



# Rescue Shall Pass: Emergency Vehicle Detection

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# AMBULANCE BEHIND YOU?

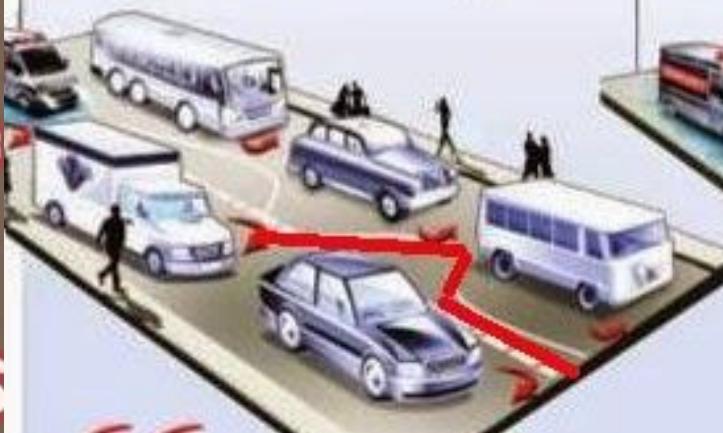


KEEP THE CENTER LANE OPEN

SAVE LIVES

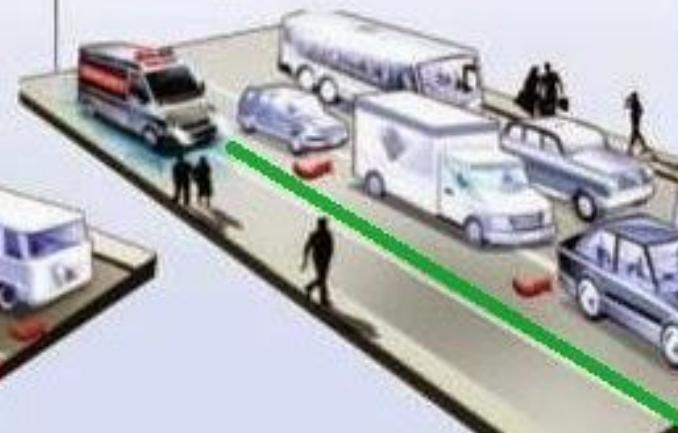
## WHAT HAPPENS

The siren of an ambulance brings chaos. While some vehicles move to the left, others shift right. The ambulance driver is forced to seek out the gaps and drive in a zig-zag manner. At times, there is mass honking to alert the traffic police if an ambulance is stuck at a signal



## WHAT SHOULD HAPPEN

Whenever an ambulance with its siren on approaches, all vehicles should move to the extreme left and stop till the ambulance goes past. Drivers too should be trained to stay only on the extreme right



emergency  
emergency



emergency



emergency



non-emergency non-emergency



# Faster-R-CNN

## PyTorch

### Model builders

The following model builders can be used to instantiate a Faster R-CNN model. These builders internally rely on the `torchvision.models.detection` code for more details about this class.

```
fasterrcnn_resnet50_fpn(*[, weights, ...])
```

```
fasterrcnn_resnet50_fpn_v2(*[, weights, ...])
```

```
fasterrcnn_mobilenet_v3_large_fpn(*[,...])
```

```
fasterrcnn_mobilenet_v3_large_320_fpn(*[,...])
```

### FasterRCNN Architecture Summary:

`Fasterrcnn_mobilenet_v3_large_fpn (100 layers):`

Backbone with Feature Pyramid Network:

```
...  
InvertedResidual blocks  
FeaturePyramidNetwork
```

