

Object Detection Writup report

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Overview

Object Detection is the key component of self-driving car systems. We do nothing if we did not understand what the object that around the car is, especially sign, persons, road...

The brower crash random because the limits of the VM memory size.

Set Up

It look like that the task is simple. It hides a lot of details using The Tensorflow Object Detection API. I have train the model many times because of the limit space of /home/workspace.

- View the Web brower in TruboVNC (the brower often crash).
- Write shell command in Web base vscode

In `Exploratory Data Analysis.ipynb` section, I just plots the images in Tfrecored.

Create new config

```
python edit_config.py --train_dir /home/workspace/data/train/ --eval_dir /home/workspace/data/val/ --batch_size 2 --checkpoint /home/workspace/experiments/retrained_model/ssd_resnet50_v1_fpn_640x640_coco17_tpu-8/checkpoint/ckpt-0 --label_map /home/workspace/experiments/label_map.pbtxt
```

Training

```
python experiments/model_main_tf2.py --model_dir=/home/backups/experiments/reference/ --pipeline_config_path=experiments/reference/pipeline_new.config
```

I have to move the model dir to /home/backups because of the limits space of /home/workspace

Evaluation

```
python experiments/model_main_tf2.py --model_dir=/home/backups/experiments/reference/ --pipeline_config_path=experiments/reference/pipeline_new.config -checkpoint_dir=experiments/reference/
```

Exporting

```
python experiments/exporter_main_v2.py --input_type image_tensor --pipeline_config_path experiments/reference/pipeline_new.config --trained_checkpoint_dir experiments/reference/ --output_directory experiments/reference/exported/
```

Inference

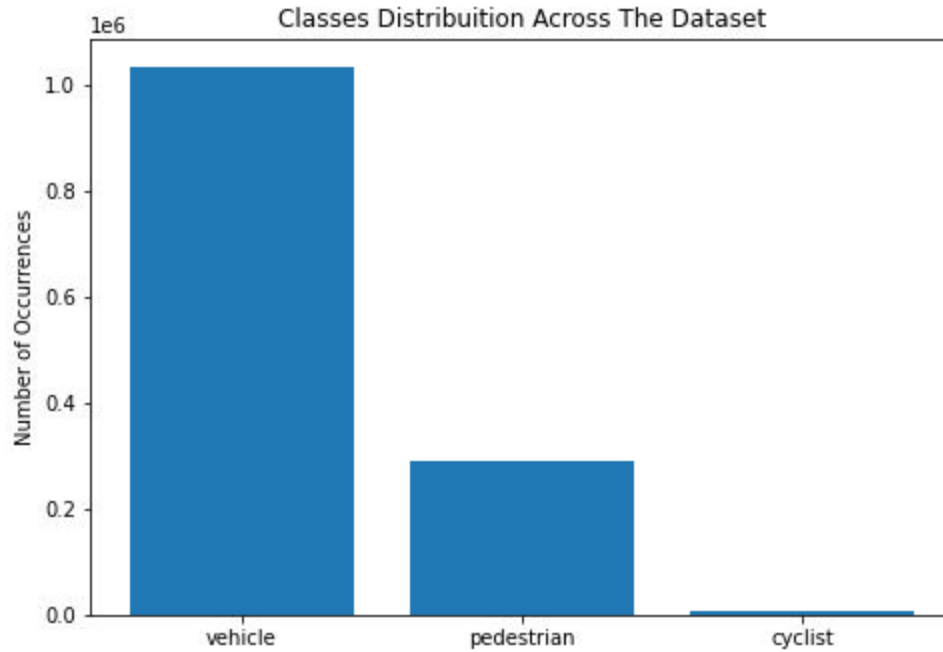
```
python inference_video.py --labelmap_path label_map.pbtxt --model_path experiments/reference/exported/saved_model --tf_record_path data/test/segment-12200383401366682847_2552_140_2572_140_with_camera_labels.tfrecord --config_path experiments/reference/pipeline_new.config --output_path animation.gif
```

