Machine Learning Engineer Nanodegree

Capstone Proposal

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Proposal

Domain Background

An autonomous car is a vehicle that can guide itself without human conduction. Imagining a car driving itself without any human interference was science-fiction and was first introduced in movies. Today, as we talk there are many companies out there building autonomous cars.

Experiments have been conducted on automated driving systems (ADS) since at least the 1920s;[8] trials began in the 1950s.

At 2016, Nvidia has proposed a new approach to build and end to end system that can drive a car using a cnn to map raw pixels to steering angles

References:
https://www.mcca.com/wp-content/uploads/2018/04/Autonomous-Vehicles.pdf

https://en.wikipedia.org/wiki/History_of_self-driving_cars

https://arxiv.org/pdf/1604.07316.pdf

Problem Statement

The system should predict the steering angle according to the road image

Using this approach the system act End-to-End : it learn the internal representations of the processing steps without being explicitly trained to do this so the problem won't be explicitly decomposed to lane marking , path planning ,control … etc , the end to end system will supposedly optimizes all this and learn it

The objective of this project is that the system can drive itself the system learns to drive in traffic on local roads with or without lane markings and on highways. It also operates in areas with unclear visual guidance, This will be viewed as a supervised learning regression problem.

Datasets and Inputs

The dataset i chose is provided through this link https://github.com/SullyChen/driving-datasets i chose the second one it includes approximately 45000 image which has one label which is steering angle I will split it into train , validation and test

Dataset is a set of rgb images with dimension (256,455,3) but in preprocessing the upper part of the image that contains the sky will be cropped as it has nothing to do with the prediction also image will be resized to be (66,200,3)

So Input to the model will be in form of an rgb image with dimensions (66,200,3)

Fig (1)-Sample from dataset

Solution Statement

Training a convolutional neural network architecture (CNN) on the dataset, after which the network should be able to predict the appropriate steering angle

Benchmark Model

For this task a simple benchmarking assumption will be used , I will use a simple cnn model as a benchmark with my more robust cnn model

Evaluation Metrics

RMSE will be used as evaluation metric. RMSE is the popular choice for a metric for regression problems , it is the root of the average of squared errors , the formula is :

Project Design

Preprocessing:

- Explore data and make sure that the data represent well the sample space
- Make sure that the data is clean
- Augment the data using techniques like horizontal flipping .
- Cropping the region of interest (the lane) to be the input to the network (200,66,3) and drop the part that includes the sky
- Normalizing the dataset so that all values are from 0 -> 1

Data Splitting:

- Data will be split to train, valid and test sets with ratio 70:15:15 respectively.
- Explore each set and make sure that it represent the problem and contain wide range of angles

Model Architectures:

- I will try the mentioned architecture on the paper which is called PILOTNET : it contains 5 convolutional layers and 5 fully connected layers
- Maybe I will try some pretrained SOTA model from keras with transfer learning

Model Training and Evaluation:

- Training the proposed models and evaluating the models until we reach a good accuracy, hopefully.

References:

[1] https://arxiv.org/pdf/1604.07316.pdf

[2] $$RMSE = \sqrt{\sum_{i=1}^{n} \frac{(\hat{y}_i - y_i)^2}{n}}$$