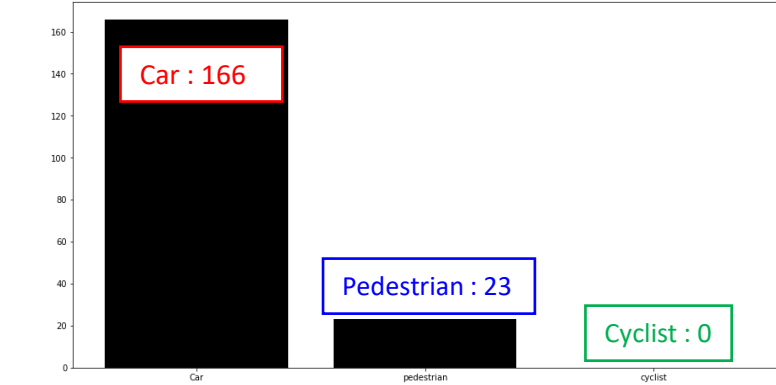


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Exploratory Data Analysis on Waymo image dataset:

The Exploratory Data Analysis for Waymo image dataset classes is correctly processed as shown:

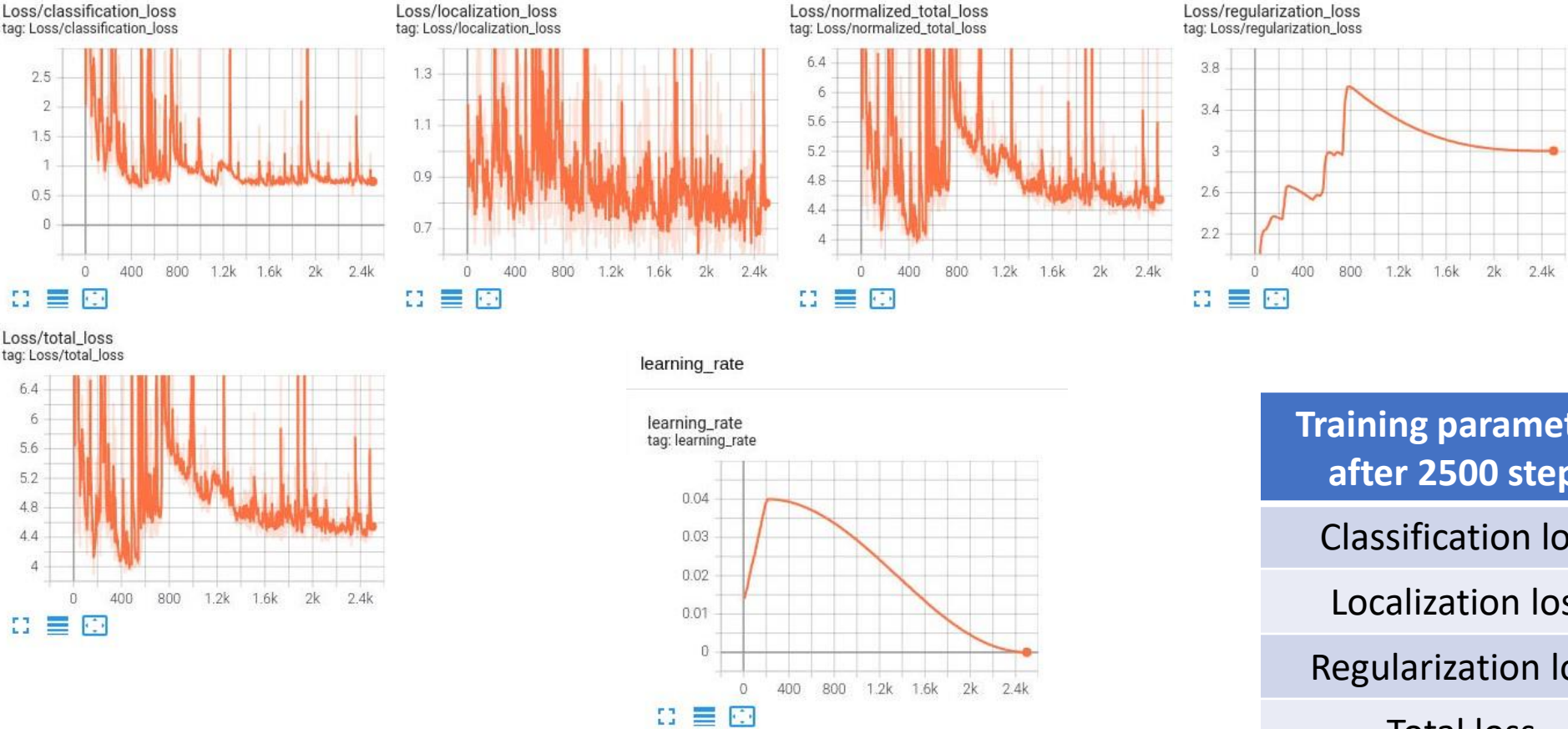
- Car class bounding box
- Pedestrian class bounding box
- Cyclist class bounding box