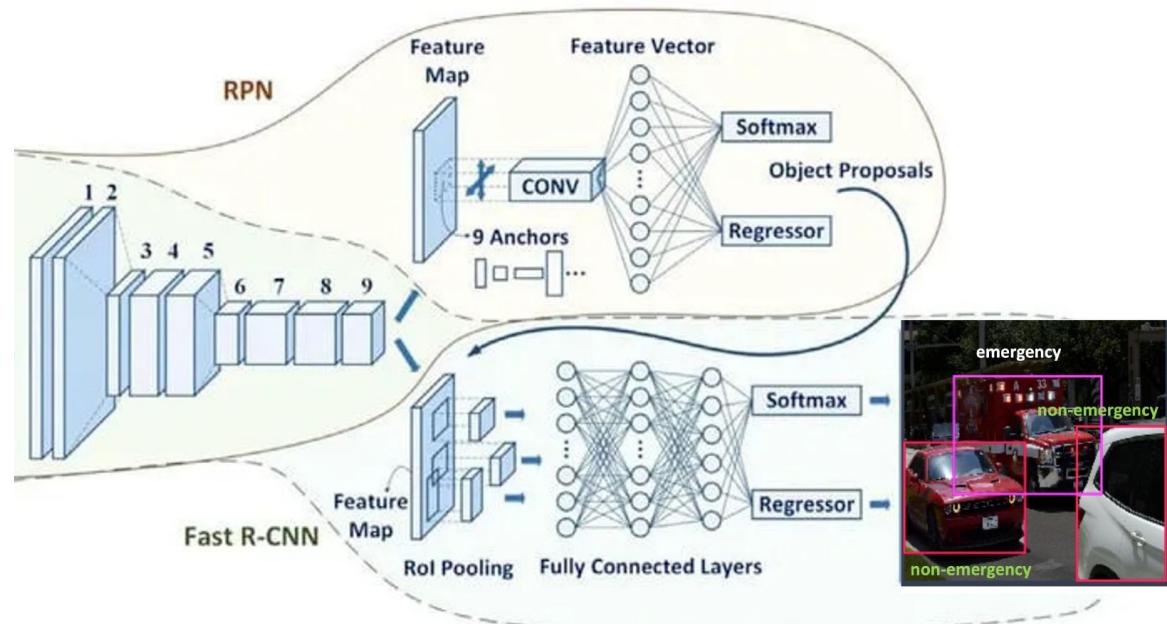
RegionProposalNetwork:

```
classification_logits: Conv2d(256, 15)  
boundingBox_predictor: Conv2d(256, 60)
```

RoIHeads:

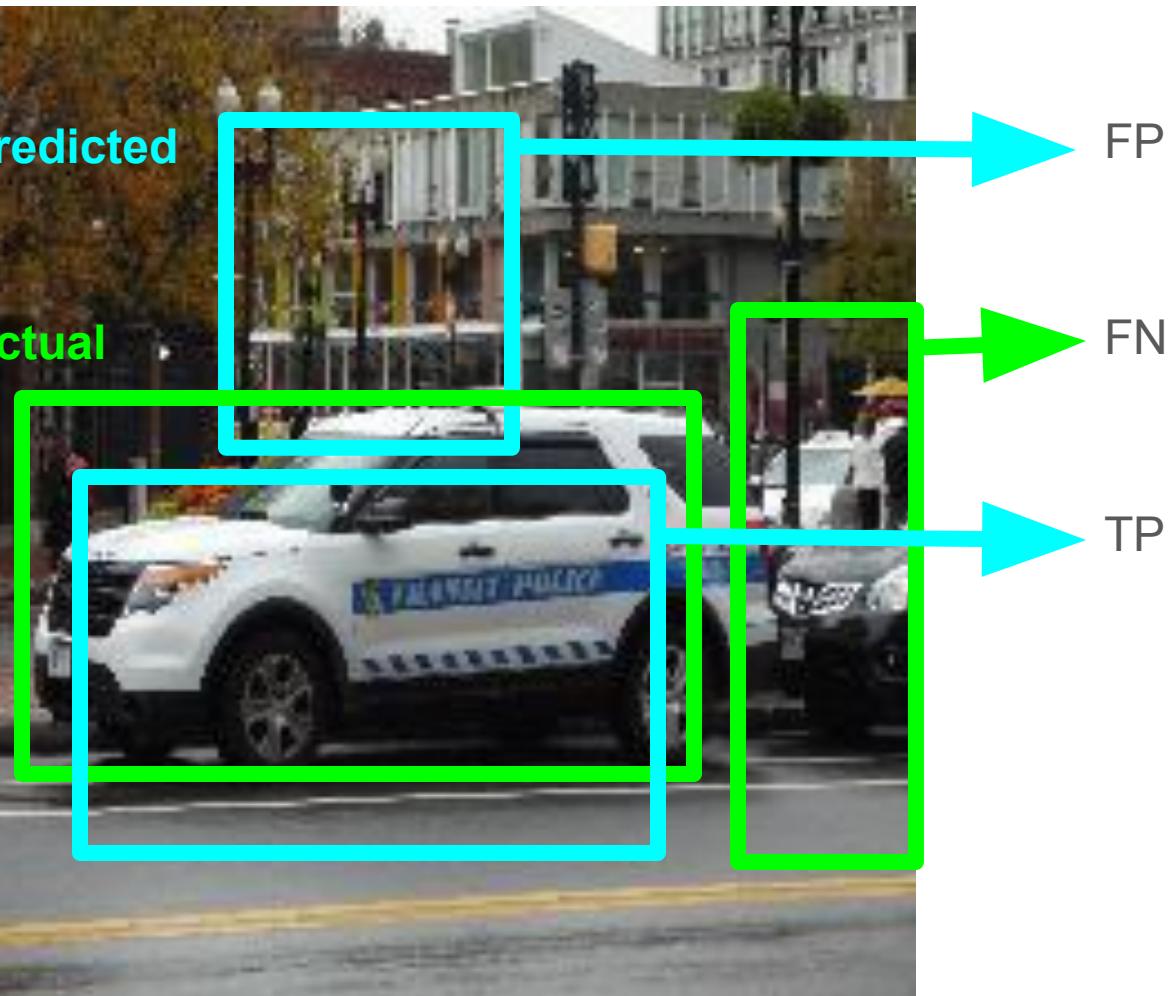
```
...
```

```
box_predictor: FastRCNNPredictor  
classification_score: Linear(in=1024, out=3)  
boundingBox_predictor: Linear(in=1024, out=12)
```



