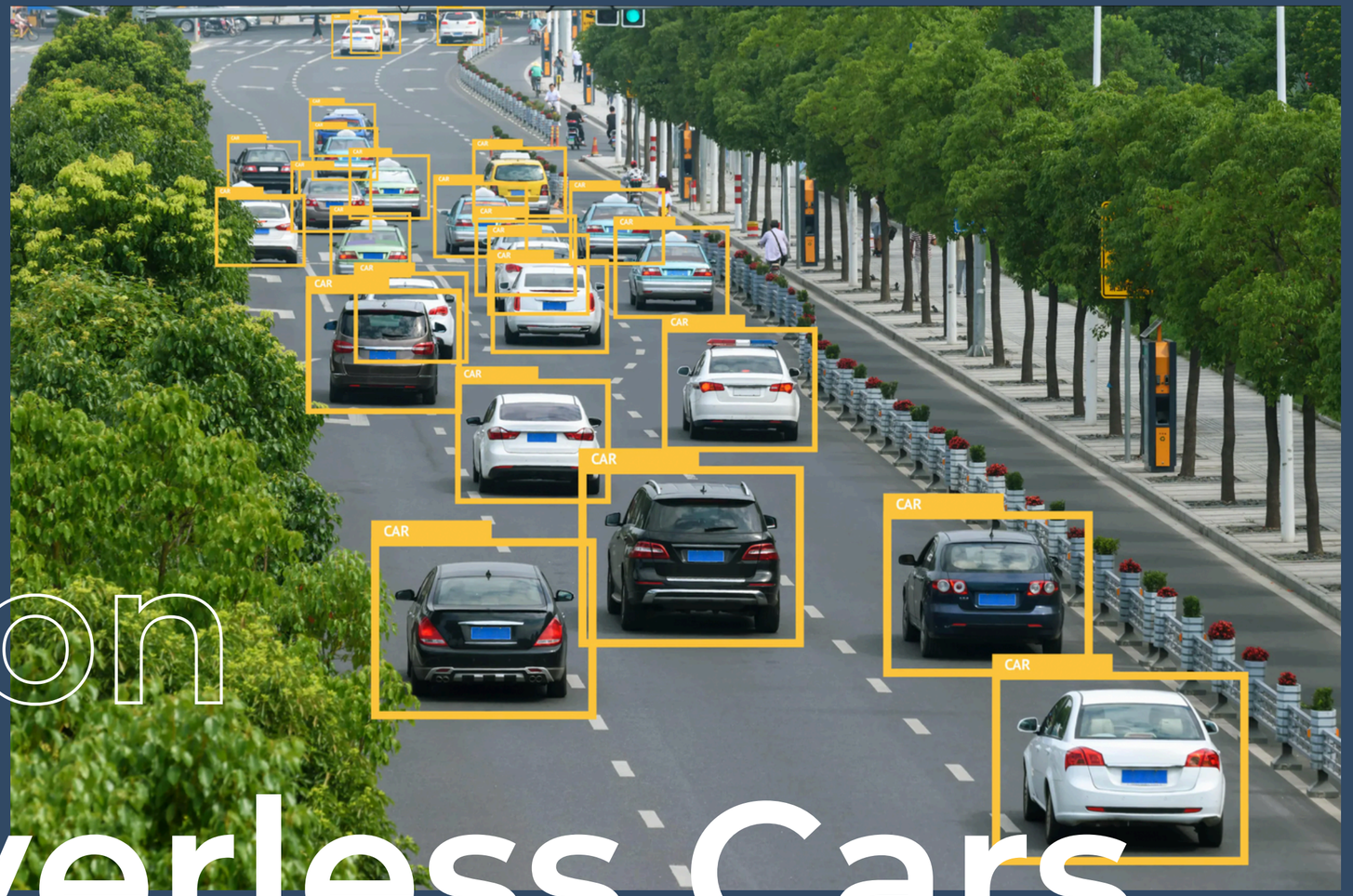
Object Detection For Driverless Cars



Nick Tjandra

01

Background

02

The Data

03

Modeling

04

Results

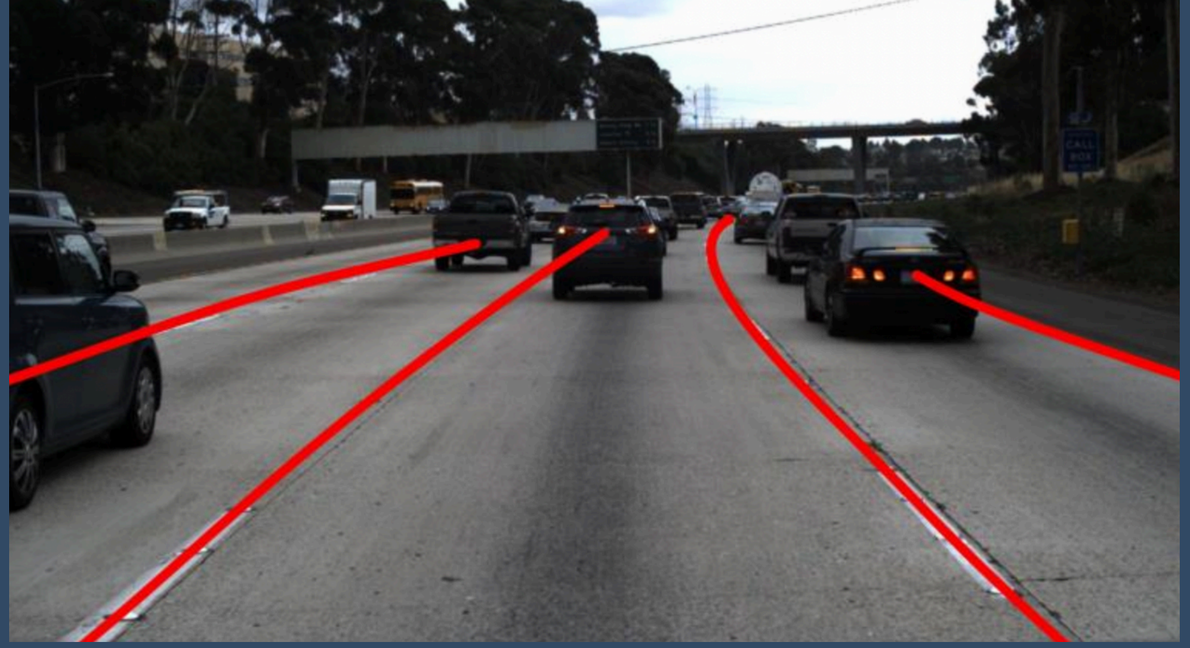
05

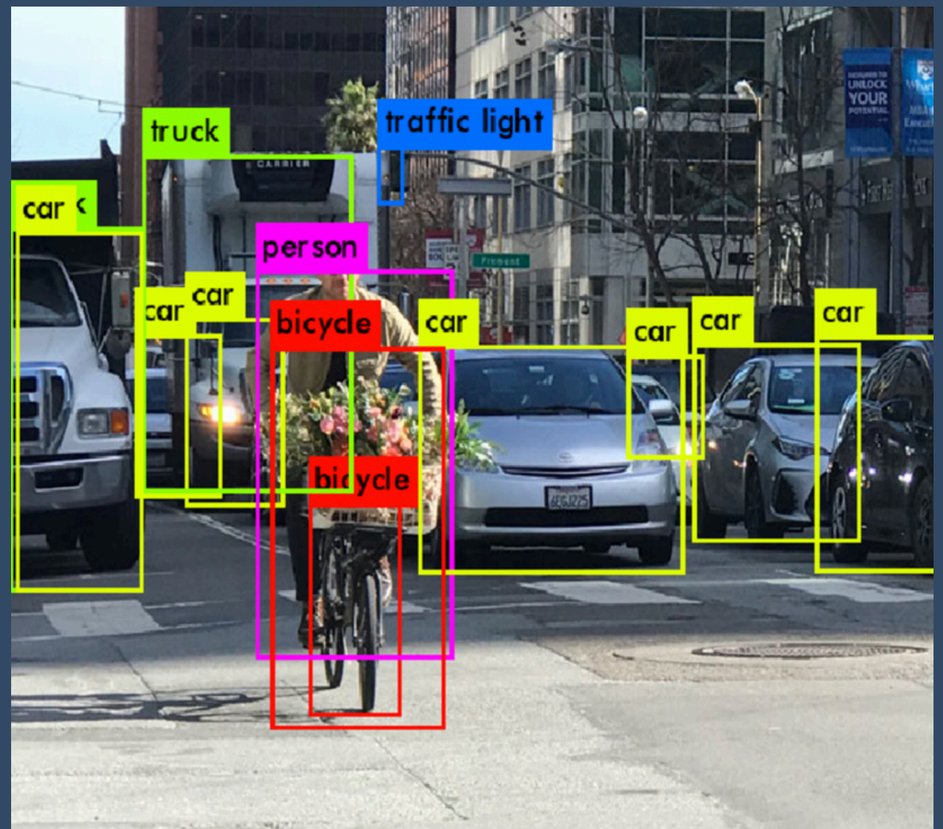
