❖ Write a brief summary of your experiments and suggest the best model for this problem.

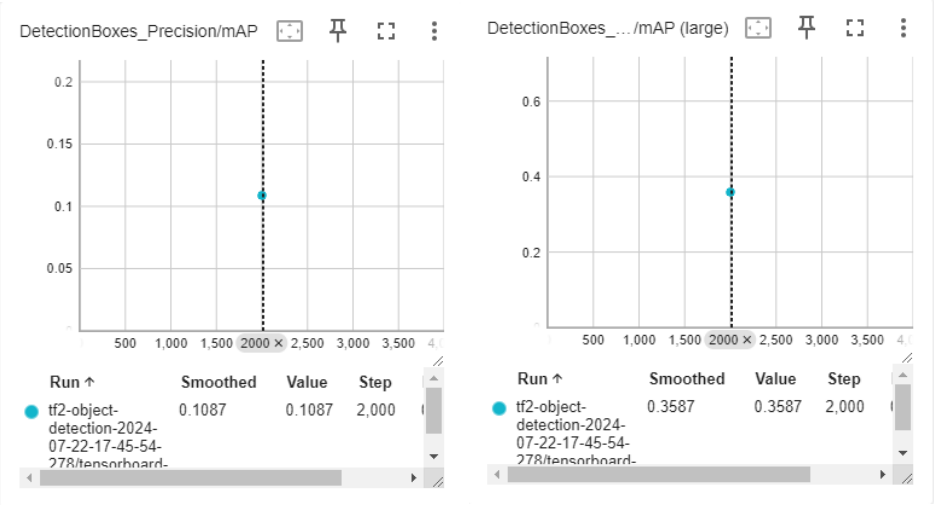
In this project, vehicles, pedestrians, and bicycles will be identified using the Tensorflow Object Detection API. Object detection is a crucial component of a system for autonomous vehicles since, a self-driving car needs to perceive its surroundings and interpret the objects around it accurately in order to make autonomous movements.

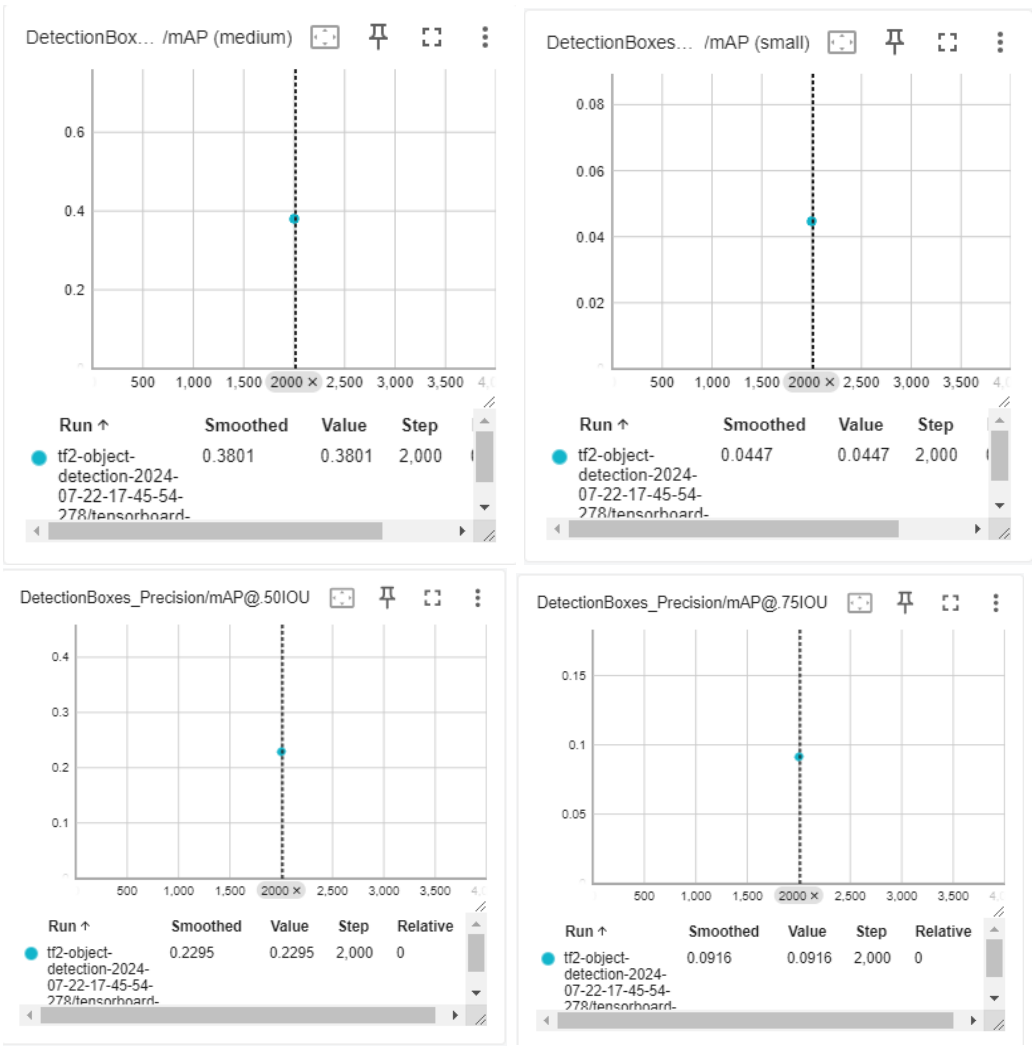
- For experiment 1:
  I have used pre-trained model SSD MobileNet V2 FPNLite which is available in the TensorFlow 2 Object Detection Model Zoo, and they were trained on the COCO 2017 dataset.
- For experiment 2:
  I have used pre-trained model SSD ResNet50 V1 FPN which is also available in the TensorFlow 2 Object Detection Model Zoo, and they were trained on the COCO 2017 dataset.