# BOUNDING BOX PERFORMANCE MEASURE

Proposed Regions → Non-Maximum suppression (0.5) → thresholding (0.1) → Regions



$$precision = \frac{TP}{TP + FP}$$

$$recall = \frac{TP}{TP + FN}$$

# INITIAL Set of Experiments (In Our Report)

## Training:

epoch: experimented from 20 to 150

Learning\_Rate: 0.01 , 0.001 , 0.0001 , 0.00001

optimizer: Gradient\_descent , Adaptive Movement Estimation

batch\_size: 25 , 75 , 100

runtime: 750 to 1500 seconds

## Test:

runtime: 5 seconds

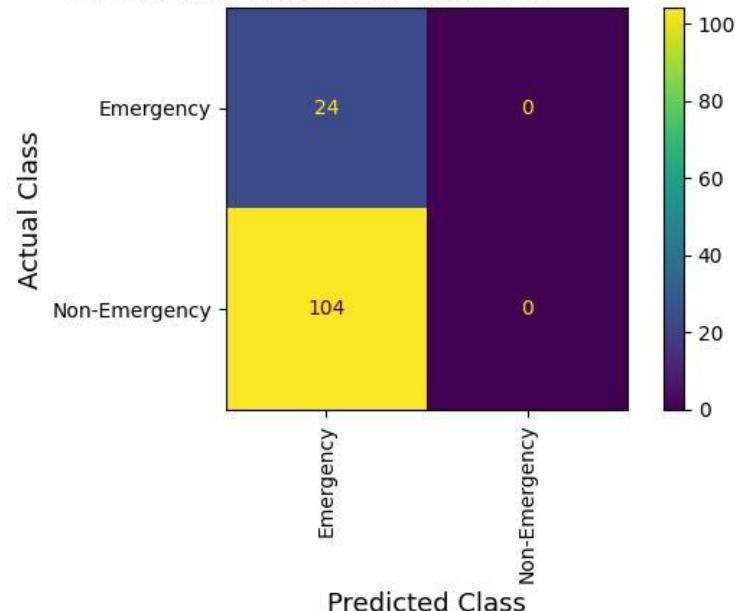
Actual Vehicle : 285

Predicted Vehicle : around 550

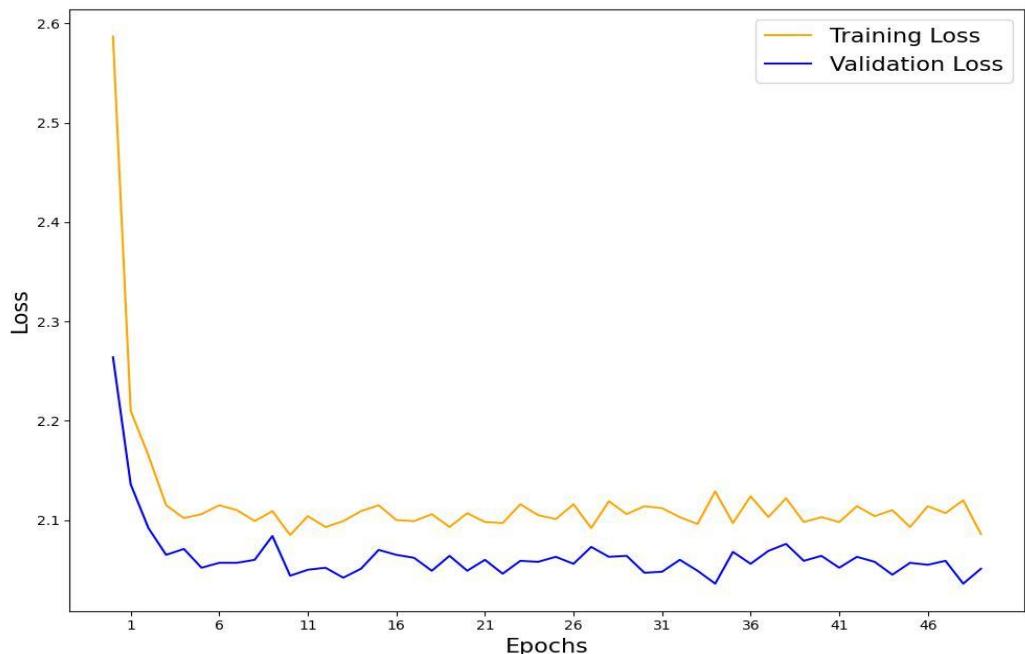
Bounding box Precision: 0.18    Recall: 0.65

