

Reflections on PRBX

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The overarching objective of the project was to accelerate DL safety and security research through improved data availability, i.e., using data augmentation techniques. Although this was the official project description, Dr. Gerasimou had always encouraged me to proceed in any direction I pleased. And so, since I personally have always had a passion for automobiles, and since the Udacity Self-Driving Car Challenge dataset was one of the 2 datasets referenced in the project description, I decided (with the guidance of Dr. Gerasimou) to explore the effects, advantages, and limitations of data augmentation for training and testing DL-based autonomous vehicles, using the Udacity dataset and the competition steering models as simplification of the real world application. The intuition here was to experiment with techniques could potentially scale to larger datasets and more complex models, and finally to actual autonomous vehicles.

The initial idea was to use the entire Udacity dataset, which contained hours of onboard footage, and to train and test the top 3 models. Since I do not possess the hardware to run even a tenth of the computations required for such a task, I managed to get access to the departmental GPU cluster, which would have easily handled this. Due to the nature of the dataset, which came in the native to vehicles ROS format, the extraction of the dataset also required hardware beyond that of my possession but would be possible on the departmental cluster.

Due to the generally accepted to be heavy workload of third year computer science, I found myself unable to start working on the project as early as I wanted to. However, when I did have time during the winter vacation, I was disappointed to find the departmental GPU cluster to be always at maximum capacity. This was further exasperated with the constant technical issues that had me going back and forth with IT Support. In hindsight, the optimal choice would have been to find and ask a regular user of the cluster if there was ever going to be a time when I can run my calculations on it. I instead decided to wait and see for myself, focusing on the other modules of course in the meantime. By the time of spring break, I found myself with all the prerequisite coding done, but with no idea whatsoever if any of it would even work, as I still did not get a window to run my calculations. Without extracting the dataset or executing any of the code, I had nothing of substance to write in the document, save for the literature review. With the deadline fast approaching and lack of funding to rent a GPU, I ultimately had to ask every last acquaintance I made in York if they owned capable hardware, and if they would let me borrow it at night (or whenever they were not using it) to train and test the model. The lack of hardware consistently at my disposal meant the scope of the project had to be cut down many times over, until it came to the point where I was using only a few minutes of footage from the dataset, and experimenting with only 1 model, which also had to be reduced in complexity to match the now reduced size of the dataset. As a result, I was able to fully train the model on a variant

of the dataset in a matter of a few hours, and had modularised the code to easily run on whoever's device I was borrowing that night. The scope had to also be shifted from increasing the data available for training, to increasing the efficiency of the data available for training by augmenting it. This was because increasing the size of datasets resulted in much longer training times, which was not justifiable for the insignificant results that were being observed.

After several nights of this, I was eventually able to meet the (now scaled down) objectives of the project. Although I was able to show how data augmentation can increase the overall quality of the trained model by making it more accurate and resilient to strange/abnormal data, the reduced scale of the project meant the significance of my findings were also reduced. This would be the most frustrating part of the experience, as this is an avenue not yet fully explored. I struggled to find many academic papers on the effect of domain randomisation on LSTM-based models, even less so in the context of autonomous vehicles, making these experiments all the more non-trivial.

It is due to these challenges, had I the chance to do this project all over again, knowing the difficulties, I would make it an everyday priority throughout the academic year. That is, instead of focusing purely on 1 or 2 modules at a given time, I would dedicate a fixed amount of time of probably 2 hours a day, every day of the week. I believe keeping a constant check on the progress of the project would have been enough to mitigate these issues, even if they were largely out of my control.

The lesson learned during this project was to plan and account for unforeseen and uncontrollable circumstances, and to have a solid backup plan. In this scenario, the backup plan would be an alternative strategy that I would have devised if I kept a constant check, and thus would not have to spend many consecutive sleepless nights towards the tail end of the time allotted. Although it may sound relatively straightforward, appropriate planning for such circumstances would be essential to be an effective team leader and is a highly desirable trait sought after by employers.

However, it must be noted that working on the project has still been an overall positive experience, as I was able to learn a great deal about DL testing from the background literature I had to read in preparation and had the opportunity to research a topic that interests me greatly. I was able to use skills I from a variety of modules I took over the course of the last 3 years, in a way unlike in any other module. Most importantly, I had the pleasure of working with Dr. Simos Gerasimou, an expert whose advice and guidance was priceless.

As I approach end of the course, I will be hunting for jobs in the automotive sector, where I hope to build on the foundational knowledge I have acquired through this course and this project, and aim to further the progress in the growing autonomous vehicles sector.