The absolute classes distribution to the right represents the variation of classes across the above chosen waymo image dataset

Baseline Experiment – Transfer learning – Training :

Transfer learning is processed through SSD ResNet 50 layers – single shot object detection neural network model with given tensor flow configuration file over given waymo images tensor flow records data – 2500 steps

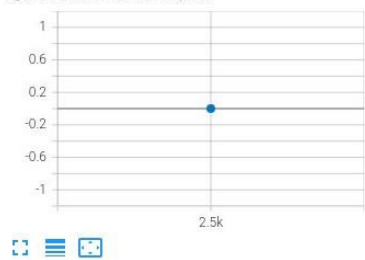


Training parameters after 2500 steps	Baseline – Exp 0
Classification loss	~0.75
Localization loss	~0.8
Regularization loss	~3.0
Total loss	~4.6

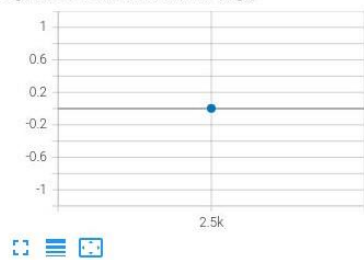
Baseline Experiment – Transfer learning – Evaluation :

Transfer learning is processed through SSD ResNet 50 layers – single shot object detection neural network model with given tensor flow configuration file over given waymo images tensor flow records data – 2500 steps

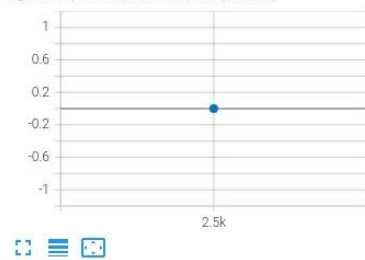
DetectionBoxes_Precision/mAP
tag: DetectionBoxes_Precision/mAP



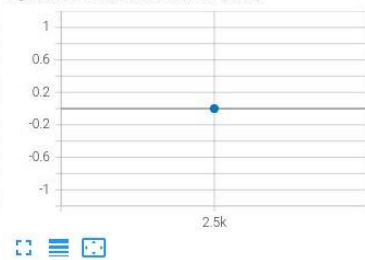
DetectionBoxes_Precision/mAP (large)
tag: DetectionBoxes_Precision/mAP (large)



DetectionBoxes_Precision/mAP (medium)
tag: DetectionBoxes_Precision/mAP (medium)

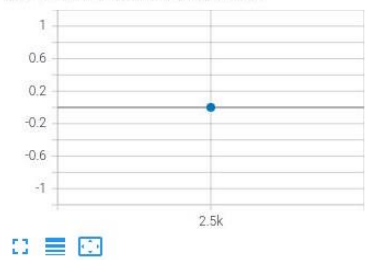


DetectionBoxes_Precision/mAP (small)
tag: DetectionBoxes_Precision/mAP (small)

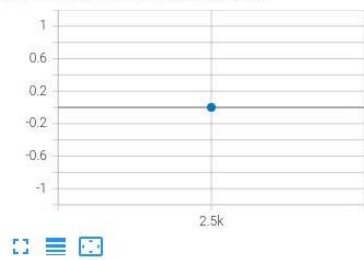


Evaluation parameters after 2500 steps	Baseline – Exp 0
max. Average precision	~0
Recall	~0

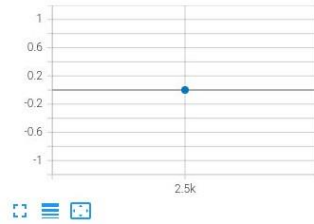
DetectionBoxes_Precision/mAP@.50IOU
tag: DetectionBoxes_Precision/mAP@.50IOU



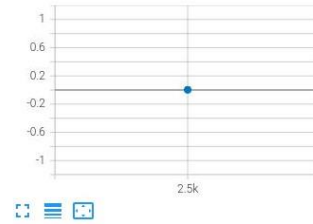
DetectionBoxes_Precision/mAP@.75IOU
tag: DetectionBoxes_Precision/mAP@.75IOU