Classification ACCURACY: 0.19

Confusion Matrix of Test Set



Training and Validation Loss vs Epochs



# CLASS LABEL ERROR

Dataset:

0: Emergency



Faster-R-CNN model considers

0: Background

1: Non-Emergency



1: Emergency

nothing (no examples)



2: Non-emergency

incorrect Prediction when Trained with incorrect mapping

# FIX

preprocess Dataset before Training:

1: Emergency

2: Non-Emergency

Another Performance Calculation Error

Fixed now. Number of False Positives were duplicating for each ground\_truth box.

# NEW: MODEL 6

## Training:

epoch: 25

Learning\_Rate: 0.01

optimizer: Adaptive Movement Estimation

batch\_size: 75

runtime: 560 seconds

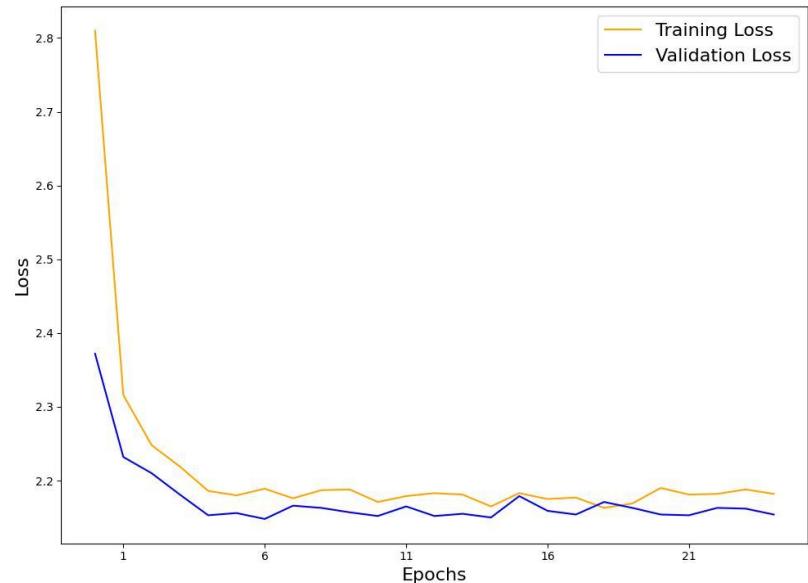
## Test:

runtime: 4 seconds

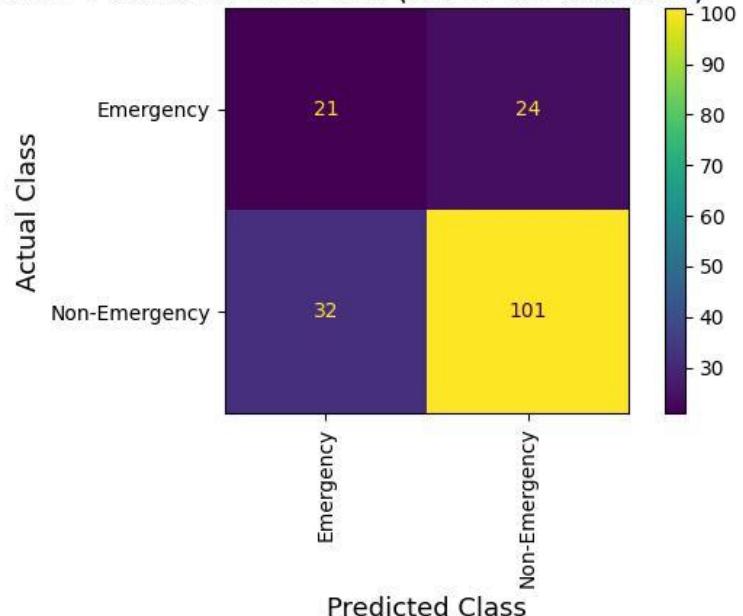
Actual Vehicle : 285    Predicted Vehicle : 304