Next Steps

Overview

WHAT WE'LL DISCUSS TODAY

01
Background



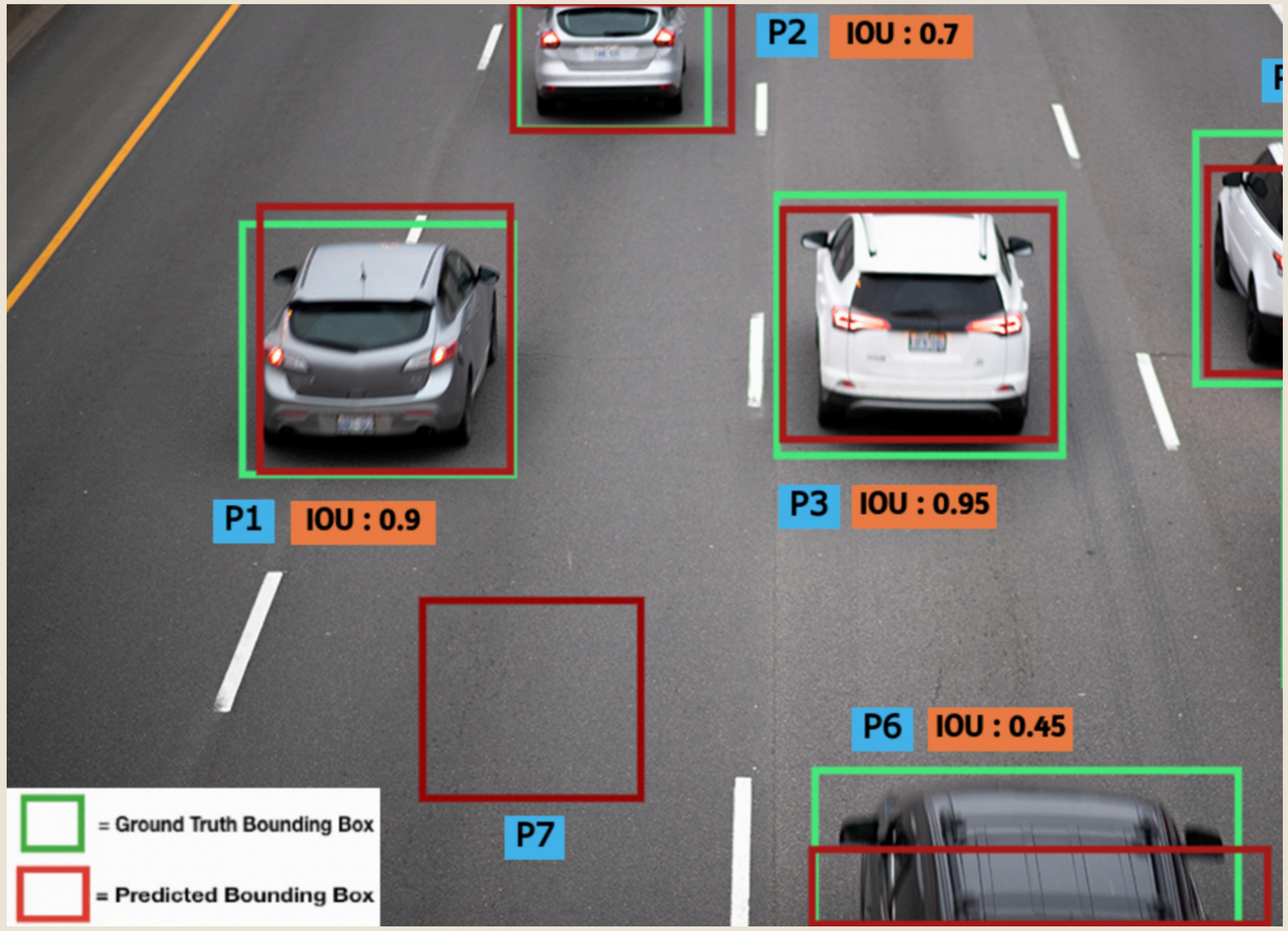


DRIVERLESS CARS NEED CAMERA DATA

To distinguish objects in their periphery, calculate the velocities of objects, and make decisions.