Dataset

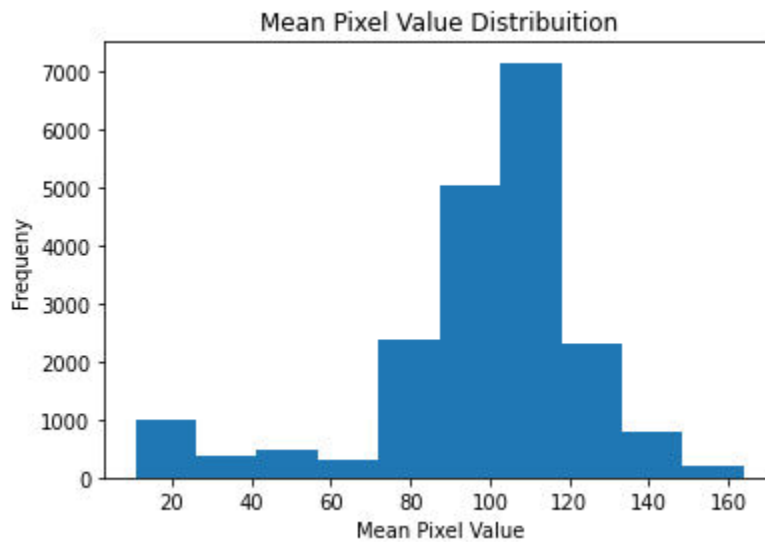
I have loaded 60000 images in this training dataset.

- 1035407 vehicles in the datasets
- 290753 pedestrians
- 7481 cyclists

{1: 1035407, 2: 290753, 4: 7481}

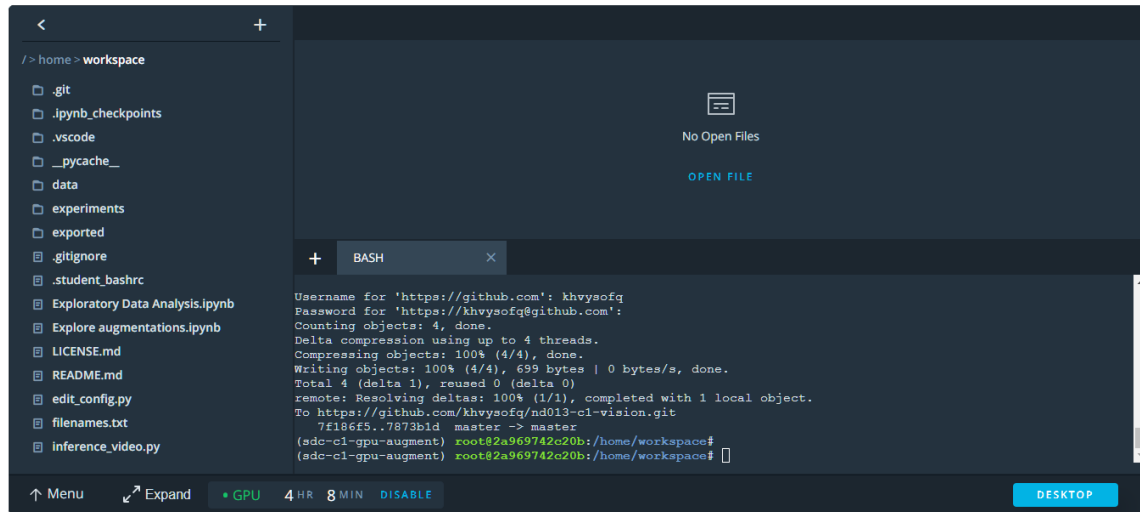


Below is the mean pixel value Distribution



Training

I have trained many times of this model with different num_steps and different parameters.

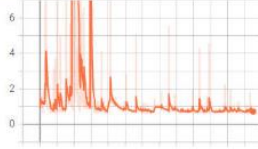


The GPU remains 4 Hours

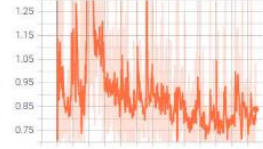
```
batch_size: 2
data_augmentation_options {
  random_horizontal_flip {
  }
}
data_augmentation_options {
  random_rgb_to_gray {
    probability: 0.2
  }
}
data_augmentation_options {
  random_adjust_contrast {
    min_delta: 0.2
    max_delta: 1.0
  }
}
data_augmentation_options {
  random_adjust_brightness {
    max_delta: 0.2
  }
}
data_augmentation_options {
  random_image_scale {
    min_scale_ratio: 0.8
    max_scale_ratio: 2.2
  }
}
data_augmentation_options {
  random_crop_image {
```

