Deep Learning Lab

Assignment 3

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I needed a lot of time to understand the provided code and get started. There were insufficient comments on why and what exactly is being done. Also, it would have been helpful if there was some information before starting to collect data that we are expected to press only one button at a time while driving the car. I ended up with 9 different actions in total (left_and_brake, left_and_accelerate, etc…). I handled it by treating the two-button-cases as one-button-cases and oversimplifying my data. I also had a lot of trouble starting with tensorflow because I could not find a proper tutorial. Eventually, I found one and one of the tutors (Maria) provided me also with one. After that I managed to implement my CNN. Maybe for the future you could provide students with good tutorials which will accelerate the learning experience.

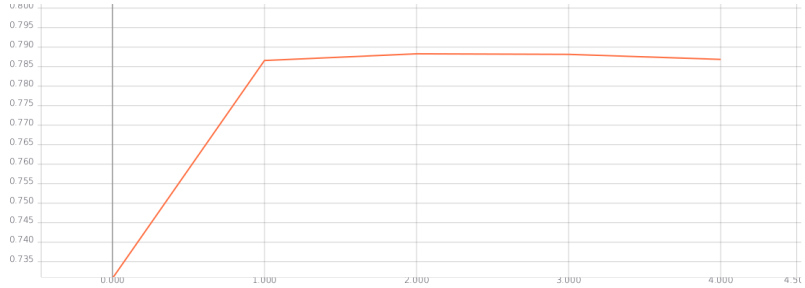
I collected 70 000 samples and created my first model as follows:

1. Conv 1: n_filters = 32, filter_size = 5, stride = 1, pad = ‘SAME’
2. Pool 1: size = 2, stride = 2
3. Conv 2: n_filters = 64, filter_size = 5, stride = 1, pad = ‘SAME’
4. Pool 2: size = 2, stride = 2
5. Conv 3: n_filters = 64, filter_size = 3, stride = 1, pad = ‘SAME’
6. Pool 3: size = 2, stride = 2
7. Conv 4: n_filters = 128, filter_size = 3, stride = 1, pad = ‘SAME’
8. Pool 4: size = 2, stride = 2
9. Dense 1: n_weights = 1024
10. Dense 2: n_weights = 1024
11. Output: out = 5
12. Loss: Softmax Cross-Entropy

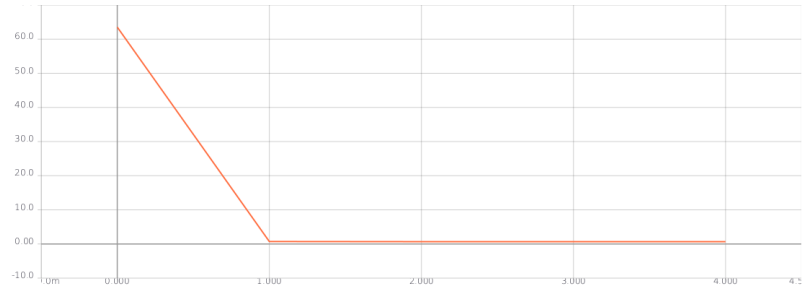
I trained it for 5 epochs with batch_size = 100 and learning_rate = 0.008. Here are the results

Training Accuracy:

Validation Accuracy:



Loss:



It seems like the model cannot learn well enough and the performance is not satisfying. The tests were not satisfying either because the car just stood still. After further inspection of the data as suggested in the exercise sheet, I noticed that about 43 000 out of my 63 000 training samples are labelled as the action “STRAIGHT” which means the car is not accelerating. So my model did not learn to start driving on the track.

Further, I implemented uniform sampling to from my training data and the performance started changing instantly. The hyperparameter I have tested is the number of training epochs. I used batches of 100 uniform random samples with a learning rate of 0.001 and using: 15, 20, 30 and 40 epochs of training. In the table below you can observe the test results for those agents. All tests have been performed with 15 episodes and 1000 time steps.

Table 1. Test results with agents trained for a different number of epochs

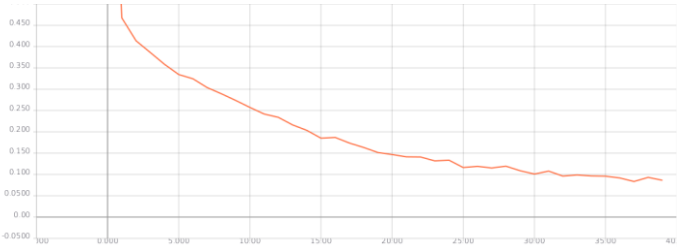
Nr. epochs	Test Agent score	Expert score
15	42.21 +- 107.1029	898.47 +- 12.37
20	808.03 +- 96.96	
30	730.61 +- 91.38	
40	855.60 +- 66.93	

The result with the longest training time seems to work best. I believe it is because the network needs more time to learn better with the provided learning rate. The classification task is complicated and the model is more complex – resulting in the need of more time to train. I am satisfied with the results because the agent manages to make training runs almost as good as me and I believe it will be difficult in such a learning task for the agent to learn better that the provided expert. Bellow the plots from the training of the agent with the best testing performance.

Test accuracy:

Validation accuracy:

Loss:



Further, I have implemented training with history for N = {1, 3, 5}, where 1 is the default used so far. The other parameters stay as default (epochs = 40). In the table below are the results for testing after training with history.

Table 2. Test results for agents with different history lengths.

N	Test Agent score
3	545.83 +- 182.08
5	625.23 +- 214.78

It seems like adding the history did not make the performance better it even made training slower.

Unfortunately, I did not have enough time to implement the LSTM exercise.

Final remarks: In general I really enjoyed doing this exercise sheet. We had to collect the data ourselves, build a cnn using tensorflow, deal with sessions, tensorboard, gym… It was a lot of work but it was rewarding when things started working. However, we had three weeks time so I guess it was kind of fair from time perspective. But I think that the amount of work is scaring some of the students off.