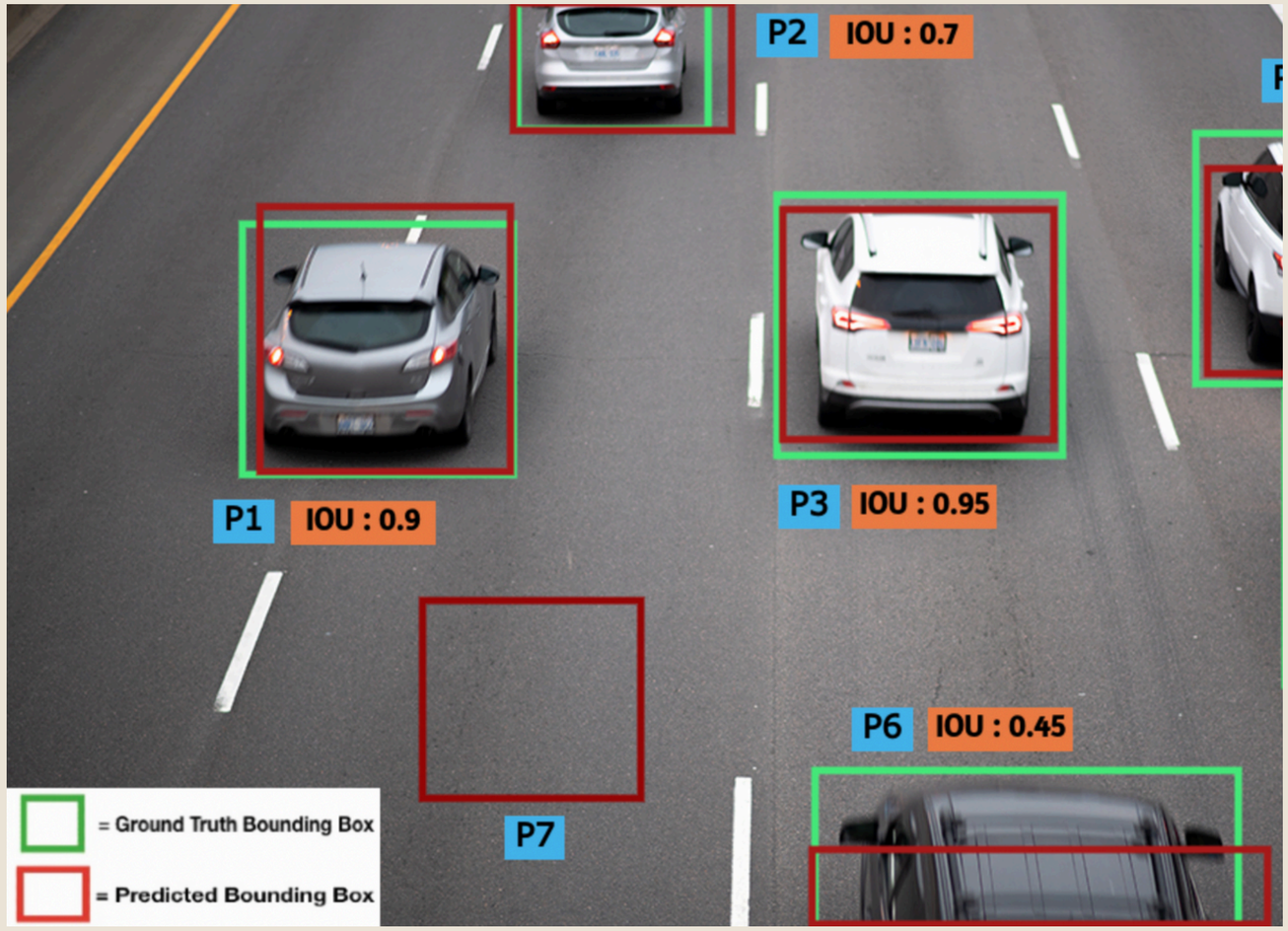
02
The Data

- Thomas Jefferson high school competition dataset
- 1176 street view images
- Ground truth bounding box coordinates