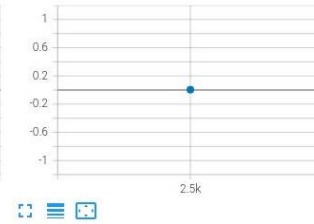
DetectionBoxes_Recall/AR@1
tag: DetectionBoxes_Recall/AR@1



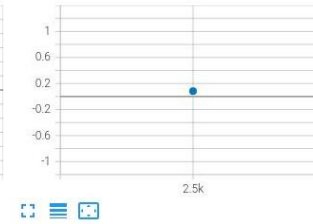
DetectionBoxes_Recall/AR@10
tag: DetectionBoxes_Recall/AR@10



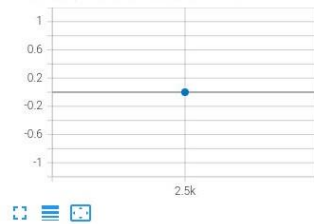
DetectionBoxes_Recall/AR@100
tag: DetectionBoxes_Recall/AR@100



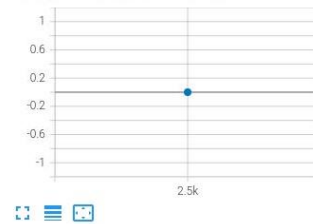
DetectionBoxes_Recall/AR@100 (large)
tag: DetectionBoxes_Recall/AR@100 (large)



DetectionBoxes_Recall/AR@100 (medium)
tag: DetectionBoxes_Recall/AR@100 (medium)



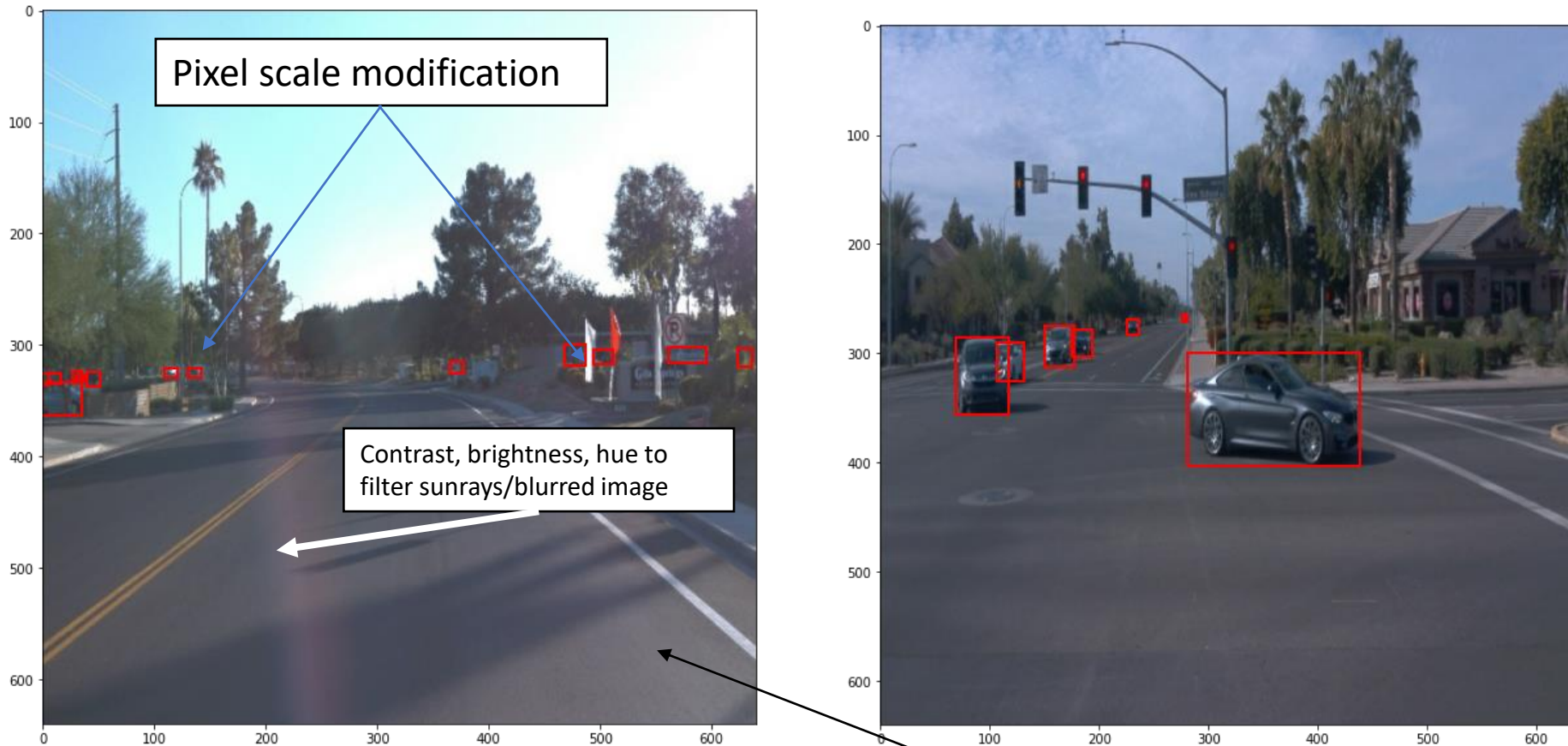
DetectionBoxes_Recall/AR@100 (small)
tag: DetectionBoxes_Recall/AR@100 (small)