Bounding box Precision: 0.6    Recall: 0.5

classification ACCURACY: 0.7



Confusion Matrix of Test Set (TruePos. b.boxes)



# NEW: MODEL 7

## Training:

epoch: 20

Learning\_Rate: 0.01

optimizer: Gradient Descent

batch\_size: 25

runtime: 560 seconds

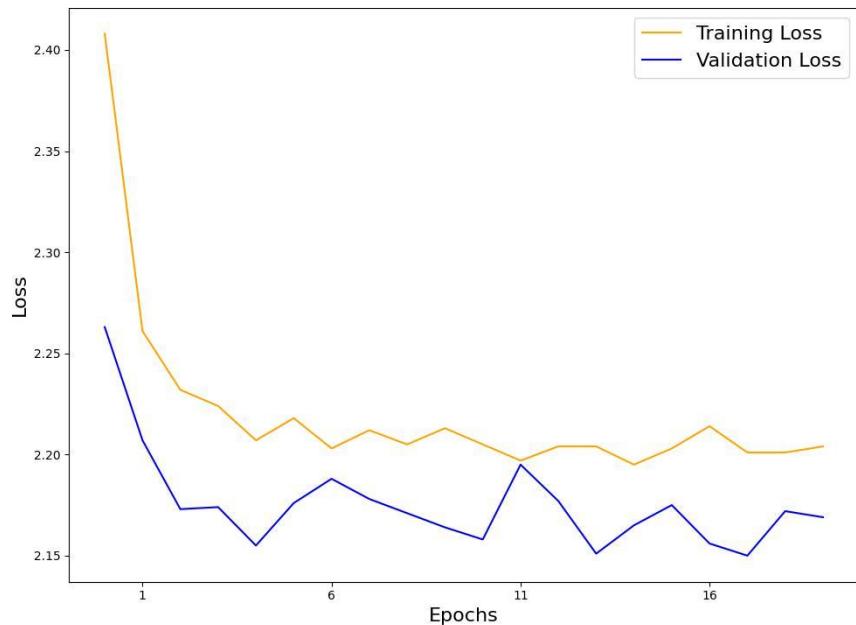
## Test:

runtime: 4 seconds

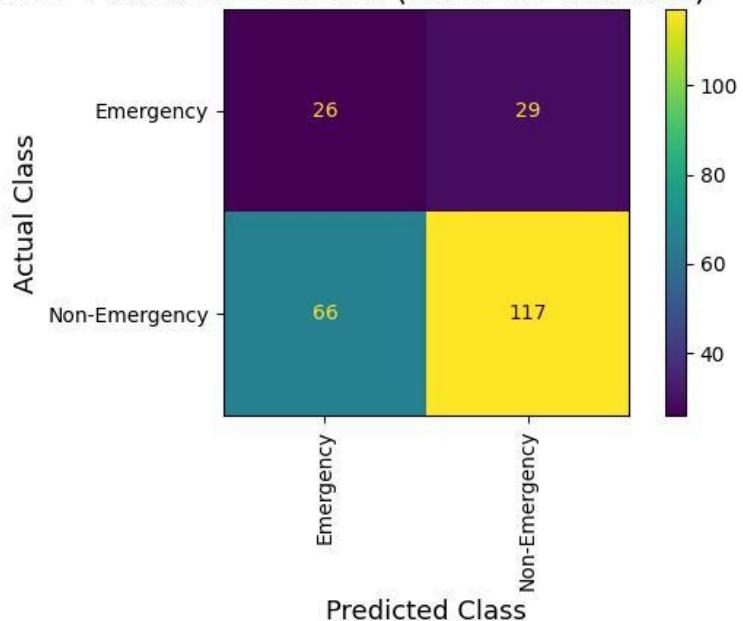
Actual Vehicle : 285    Predicted Vehicle : 650

Bounding box Precision: 0.37   Recall: 0.6

classification ACCURACY: 0.6



Confusion Matrix of Test Set (TruePos. b.boxes)