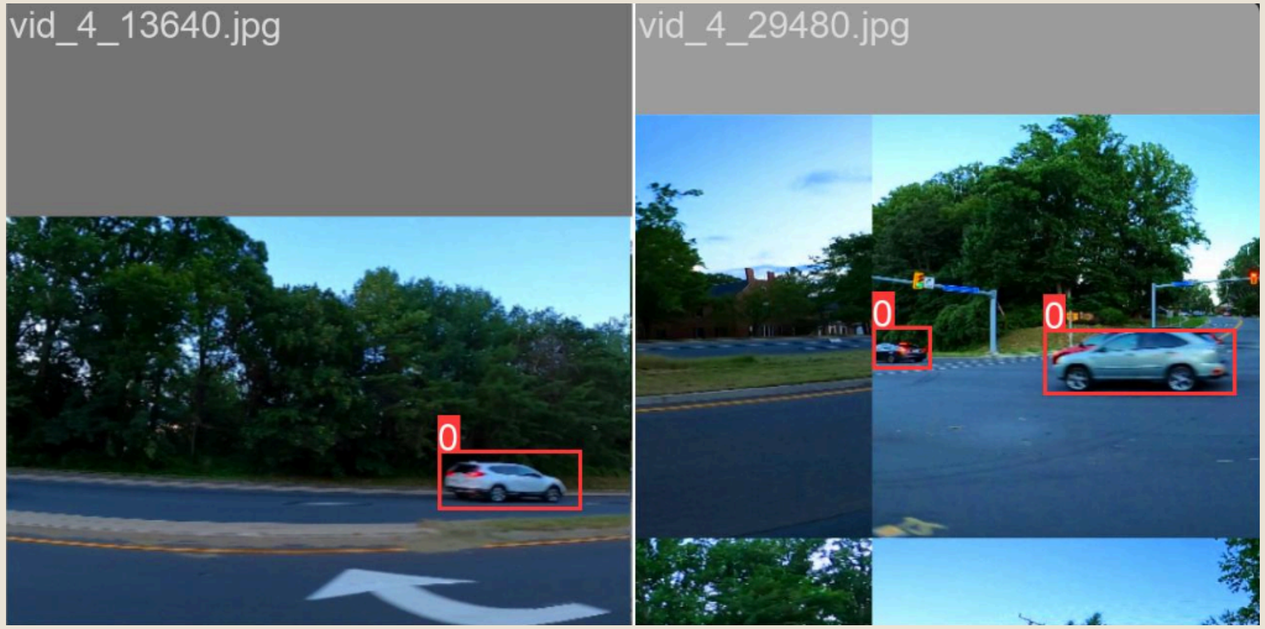
02
The Data

- Adjusted image sizes to 224x224
- Normalized pixel values
- Adjusted boxes that were outside image dimensions
- Every model required different data processing steps



02
The Data

image	xmin	ymin	xmax	ymax
vid_4_1000.jpg	281.2590449	187.0350708	327.7279305	223.225547
vid_4_10000.jpg	15.16353111	187.0350708	120.3299566	236.4301802
vid_4_10040.jpg	239.1924747	176.7648005	361.9681621	236.4301802
vid_4_10020.jpg	496.4833575	172.3632561	630.0202605	231.5395753
vid_4_10060.jpg	16.63096961	186.5460103	132.5586107	238.3864221



03. Modeling

These models classify objects then predicts bounding boxes around them in an image

