# DEPLOY AN OBJECT DETECTION ALGORITHM ON NVIDIA DRIVE PX2 HARDWARE AND BENCHMARK ITS PERFORMANCE

Mahesh Chaudhari ED18B018 | DDP Guide: Dr. Jayaganthan R.

## INTRODUCTION

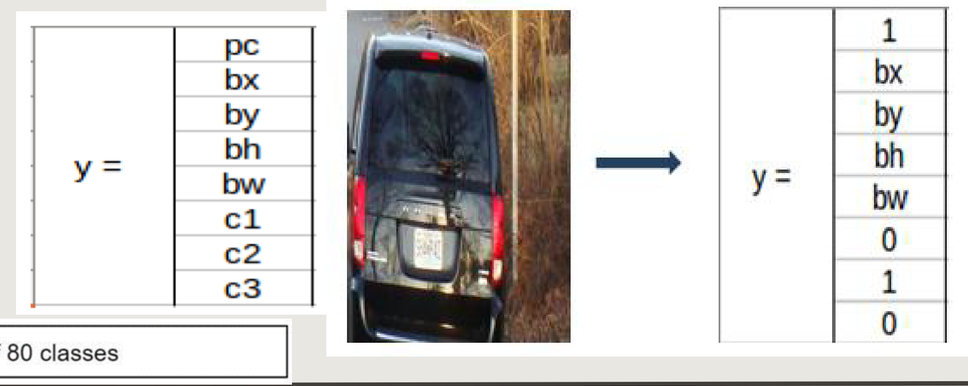
Autonomous driving is an emerging technology that has the potential to revolutionize transportation by making driving safer and more efficient. One of the key components of autonomous driving is object detection, which allows the vehicle to recognize and respond to objects in its environment, such as pedestrians, vehicles, and obstacles.

In this project, I will be focusing on deploying an object detection algorithm called YOLO (You Only Look Once) for autonomous driving. YOLO is a state-of-the-art deep learning algorithm that can detect objects in real-time with high accuracy and speed.

## LITERATURE REVIEW

The objective of this study is to utilize the You Only Look Once (YOLO) approach for object detection. YOLO offers numerous advantages compared to other existing object detection algorithms. Unlike Convolutional Neural Network (CNN) or Fast-Convolutional Neural Network (Fast-CNN) algorithms, YOLO comprehensively analyzes the entire image. It achieves this by leveraging a convolutional network to predict bounding boxes and associated class probabilities. As a result, YOLO exhibits faster object detection capabilities compared to alternative algorithms.

In summary, YOLO's examines the complete image and leverages convolutional networks to predict bounding boxes and class probabilities, YOLO achieves faster and more comprehensive object detection. Its efficiency and accuracy make it a highly promising choice for a range of applications.




| X | Y | W | H | Confidence | Class scores of 80 classes |
|---|---|---|---|---|---|

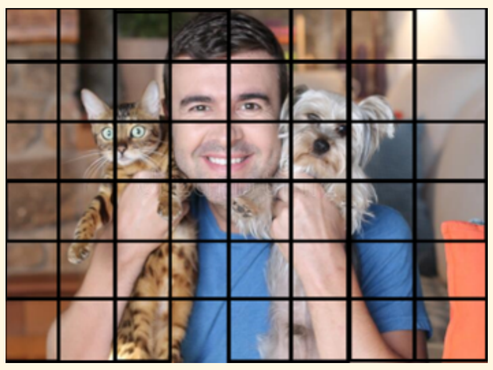
## APPROACH

- Studied basics of object detection and classification using YOLO algorithm
- Developed a python code for classifying objects in images and videos using yolov3 algorithm pretrained on COCO dataset
- Executed the training of the model on custom dataset, used ClearML platform for visualization purpose
- Converted the python code into CPP to compare its performance on the hardware
- Deployed both the codes on the hardware shown below

