**Proposal Data 698**

**CUNY MS in Data Science – Research Project**

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# Problem Statement

The transportation sector is currently undergoing significant changes and developments, particularly in the past five years with coming online of mobile apps and the development of technology platforms like Uber, Lyft and others. With the advent of mobile apps, great advancement in machine learning together with computing power and advance have all encouraged the development, research and processing of autonomous vehicles.

Autonomous vehicles pose a variety of challenges – most importantly accurately identifying objects / cars on the roadway using inputs from sensor data. Data input from sensors can be processed to develop machine learning models, which can in turn help with the development of autonomous vehicles.

# Data Set

In 2019, Lyft released one of the first public repositories of autonomous vehicle sensor data. The data was posted in conjunction with the launch of Kaggle competition. The goal of the competition and the released dataset was to improve upon object detection in the context of autonomous vehicles. The Lyft team developed a Software Development Kit (SDK) (by modifying an existing industry standard nuScenes SDK).

Data provided by Lyft as part of the competition consists of video files, images, Lidar data and maps. In addition, nuScenes ([https://www.nuscenes.org/](https://www.nuscenes.org/nuscenes?externalData=all&mapData=all&modalities=Any) ) also provides an labelled dataset for autonomous vehicle classification

# Hypothesis

As part of this paper I propose to study different convolution networks (along with other neural network structures that maybe applicable such as long-short memory recurrent neural networks) used in the literature for object detection particularly in the context of autonomous vehicles.

The goal is to experiment and understand the performance of different neural network structures against a reference model (a top-down u-net trained model). This will be an opportunity to delve deeper into the literature, work with new datasets including LiDAR data, videos along with images. The goal is not to develop state of the art performance models but rather to work with different datasets and develop a deeper understanding of the current state of the art and practice.

Examples of areas where additional learning will be acquired:

* Working with autonomous vehicle data
* Visualizing and analyzing data from LiDAR for object detection
* Understanding and utilizing different neural network models used currently for 3-D object detection
* Utilizing Spark for neural network training
* Hosting and utilizing AWS or GCP infrastructure for processing and analyzing data from autonomous vehicles

# Literature and References

The literature and references cited below include both dataset references that are needed and also a number of literature review works that can be reviewed to gain a deeper understanding of neural networks.

1. Lyft 2019, Lyft Level 5 Perception Dataset 2020, Kesten, R. and Usman, M. and Houston, J. and Pandya, T. and Nadhamuni, K. and Ferreira, A. and Yuan, M. and Low, B. and Jain, A. and Ondruska, P. and Omari, S. and Shah, S. and Kulkarni, A. and Kazakova, A. and Tao, C. and Platinsky, L. and Jiang, W. and Shet, V.}, <https://level5.lyft.com/dataset/>
2. <https://self-driving.lyft.com/level5/perception/>

Literature and Code Reviews:

1. Lyft Competition Understand the Data, Tarun Paparaju : <https://www.kaggle.com/tarunpaparaju/lyft-competition-understanding-the-data>
2. Class-balanced Grouping and Sampling for Point Cloud 3D Object Detection, Zhu, Benjin and Jiang, Zhengkai and Zhou, Xiangxin and Li, Zeming and Yu, Gang (2019)

(code: <https://github.com/poodarchu/Det3D/tree/master/examples/cbgs> )

1. NuScenes: A multi-modal dataset for autonomous driving - H. Caesar, Varun Bankiti, A. Lang Sourabh Vora, Venice Erin Liong, Q. Xu, A. Krishnan, Yu Pan, Giancarlo Baldan, Oscar Beijbom (2020)
2. EDA 3D Object Detection Challenge, Beluga –

<https://www.kaggle.com/gaborfodor/eda-3d-object-detection-challenge>

1. SECOND: Sparsely Embedded Convolutional Detection - Yan Yan, Yuxing Mao and Bo Li (2018)
2. The Cityscapes Dataset for Semantic Urban Scene Understanding, Marius Cordts, Mohamed Omran, Sebastian Ramos, Timo Rehfeld, Markus Enzweiler, Rodrigo Benenson, Uwe Franke, Stefan Roth, Bernt Schiele (2016) (<https://www.cityscapes-dataset.com/downloads/>)