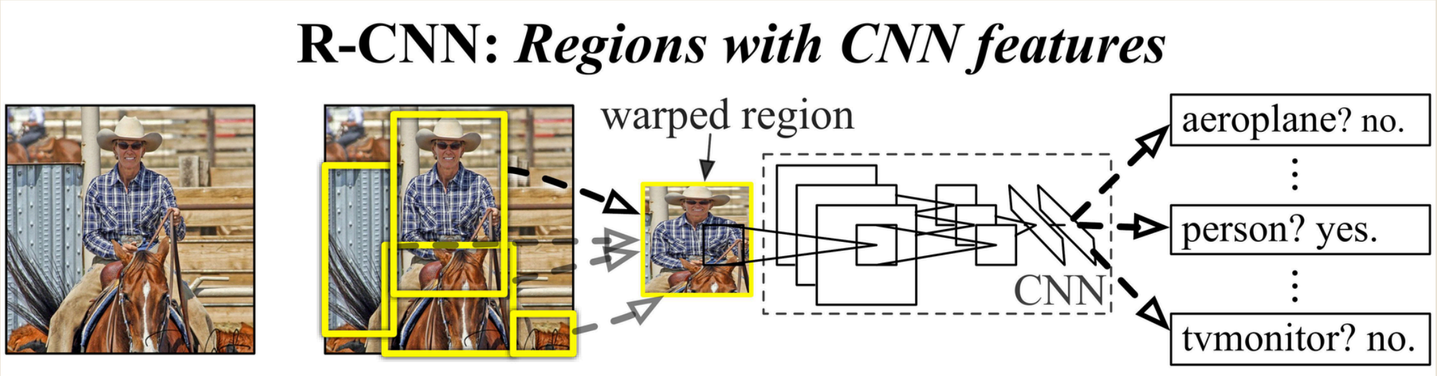
YOLOv8

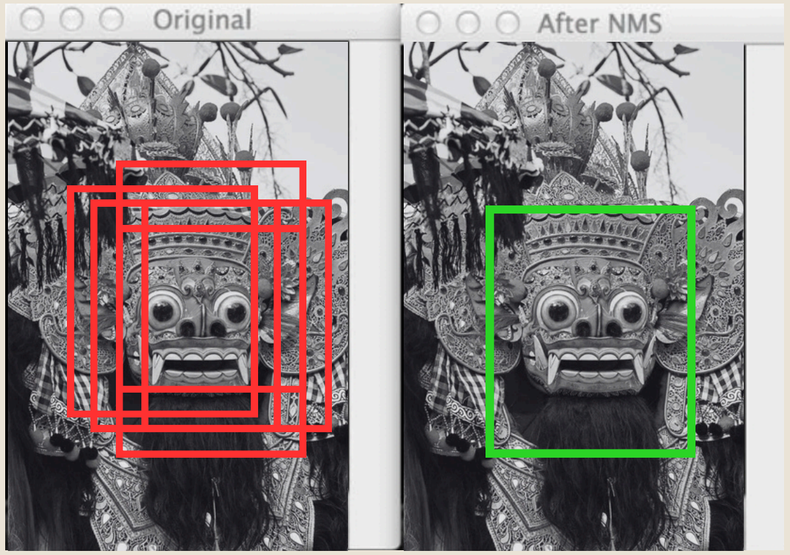
R-CNN

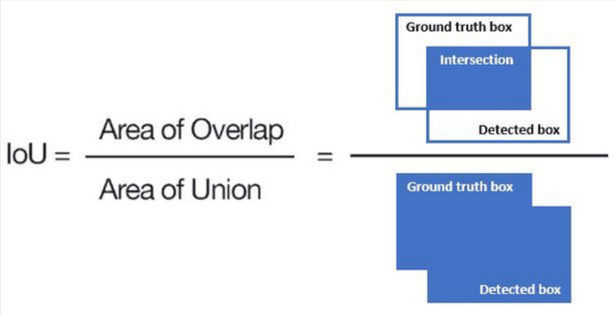
Bounding Box Regression

03. Modeling

R-CNN explained



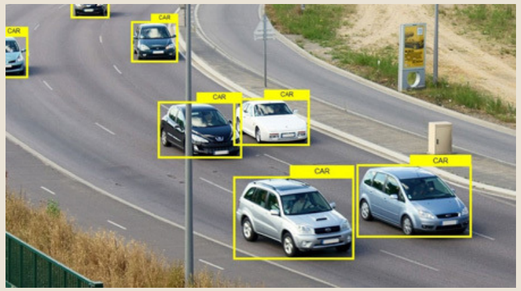


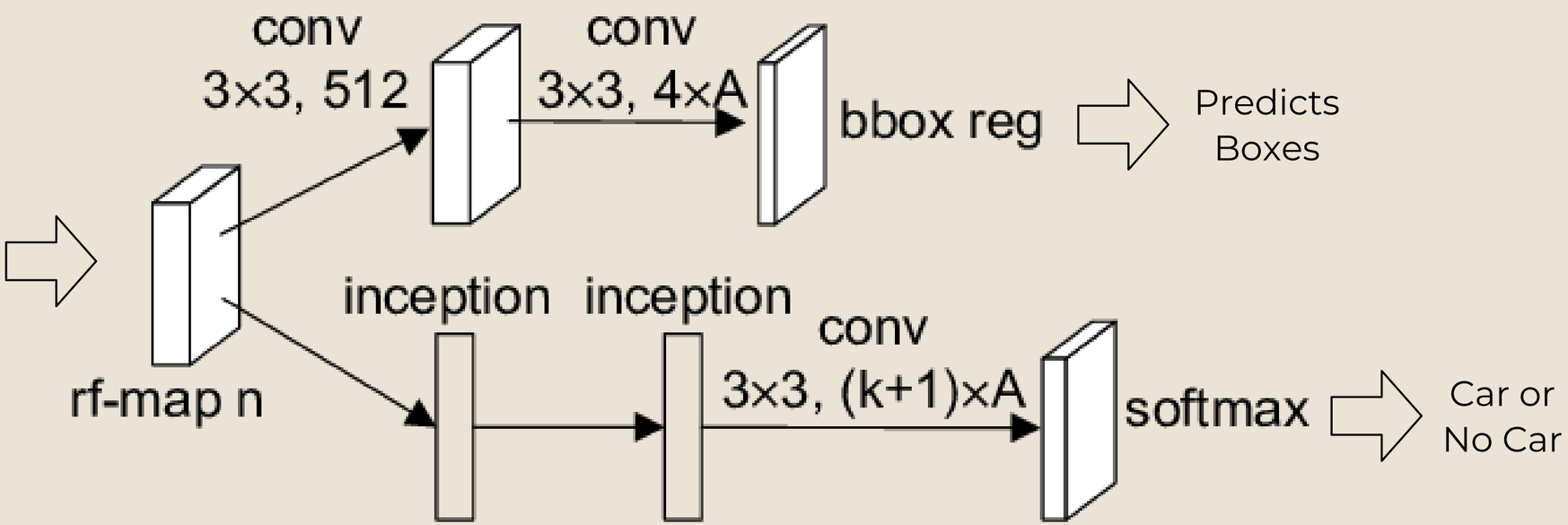


1. Selective search