Computer Vision project : Object detection in Urban Environment

Experiment 1– Transfer learning – Training Improvement on Baseline

Training improvement is carried out by manipulating the augmentations in the below chosen images



Since the cars are far away / smaller in the image. So, data augmentation options like pixel scale modification & the sun rays need to clear contrast, brightness and hue

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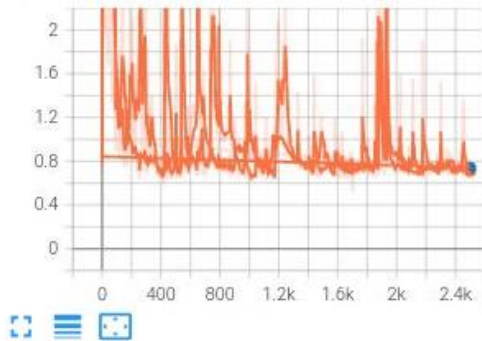
Self-Driving Car Engineer

Pawan Korareddy

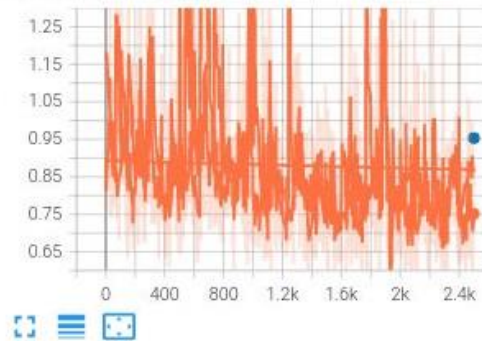
Experiment 1 with augmentation updates – Transfer learning – Training results:

Transfer learning is processed through SSD ResNet 50 layers – single shot object detection neural network model with given tensor flow configuration file over given waymo images tensor flow records data – 2500 steps

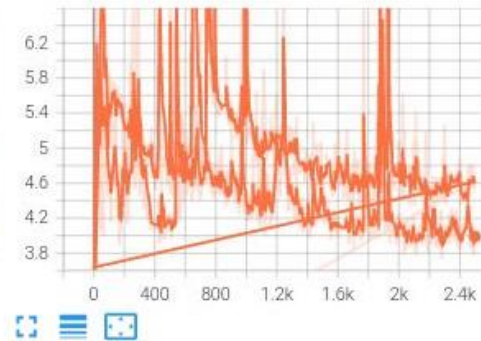
Loss/classification_loss
tag: Loss/classification_loss



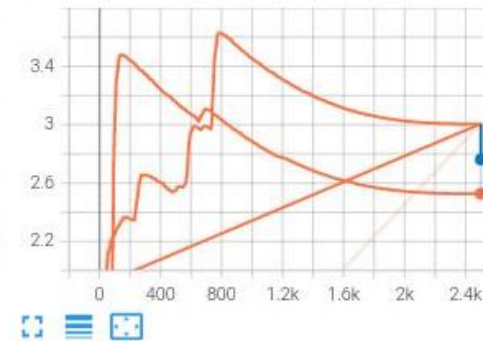
Loss/localization_loss
tag: Loss/localization_loss