Loss

Loss/classification_loss
tag: Loss/classification_loss



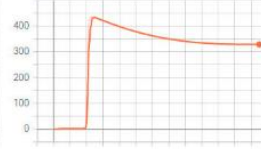
Loss/localization_loss
tag: Loss/localization_loss



Loss/normalized_total_loss
tag: Loss/normalized_total_loss



Loss/regularization_loss
tag: Loss/regularization_loss

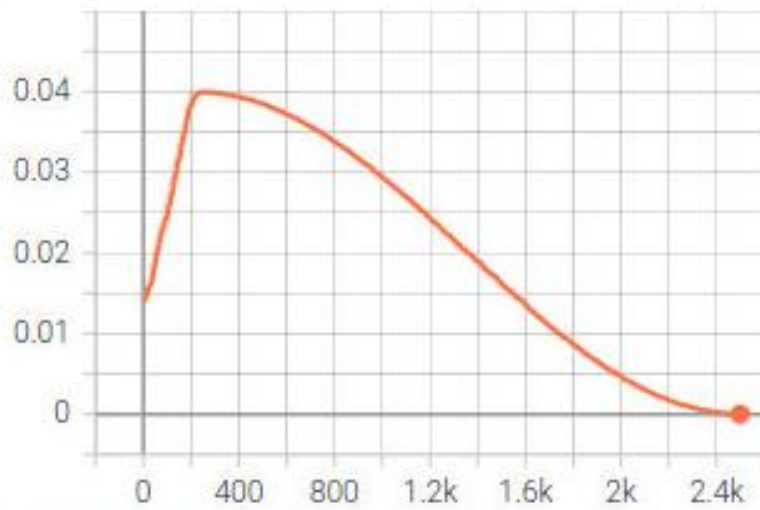


Loss/total_loss
tag: Loss/total_loss

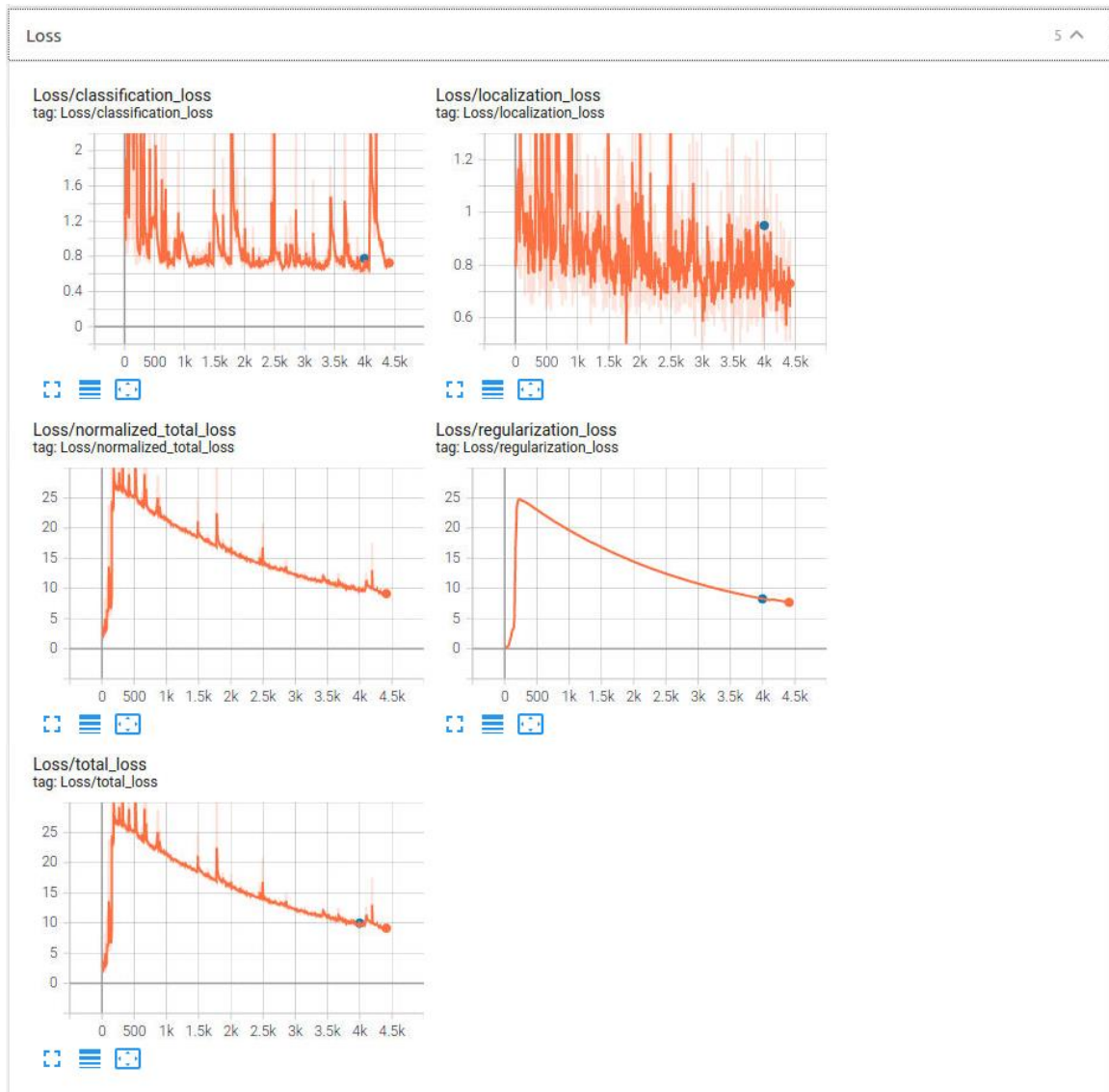


learning_rate

learning_rate
tag: learning_rate