2. Classify using IoU
3. CNN learns features
4. Selective search again
5. Predict then keep true boxes
6. Non-maxima suppression

03. Modeling

Bounding Box Regression explained

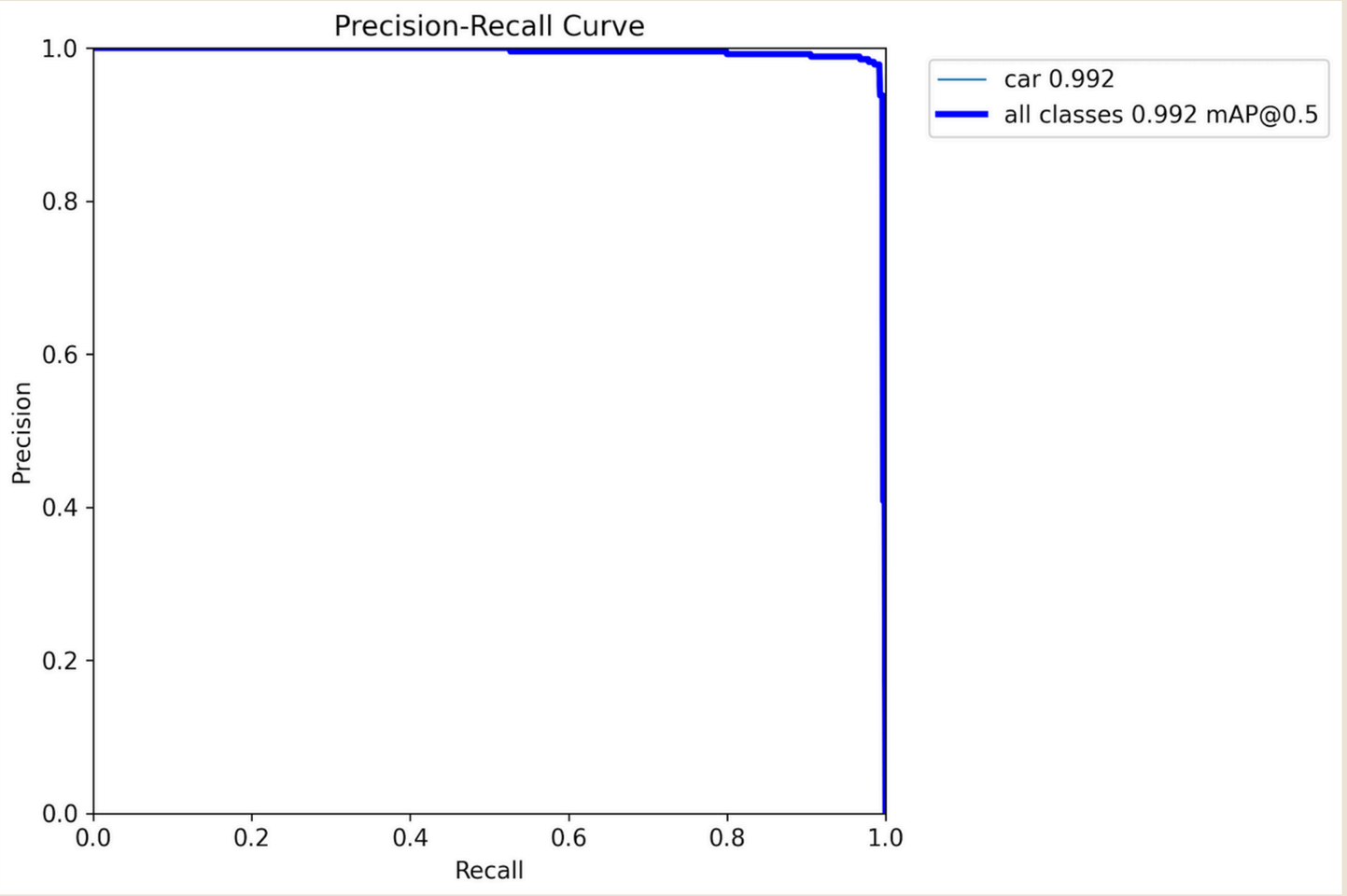




03. Modeling

Chosen metric: mean average precision (mAP)