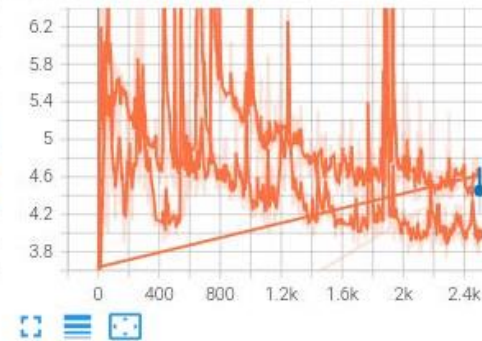
Loss/normalized_total_loss
tag: Loss/normalized_total_loss



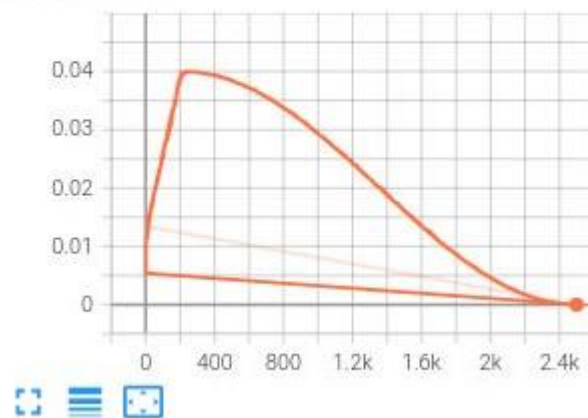
Loss/regularization_loss
tag: Loss/regularization_loss



Loss/total_loss
tag: Loss/total_loss



learning_rate
tag: learning_rate



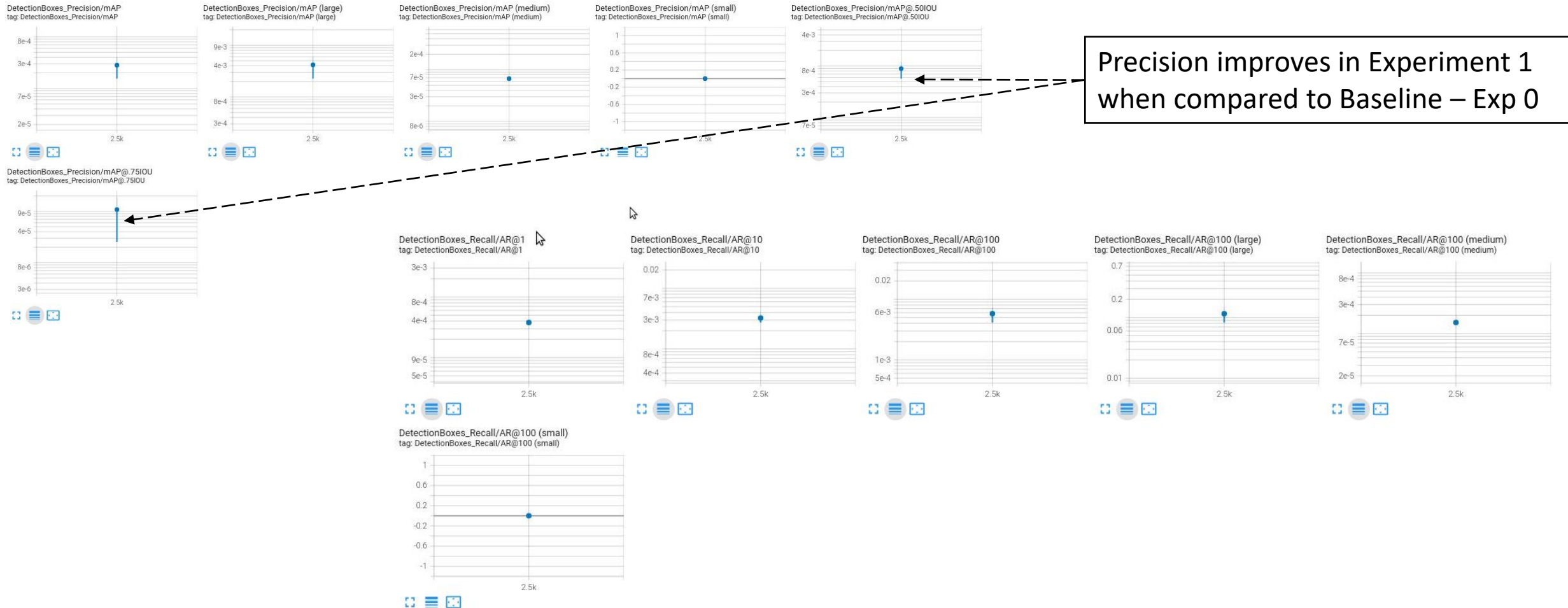
Training parameters after 2500 steps	Baseline – Exp 0	Experiment 1 with augmentation updates
Classification loss	~0.75	~0.75
Localization loss	~0.8	~0.75
Regularization loss	~3.0	~2.55
Total loss	~4.6	~4.0