# NEW: MODEL 8

## Training:

epoch: 20

Learning\_Rate: 0.1

optimizer: Adaptive Movement Estimation

batch\_size: 25

runtime: 370 seconds

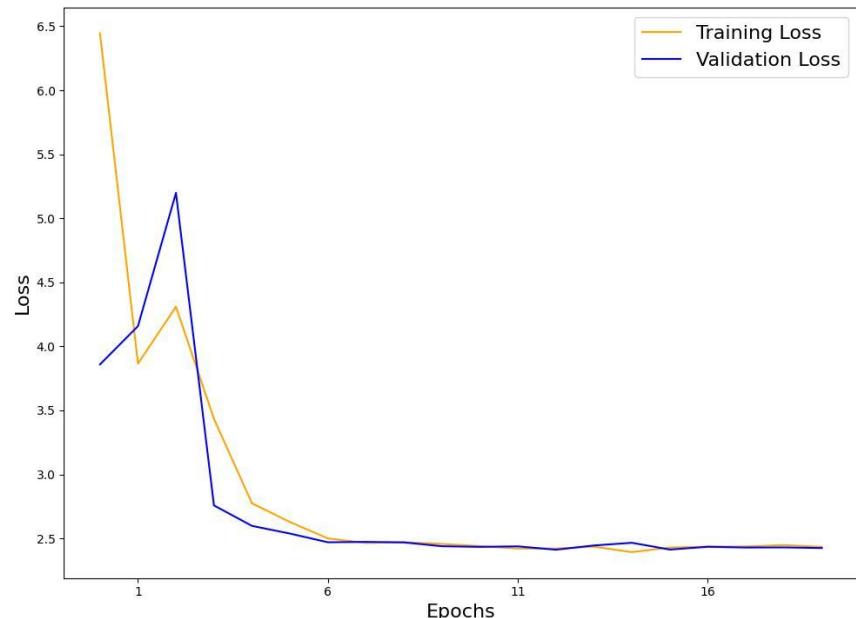
## Test:

runtime: 4 seconds

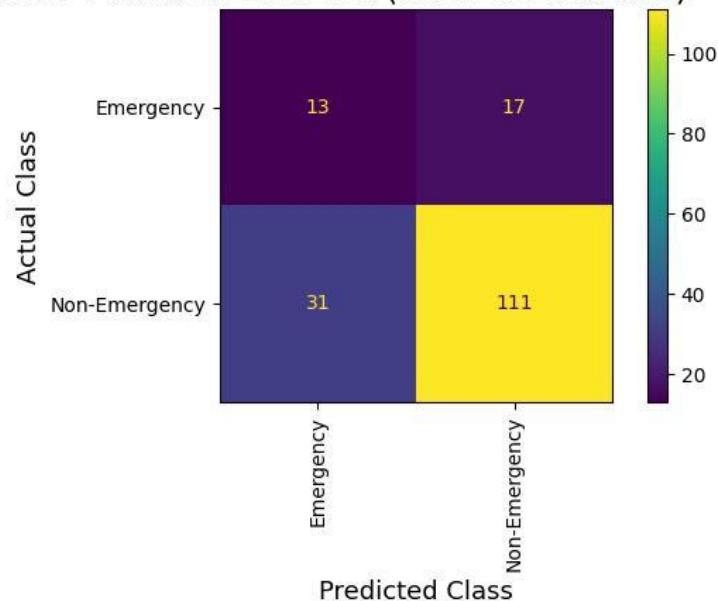
Actual Vehicle : 285    Predicted Vehicle : 400

Bounding box Precision: 0.37   Recall: 0.5

classification ACCURACY: 0.73



Confusion Matrix of Test Set (TruePos. b.boxes)



