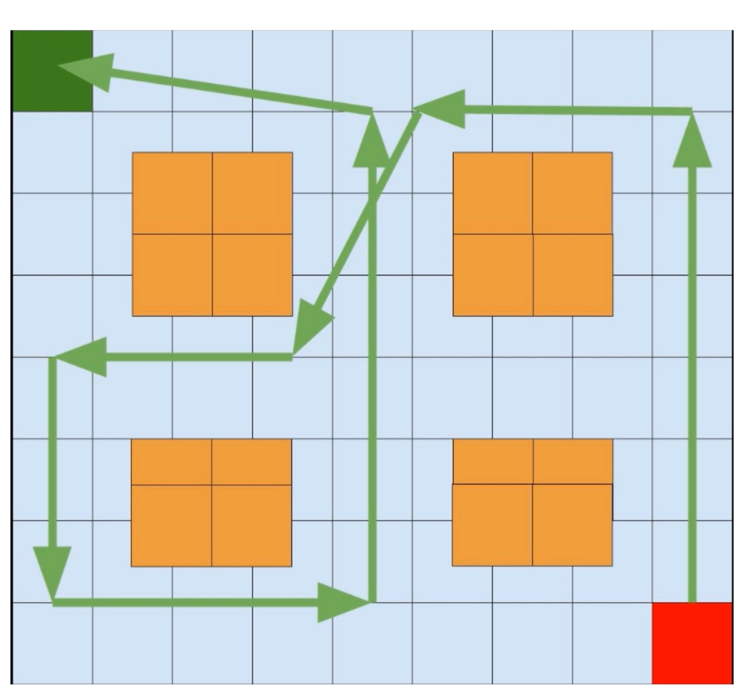

Figure 1: example of predefined path

SOLUTIONS:

- **Task 1 solution:** As previously said, this task is all about generalization. To be honest, we knew nothing about self-driving cars. The only things we could rely on were experimentation and learning from our mistakes. After many tries and errors, we eventually made our first breakthrough "100k images is what you need". The model generalizes so effectively that it begins to avoid previously unseen obstacles. We were surprised, but life is cruel; the car avoided unseen obstacles only if they were on the left side. Nonetheless, it gave us an answer on how to generalize for obstacle avoidance. So we go again for another dose of "100k images is what you need" with diverse arrangements of obstacles.

- **Task 2 solution:** In comparison to the first task, this one appeared to be even more difficult. Because we were completely perplexed as to how to acquire data for that type of model. There was nothing left to do but try and see what would work. Guess what we discovered? "Overfitting is what you need". The reason for this is that the goal of this task is to follow the stated path exactly; otherwise, you fail. Throughout our experimentation, we discovered that the car may occasionally ignore our intentions, which we wish to avoid. So, what we really want from the model is, to remember what prediction should be made for a particular input. In machine learning terminology, this implies we need to overfit to that input. Overfitting was accomplished by automatically setting left or right intent in the dataset for just five frames during a turn, after that the car reverted to the default intent (straight), which is able to complete initiated turn.

RESULTS

Our ideas performed admirably during the competition, allowing us to win(figure 2). And our solutions are being showcased to University of Tartu visitors. Furthermore, new students are relying on our methods as a foundation. We also tested our model in several locations outside of the training environment. To our astonishment, the car generalized so effectively that it was able to avoid obstacles it had never encountered before (such as chairs, doors, different type of walls and human feet).

Figure 2: DeltaX competition video

CONCLUSION

At the end of the day, there are still some things that could be better. But that would be another tale. We would like to express our gratitude to Ardi Tampuu for his supervision and support.

REFERENCES

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- **https://www.youtube.com/watch?v=oBzAagklxBM&ab_channel=RustamAbdumalikov**
- **https://www.youtube.com/watch?v=cjm21muWZG4&t=1s&ab_channel=RustamAbdumalikov**
- **https://github.com/rabdumalikov/self-driving-donkey-car**

Detailed description available in the Github.

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