Area under the curve of the precision-recall curve

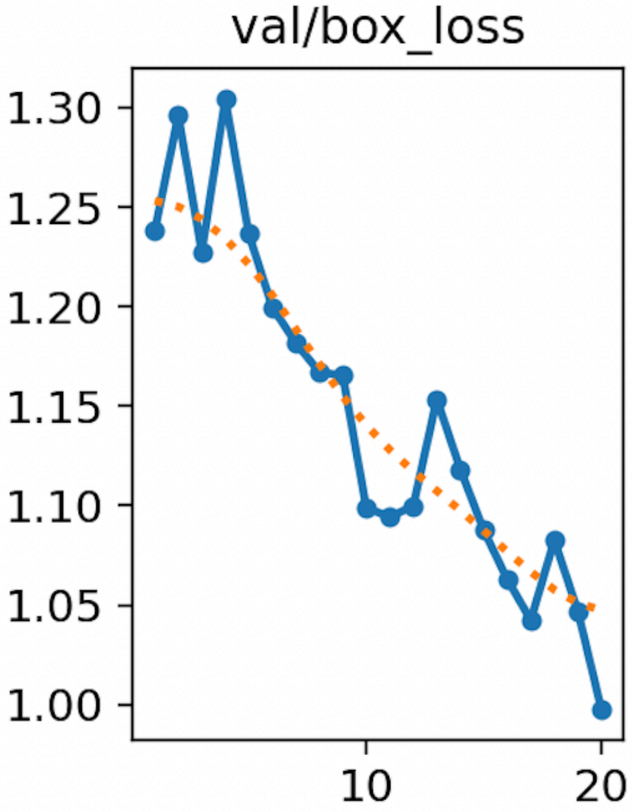


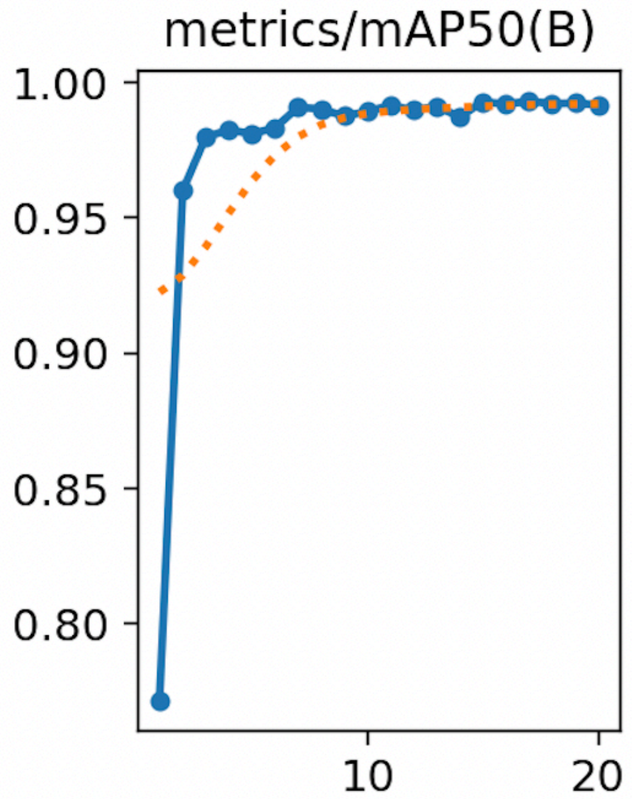
04. Results

OVERALL YOLOV8 HAD THE BEST PERFORMANCE

YOLOv8

Validation mAP = 0.992
Test mAP = 0.963





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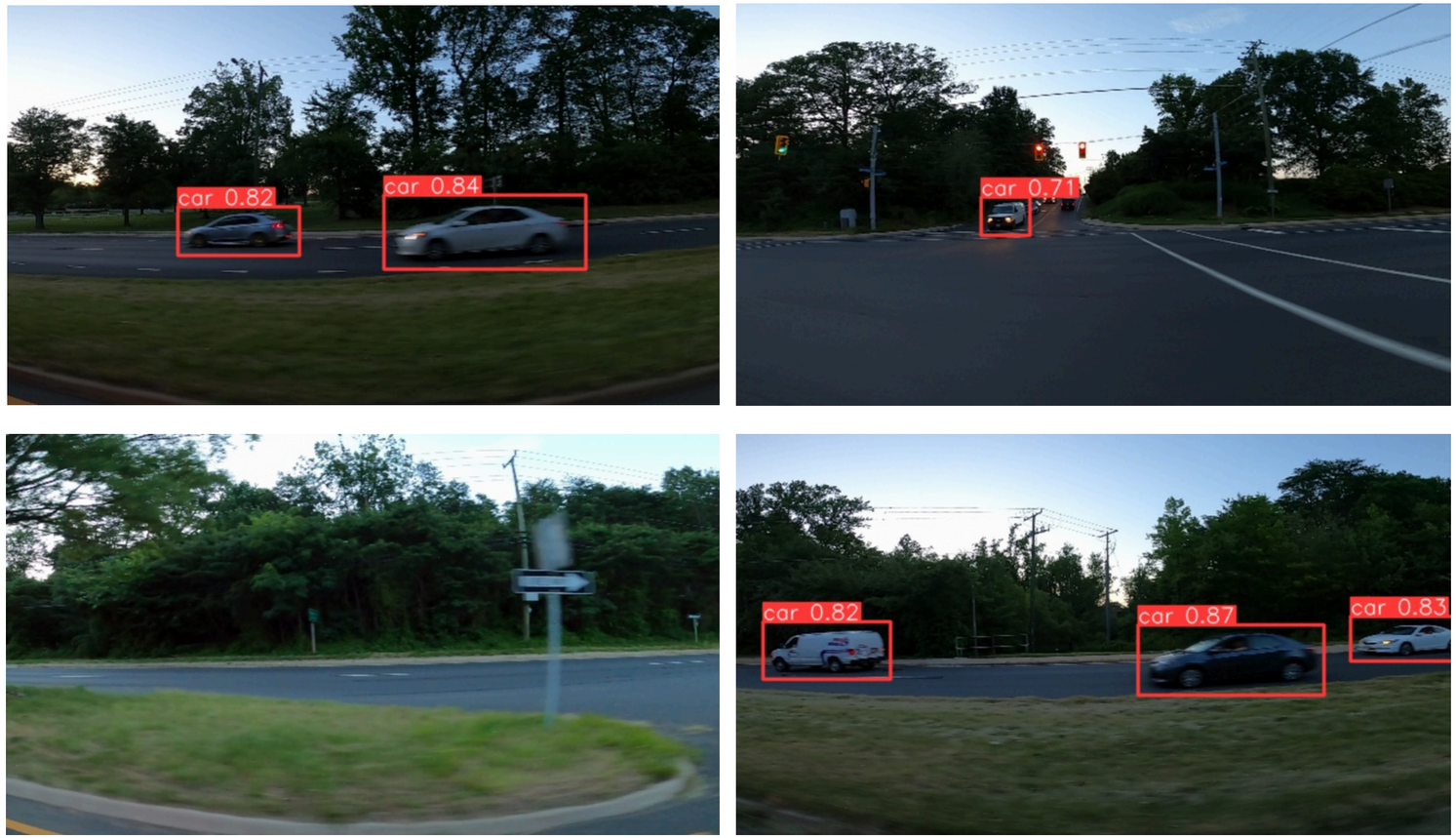
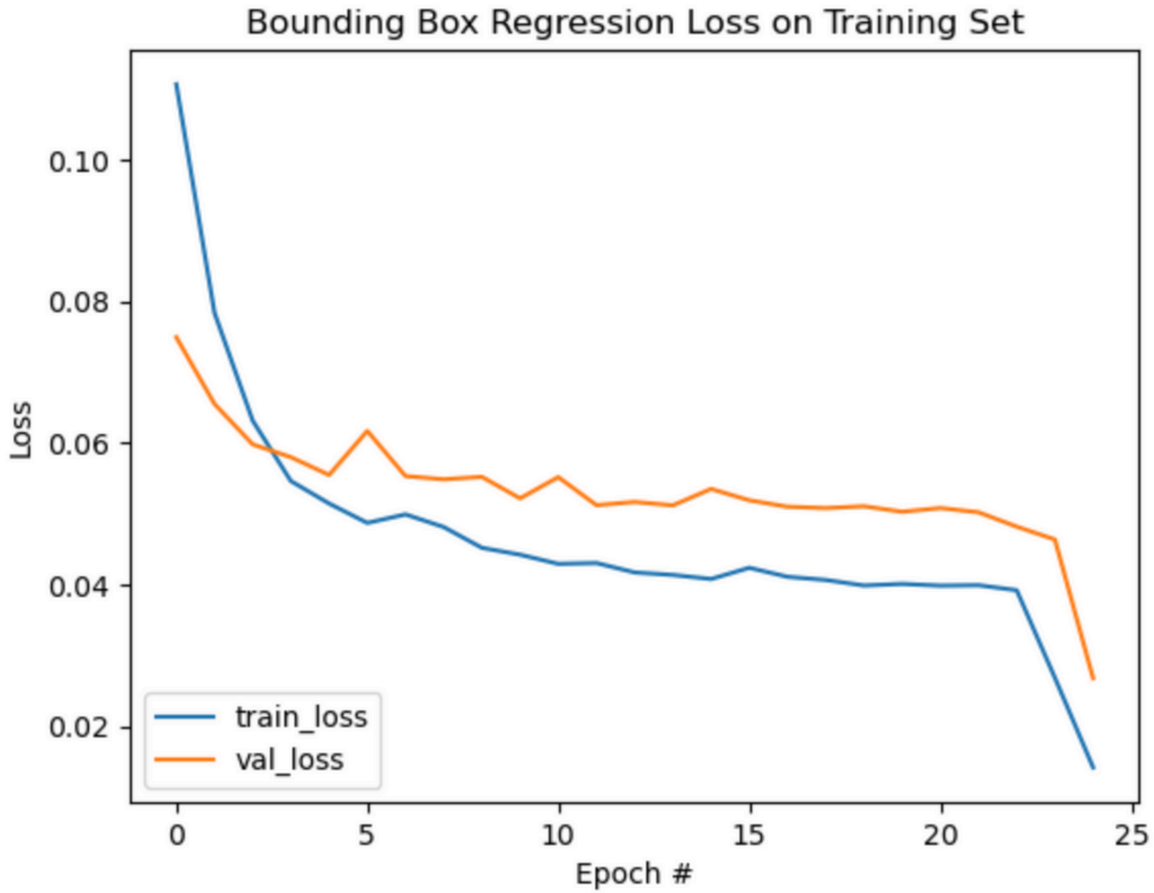