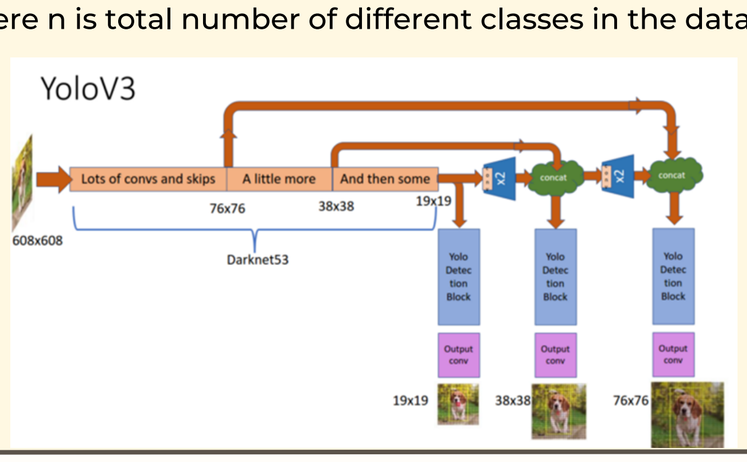
This is the Nvidia PX2 hardware on witch we implemented our codes

## WORKING OF YOLO ALGORITHM

- Image is divided into a grid of let say 8x8

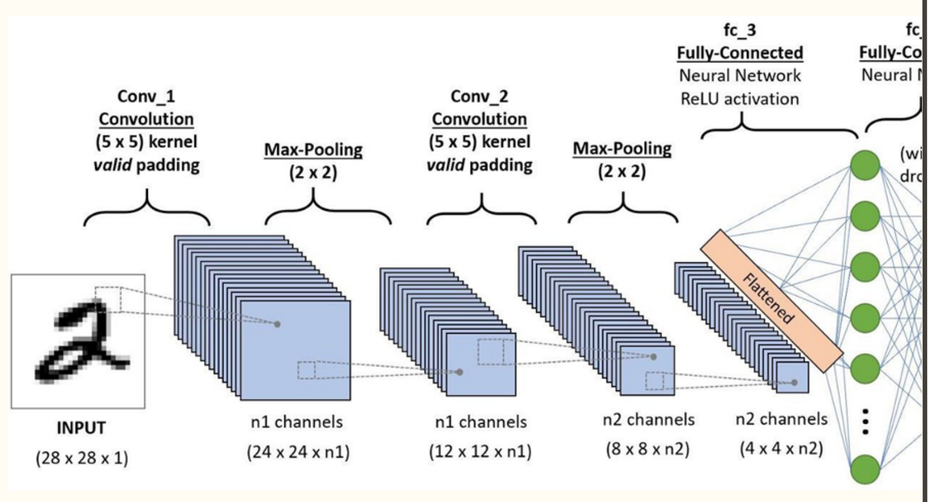


- Predict the bounding box co-ordinates and class probabilities
- Calculate confidence score for each bounding box
- Apply non-max suppression
- Each cell gives output vectors has (5+n) components where n is total number of different classes in the dataset