# NEW: MODEL 9

## Training:

epoch: 20

Learning\_Rate: 0.001

optimizer: Adaptive Movement Estimation

batch\_size: 50

runtime: 380 seconds

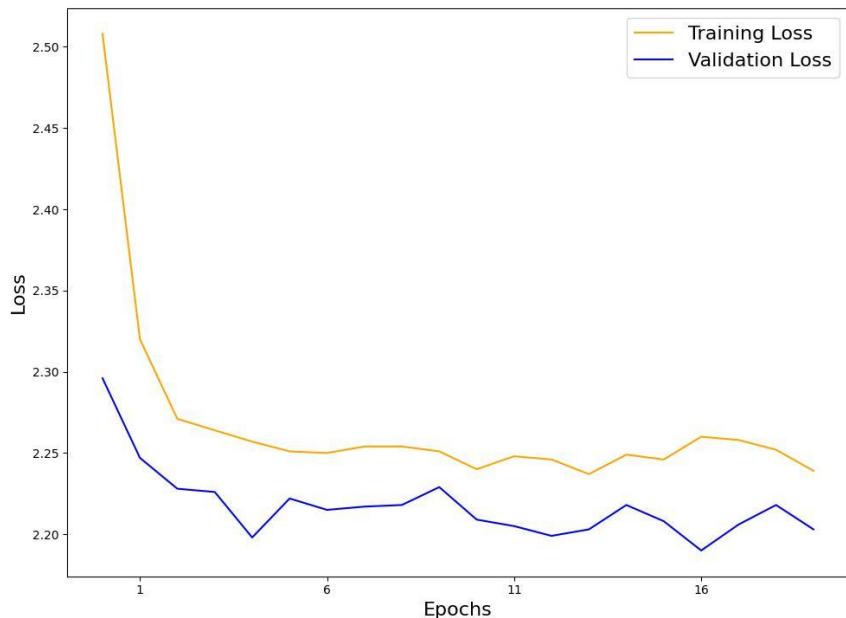
## Test:

runtime: 4 seconds

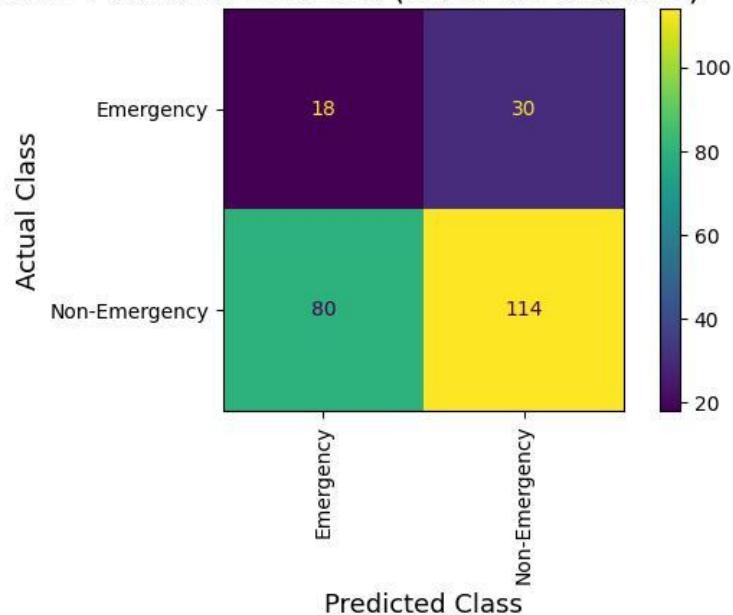
Actual Vehicle : 285    Predicted Vehicle : 700

Bounding box Precision: 0.34   Recall: 0.6

classification ACCURACY: 0.56



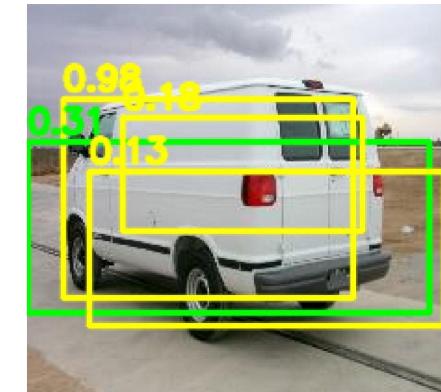
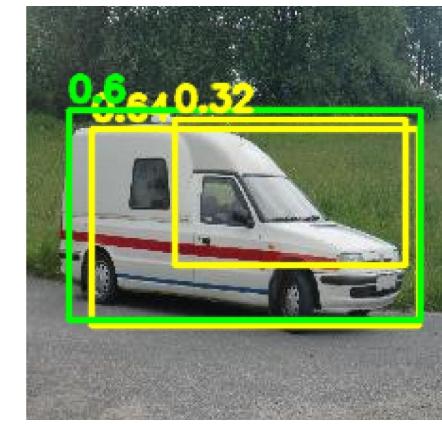
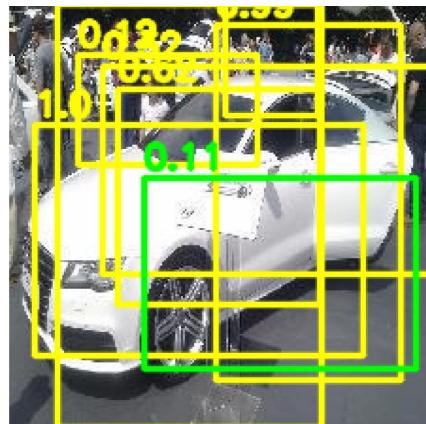
Confusion Matrix of Test Set (TruePos. b.boxes)