Computer Vision project : Object detection in Urban Environment

Pawan Korareddy

Experiment 1 with augmentation updates – Transfer learning – Evaluation results:

Transfer learning is processed through SSD ResNet 50 layers – single shot object detection neural network model with given tensor flow configuration file over given waymo images tensor flow records data – 2500 steps



Computer Vision project : Object detection in Urban Environment

Experiment 2 is attempted to train high with same momentum optimizer, cosine learning rate at reduced learning rates. But, some UDACITY – cloud memory allocation issues made me unable to try more experiments.

There could be good chances of increasing precision and low recalls, low training and evaluation loss. But, GPU, memory stopped me doing so and unable to even export the video steps

```
2023-06-10 02:45:40.042078: I tensorflow/core/common_runtime/bfc_allocator.cc:1034] 10 Chunks of size 2359296 totalling 38.00MiB
2023-06-10 02:45:40.042093: I tensorflow/core/common_runtime/bfc_allocator.cc:1034] 2 Chunks of size 2883584 totalling 5.50MiB
2023-06-10 02:45:40.042108: I tensorflow/core/common_runtime/bfc_allocator.cc:1034] 1 Chunks of size 3670016 totalling 3.50MiB
2023-06-10 02:45:40.042124: I tensorflow/core/common_runtime/bfc_allocator.cc:1034] 5 Chunks of size 4194304 totalling 20.00MiB
2023-06-10 02:45:40.042159: I tensorflow/core/common_runtime/bfc_allocator.cc:1034] 1 Chunks of size 8388608 totalling 8.00MiB
2023-06-10 02:45:40.042176: I tensorflow/core/common_runtime/bfc_allocator.cc:1034] 3 Chunks of size 9437184 totalling 27.00MiB
2023-06-10 02:45:40.042206: I tensorflow/core/common_runtime/bfc_allocator.cc:1034] 1 Chunks of size 9830400 totalling 9.38MiB
2023-06-10 02:45:40.042235: I tensorflow/core/common_runtime/bfc_allocator.cc:1034] 4 Chunks of size 20460032 totalling 78.05MiB
2023-06-10 02:45:40.042250: I tensorflow/core/common_runtime/bfc_allocator.cc:1034] 1 Chunks of size 22326528 totalling 21.29MiB
2023-06-10 02:45:40.042266: I tensorflow/core/common_runtime/bfc_allocator.cc:1034] 1 Chunks of size 62444544 totalling 59.55MiB
2023-06-10 02:45:40.042282: I tensorflow/core/common_runtime/bfc_allocator.cc:1038] Sum Total of in-use chunks: 299.67MiB
2023-06-10 02:45:40.042294: I tensorflow/core/common_runtime/bfc_allocator.cc:1040] total_region_allocated_bytes_: 333053952 memory_limit_: 333053952 available bytes: 0 curr_region_allocation_bytes_: 666107904
2023-06-10 02:45:40.042313: I tensorflow/core/common_runtime/bfc_allocator.cc:1046] Stats:
Limit: 333053952
InUse: 314225408
MaxInUse: 328673792
NumAllocs: 2101
MaxAllocSize: 83706624
Reserved: 0
PeakReserved: 0
LargestFreeBlock: 0

2023-06-10 02:45:40.042356: W tensorflow/core/common_runtime/bfc_allocator.cc:439] *****
2023-06-10 02:45:40.042400: W tensorflow/core/framework/op_kernel.cc:1767] OP_REQUIRES failed at cwise_ops_common.cc:82 : Resource exhausted: OOM when allocating tensor with shape[100,51150] and type float on
ob:localhost/replica:0/task:0/device:GPU:0 by allocator GPU_0_bfc
Traceback (most recent call last):
  File "experiments/model_main_tf2.py", line 113, in <module>
    tf.compat.v1.app.run()
  File "/data/virtual_envs/sdc-cl-gpu-augment/lib/python3.7/site-packages/tensorflow/python/platform/app.py", line 40, in run
    run(main=main, argv=argv, flags_parser=parse_flags_tolerate_undef)
  File "/data/virtual_envs/sdc-cl-gpu-augment/lib/python3.7/site-packages/absl/app.py", line 300, in run
```