04. Results

BOUNDING BOX REGRESSION

Validation mAP = 0.543
Test mAP = 0.495



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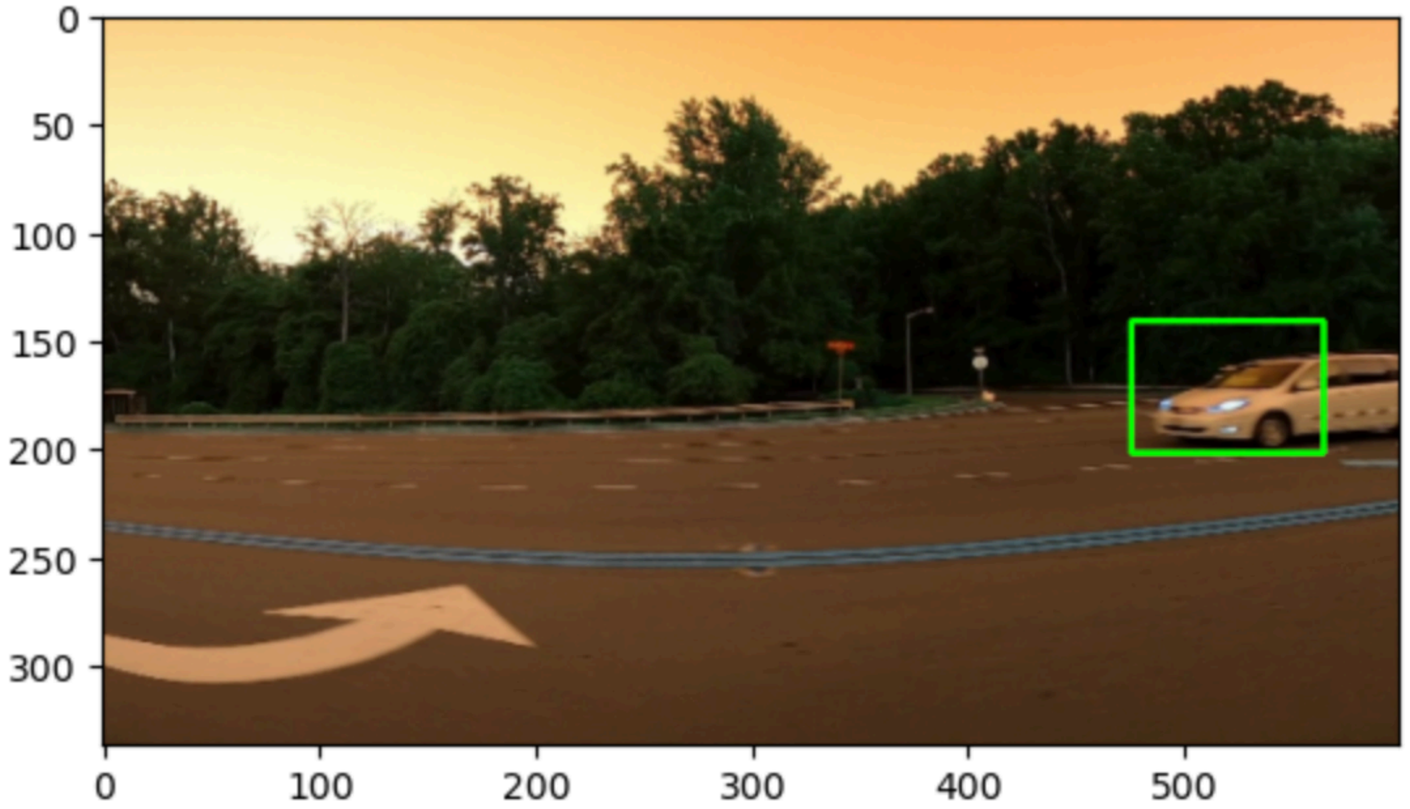
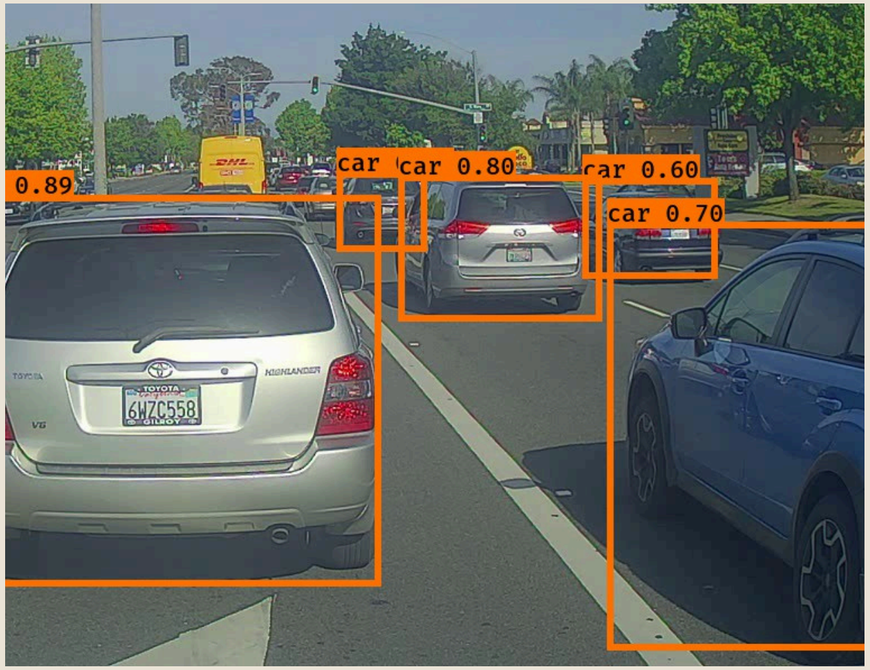
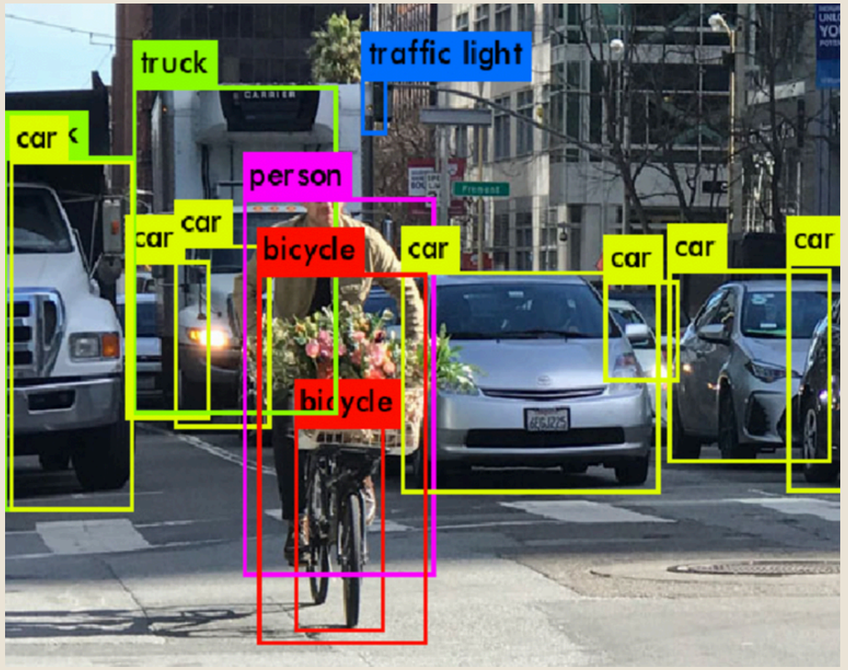


05. Next steps

- Increase object classes (omnibus model)
- Create tangential system to calculate object velocities





Thank you!

Feel free to contact me if you have any questions.

References

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- https://pyimagesearch.com/2020/10/05/object-detection-bounding-box-regression-with-keras-tensorflow-and-deep-learning/
- https://pyimagesearch.com/2023/05/01/training-the-yolov8-object-detector-for-oak-d/