2500 num_steps



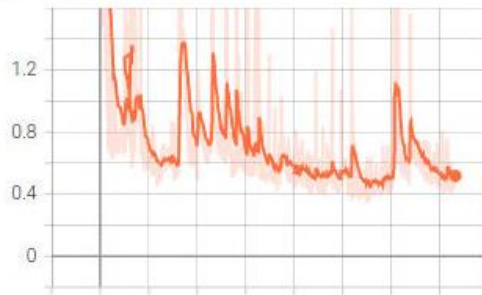
4500 num_steps

It look like that the Detection is very well.

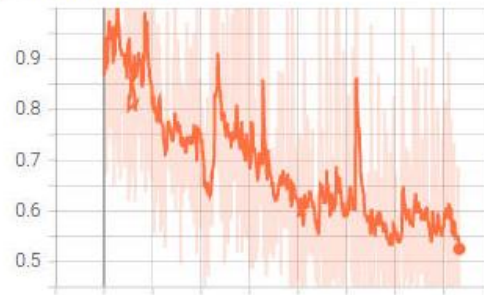
Random_image_scale

Loss

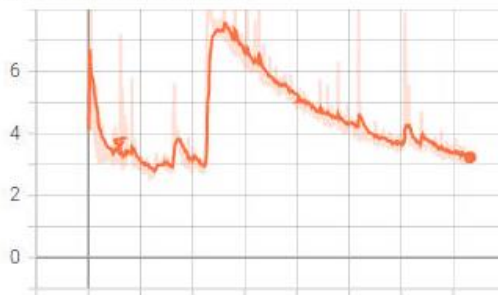
Loss/classification_loss
tag: Loss/classification_loss



Loss/localization_loss
tag: Loss/localization_loss



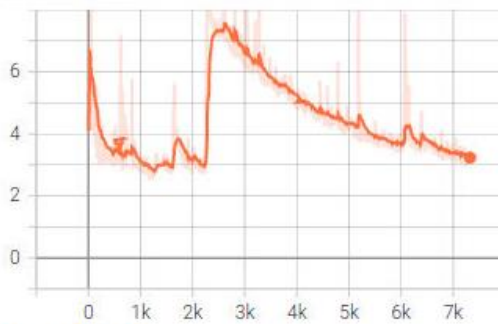
Loss/normalized_total_loss
tag: Loss/normalized_total_loss