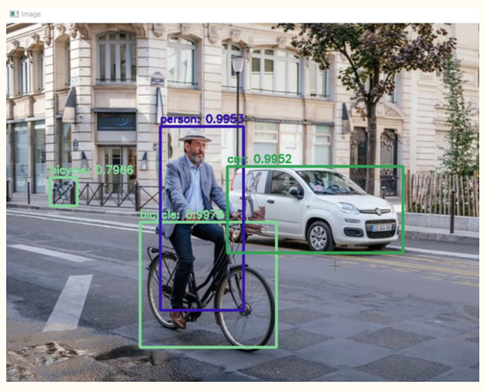


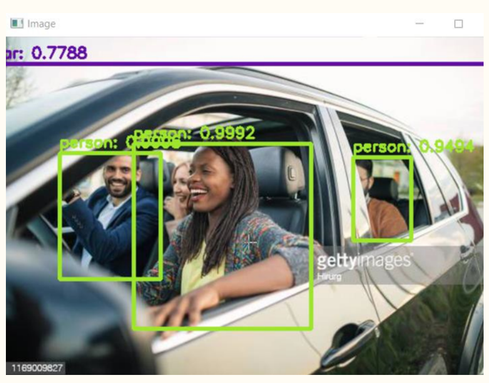

## CONVOLUTIONAL NEURAL NETWORKS (CNN)

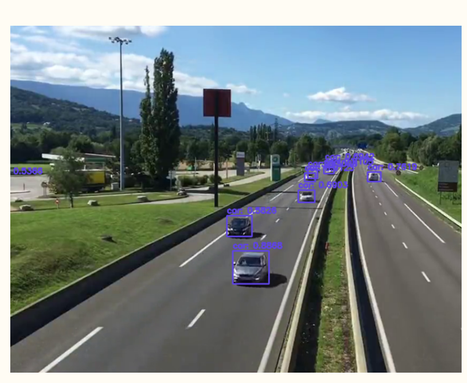
CNNs are composed of several layers of interconnected nodes, each of which performs a specific operation on the input data. The first layer is typically a convolutional layer, which applies a set of filters to the input image to extract features such as edges, corners, and textures. The output of the convolutional layer is then passed through several additional layers, such as pooling layers and fully connected layers, which help to reduce the dimensionality of the data and extract higher-level features.

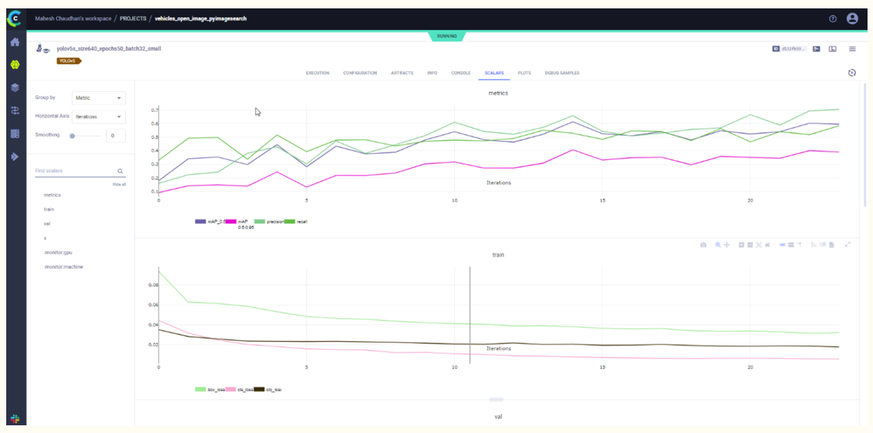


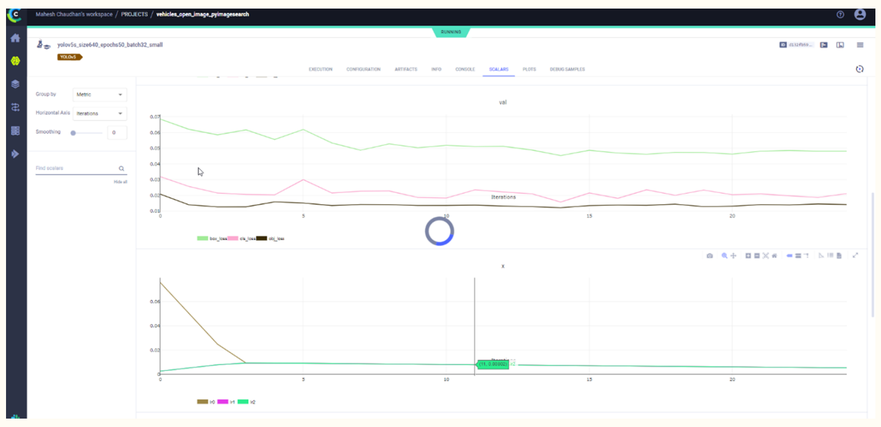

## RESULTS






| Processing Time to execute the codes (Sec) | Laptop | Nvidia Drive PX2 |
|---|---|---|
| Object Detection on a single image (Python) | 1.3 | 0.52 |
| Object Detection on a single image (CPP) | 1.85 | 0.91 |
| Object Detection on a video (Python) Video Length: 180 Seconds | 679.3 | 551.8 |

## FUTURE WORK

- leveraging deep learning techniques, such as convolutional neural networks (CNNs) and recurrent neural networks (RNNs), researchers and engineers will strive to achieve even higher precision in identifying and classifying objects in real-time scenarios
- An exciting area of future development is the exploration of real-time 3D object detection

## CONCLUSION

The project successfully deployed the YOLOv3 object detection algorithm on Nvidia Drive PX2 hardware and assessed its performance. The combination of the algorithm's real-time capabilities and the computational power of the hardware proved to be a formidable solution for object detection tasks. Further optimization of the algorithm can improve performance in the future.

## REFERENCES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