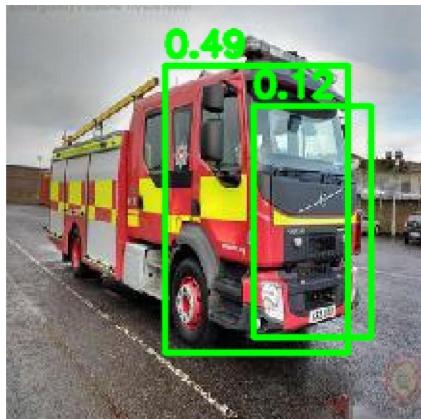


# BEST MODEL (6 and 8) RESULTS

Green = Emergency  
Yellow = Non-Emergency

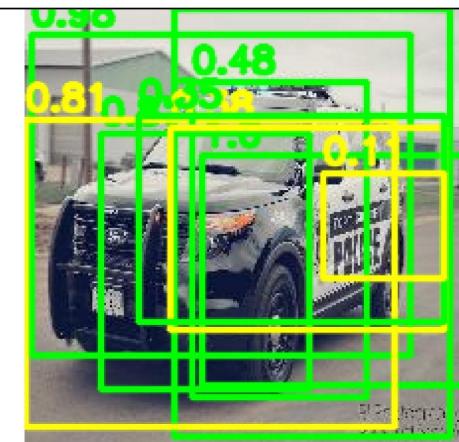
Actual VS Predicted





Green = Emergency  
Yellow = Non-Emergency

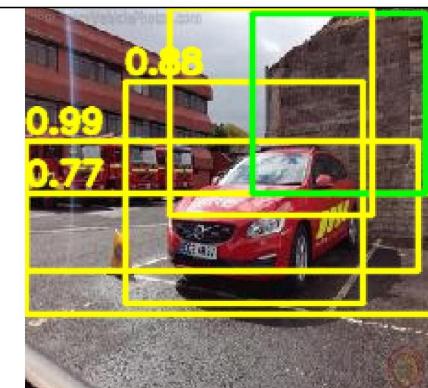
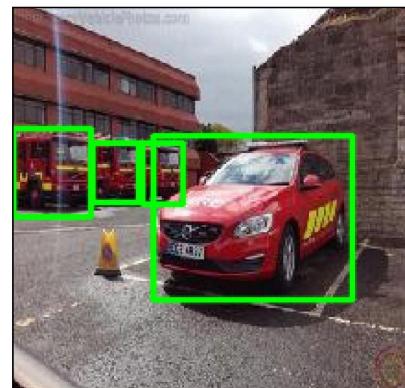
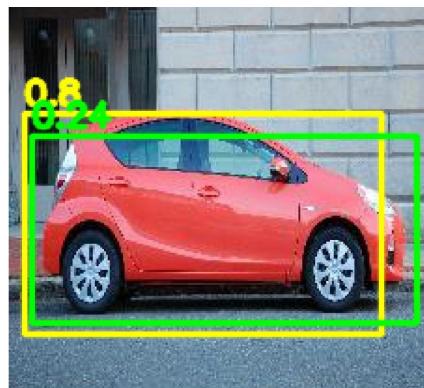
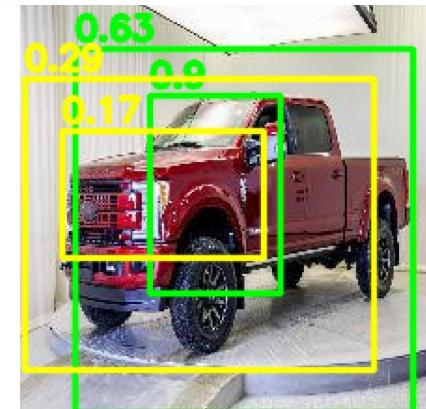
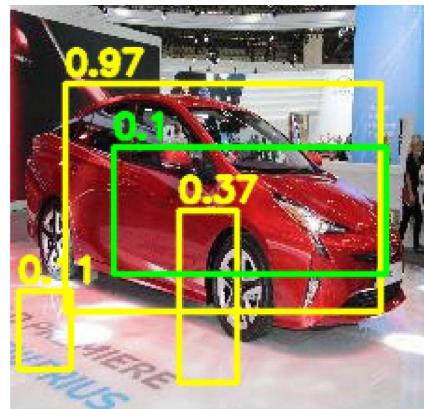
Actual VS Predicted



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