Loss/regularization_loss
tag: Loss/regularization_loss



Loss/total_loss
tag: Loss/total_loss




```

Accumulating evaluation results...
DONE (t=0.38s).
Average Precision (AP) @[ IoU=0.50:0.95 | area= all | maxDets=100 ] = 0.002
Average Precision (AP) @[ IoU=0.50 | area= all | maxDets=100 ] = 0.007
Average Precision (AP) @[ IoU=0.75 | area= all | maxDets=100 ] = 0.000
Average Precision (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.001
Average Precision (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.039
Average Precision (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.005
Average Recall (AR) @[ IoU=0.50:0.95 | area= all | maxDets= 1 ] = 0.000
Average Recall (AR) @[ IoU=0.50:0.95 | area= all | maxDets= 10 ] = 0.002
Average Recall (AR) @[ IoU=0.50:0.95 | area= all | maxDets=100 ] = 0.033
Average Recall (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.011
Average Recall (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.108
Average Recall (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.187
INFO:tensorflow:Eval metrics at step 7000
I1107 08:12:56.186412 140648646125312 model_lib_v2.py:988] Eval metrics at step 7000
INFO:tensorflow: + DetectionBoxes_Precision/mAP: 0.001689
I1107 08:12:56.193719 140648646125312 model_lib_v2.py:991] + DetectionBoxes_Precision/mAP: 0.001689
INFO:tensorflow: + DetectionBoxes_Precision/mAP@.50IOU: 0.006965
I1107 08:12:56.195389 140648646125312 model_lib_v2.py:991] + DetectionBoxes_Precision/mAP@.50IOU: 0.006965
INFO:tensorflow: + DetectionBoxes_Precision/mAP@.75IOU: 0.000484
I1107 08:12:56.197005 140648646125312 model_lib_v2.py:991] + DetectionBoxes_Precision/mAP@.75IOU: 0.000484
INFO:tensorflow: + DetectionBoxes_Precision/mAP (small): 0.000613
I1107 08:12:56.198633 140648646125312 model_lib_v2.py:991] + DetectionBoxes_Precision/mAP (small): 0.000613
INFO:tensorflow: + DetectionBoxes_Precision/mAP (medium): 0.039422

```

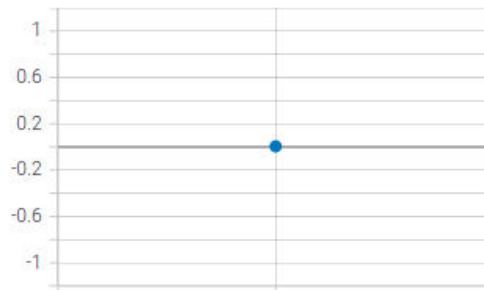
The initial decline of the curve is relatively random. After 7000 steps, the Average Precision still the same low.

DetectionBoxes_Precision

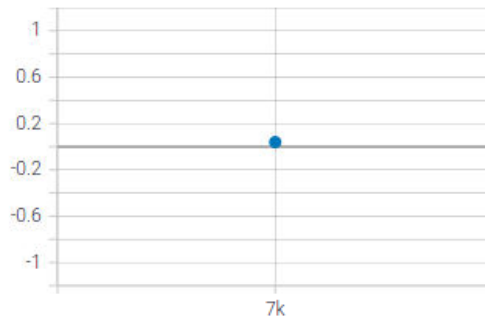
DetectionBoxes_Precision/mAP
tag: DetectionBoxes_Precision/mAP



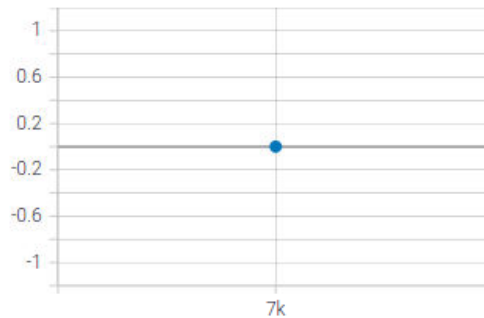
DetectionBoxes_Precision/mAP (large)
tag: DetectionBoxes_Precision/mAP (large)