For the 2 models, because of my restricted AWS budget, I utilized the same 2000 training steps. I also used Momentum Optimizer with the same batch size of 8 in the 2 experiments, for the same reason.

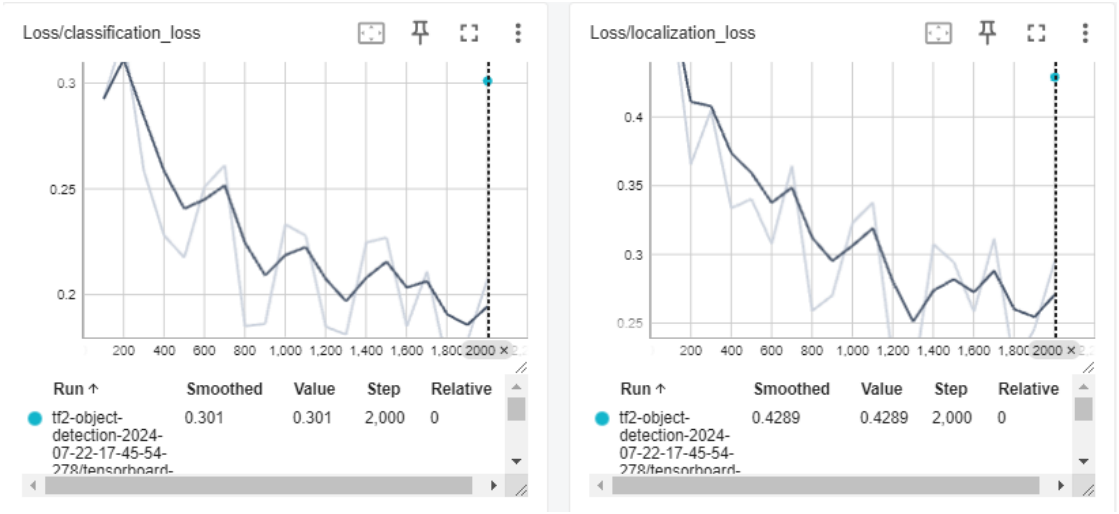
❖ How does the validation loss compare to the training loss?

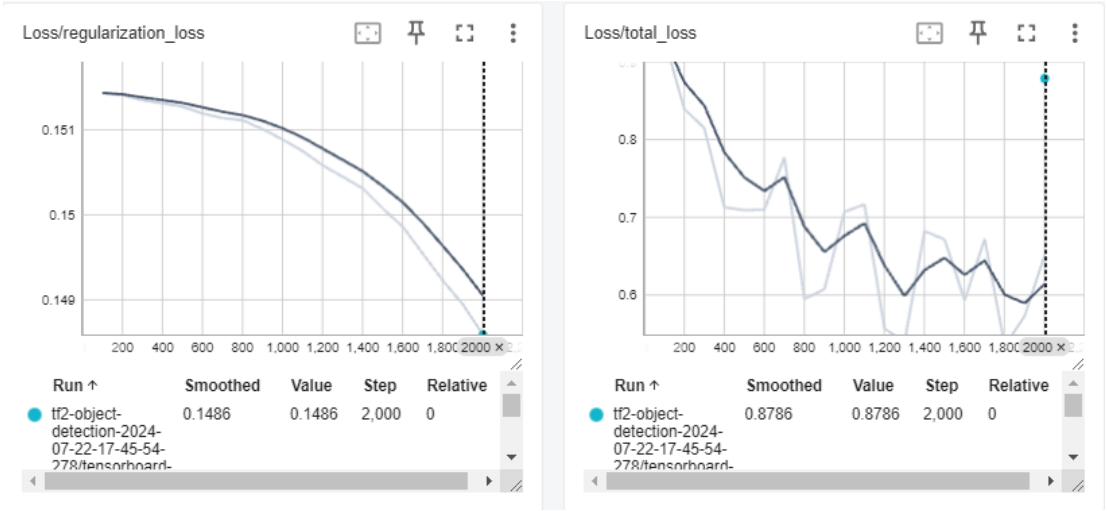
- For experiment 1:
  - Precision:



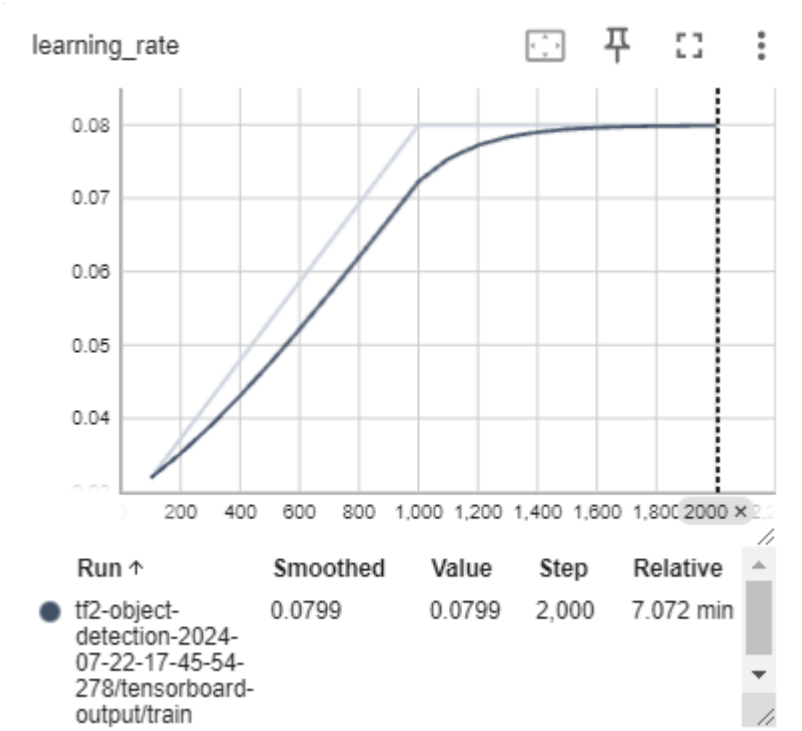

DetectionBox... /mAP (medium)
0.6
0.4
0.2
500 1,000 1,500 2000 2,500 3,000 3,500
Run ↑ Smoothed Value Step
tf2-object-detection-2024-07-22-17-45-54-278/tensorboard- 0.3801 0.3801 2,000
DetectionBoxes... /mAP (small)
0.08
0.06
0.04
0.02
500 1,000 1,500 2000 2,500 3,000 3,500
Run ↑ Smoothed Value Step
tf2-object-detection-2024-07-22-17-45-54-278/tensorboard- 0.0447 0.0447 2,000
DetectionBoxes_Precision/mAP@.50IOU
0.4
0.3
0.2
0.1
500 1,000 1,500 2000 2,500 3,000 3,500
Run ↑ Smoothed Value Step Relative
tf2-object-detection-2024-07-22-17-45-54-278/tensorboard- 0.2295 0.2295 2,000 0
DetectionBoxes_Precision/mAP@.75IOU
0.15
0.1
0.05
500 1,000 1,500 2000 2,500 3,000 3,500
Run ↑ Smoothed Value Step Relative
tf2-object-detection-2024-07-22-17-45-54-278/tensorboard- 0.0916 0.0916 2,000 0

- Recall:


Loss/classification_loss
0.3
0.25
0.2
200 400 600 800 1,000 1,200 1,400 1,600 1,800 2000
Run ↑ Smoothed Value Step Relative
tf2-object-detection-2024-07-22-17-45-54-278/tensorboard- 0.301 0.301 2,000 0
Loss/localization_loss
0.4
0.35
0.3
0.25
200 400 600 800 1,000 1,200 1,400 1,600 1,800 2000
Run ↑ Smoothed Value Step Relative
tf2-object-detection-2024-07-22-17-45-54-278/tensorboard- 0.4289 0.4289 2,000 0



- Learning rate:



- For experiment 2:
  In this experiment, I cannot access the tensor board to get the data. I am not sure about the reason, but I also attached the log file for the training at https://drive.google.com/file/d/1ziseETXk_Ka4jJxiMlGYOf5PVmCFYp3y/view?usp=sharing. Could you please check the log file? The error I got was

something like the image below:

I really want to check on this issue, but it seems my account almost reaches its limit.

- Precision: Please check the log file.
- Recall: Please check the log file.
- Learning rate: Please check the log file.

❖ Did you expect such behavior from the losses/metrics?

There still is quite some scope for improvement:

- ➢ The model still faces challenges in detecting small images.
- ➢ The model generates a large number of bounding boxes, which makes crowded areas challenging.
- ➢ Sometimes the model produces false positives as can be inferred from the animations.

❖ What can you do to improve the performance of the tested models further?

- ➢ Finding the right hyper-parameters can take more time. This could not be completed due to extremely restricted computational resources.
- ➢ More advanced techniques such as color jittering, decreasing image quality, … can also be used to improve the model's accuracy.
- ➢ Trying with more complex models.