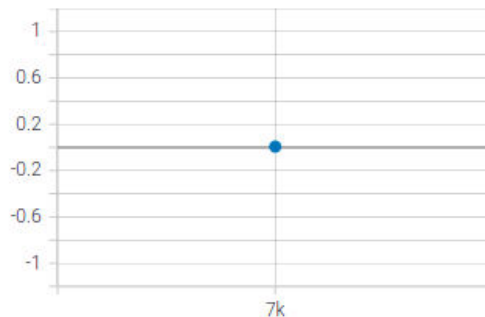
DetectionBoxes_Precision/mAP (medium)
tag: DetectionBoxes_Precision/mAP (medium)



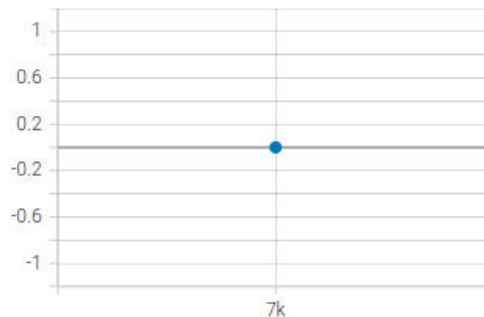
DetectionBoxes_Precision/mAP (small)
tag: DetectionBoxes_Precision/mAP (small)



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



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

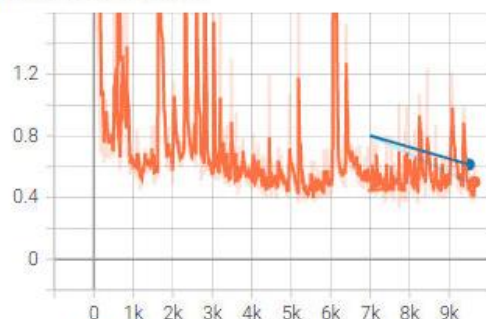


RGB to gray and scale

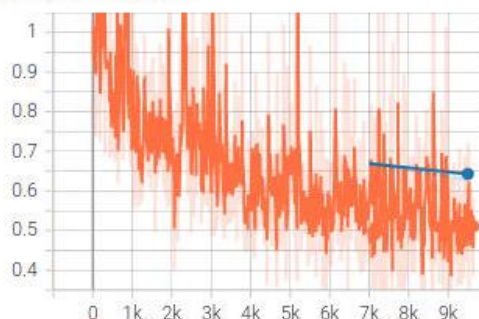
Add RGB to gray

Loss

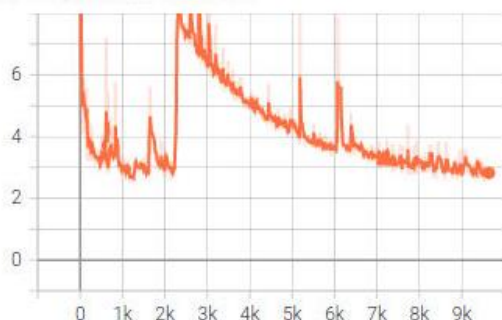
Loss/classification_loss
tag: Loss/classification_loss



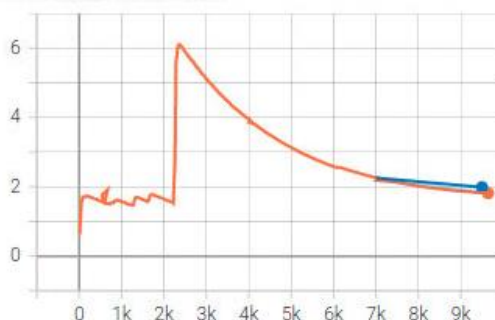
Loss/localization_loss
tag: Loss/localization_loss



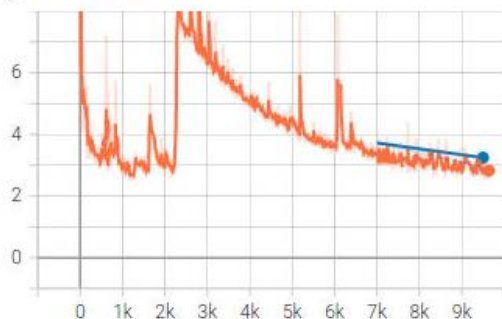
Loss/normalized_total_loss
tag: Loss/normalized_total_loss



Loss/regularization_loss
tag: Loss/regularization_loss



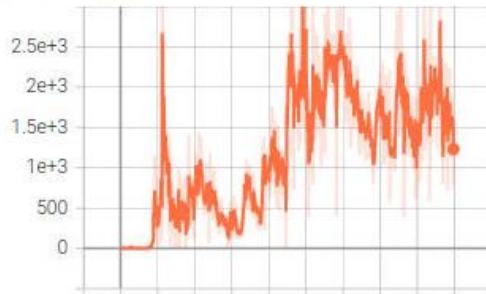
Loss/total_loss
tag: Loss/total_loss



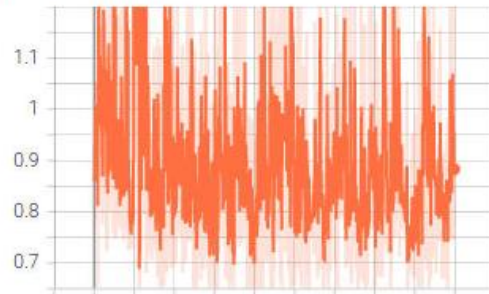
Change softmax

Loss

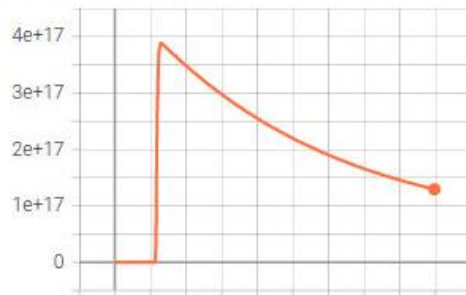
Loss/classification_loss
tag: Loss/classification_loss



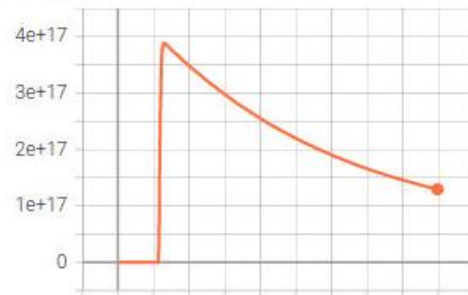
Loss/localization_loss
tag: Loss/localization_loss



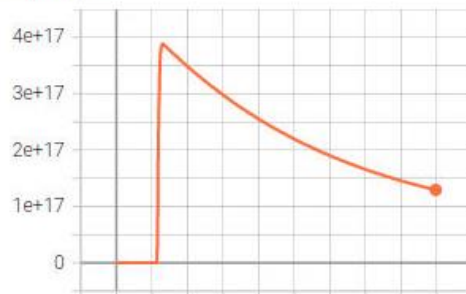
Loss/normalized_total_loss
tag: Loss/normalized_total_loss



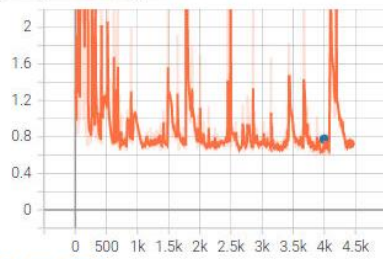
Loss/regularization_loss
tag: Loss/regularization_loss



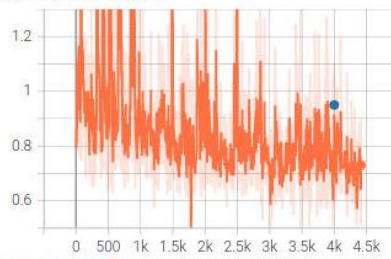
Loss/total_loss
tag: Loss/total_loss



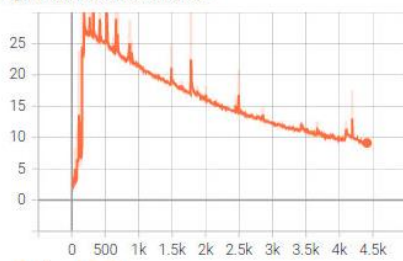
Loss/classification_loss
tag: Loss/classification_loss



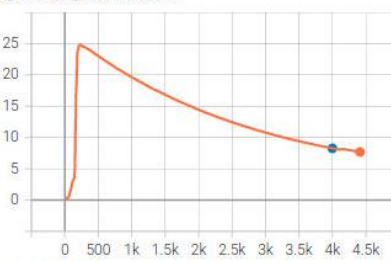
Loss/localization_loss
tag: Loss/localization_loss



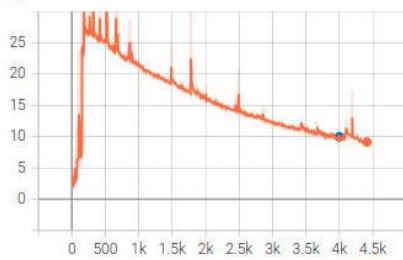
Loss/normalized_total_loss
tag: Loss/normalized_total_loss



Loss/regularization_loss
tag: Loss/regularization_loss



Loss/total_loss
tag: Loss/total_loss



eval_side_by_side_0_0

eval_side_by_side_0_0

eval

tag: eval_side_by_side_0_0

step 4,500

Sun Oct 30 2022 03:18:28 GMT+0000 (GMT)

RESET



RESET

eval_side_by_side_1_0

eval_side_by_side_1_0

eval

tag: eval_side_by_side_1_0

step 4,500

Sun Oct 30 2022 03:18:29 GMT+0000 (GMT)



nce/

eval_side_by_side_2_0

eval_side_by_side_2_0

eval

tag: eval_side_by_side_2_0

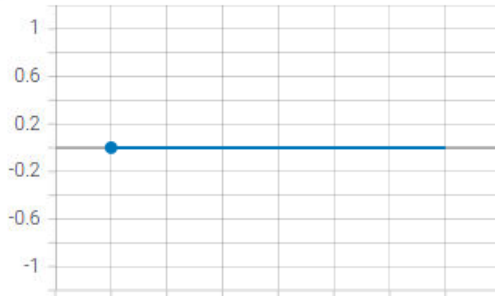
step 4,500

Sun Oct 30 2022 03:18:29 GMT+0000 (GMT)

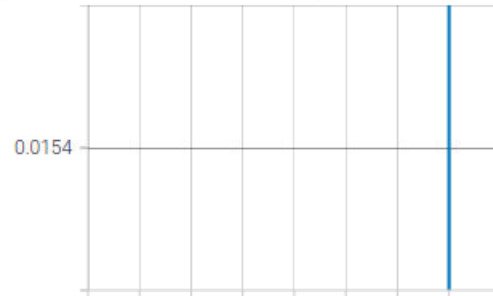


DetectionBoxes_Precision

DetectionBoxes_Precision/mAP
tag: DetectionBoxes_Precision/mAP



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



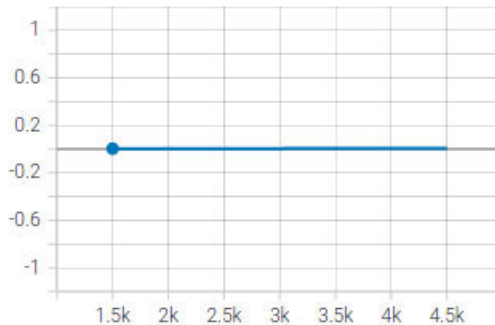
DetectionBoxes_Precision/mAP (medium)
tag: DetectionBoxes_Precision/mAP (medium)



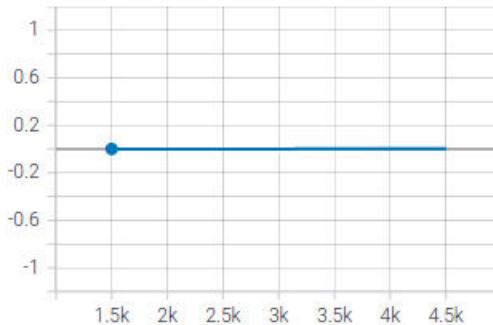
DetectionBoxes_Precision/mAP (small)
tag: DetectionBoxes_Precision/mAP (small)



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



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



It just a blue dot in this image, If we run once of the evaluation process. I changed the checkpoint_path in the checkpoint file.

I have tried many times with differents data_augmentation_options and differents steps, But the AP is still low. I think that the main reason is too little data.