```
!nvidia-smi
```

```
Sun Mar 27 19:08:56 2022
+-----------------------------------------------------------------------------+
| NVIDIA-SMI 460.32.03    Driver Version: 460.32.03    CUDA Version: 11.2     |
|-------------------------------+----------------------+----------------------+
| GPU  Name        Persistence-M| Bus-Id        Disp.A | Volatile Uncorr. ECC |
| Fan  Temp  Perf  Pwr:Usage/Cap|         Memory-Usage | GPU-Util  Compute M. |
|                               |                      |               MIG M. |
|===============================+======================+======================|
|   0  Tesla K80           Off  | 00000000:00:04.0 Off |                    0 |
| N/A   72C    P8    35W / 149W |      0MiB / 11441MiB |      0%      Default |
|                               |                      |                  N/A |
+-------------------------------+----------------------+----------------------+

+-----------------------------------------------------------------------------+
| Processes:                                                                  |
|  GPU   GI   CI        PID   Type   Process name                  GPU Memory |
|        ID   ID                                                   Usage      |
|=============================================================================|
|  No running processes found                                                 |
+-----------------------------------------------------------------------------+
```

```
!git clone https://github.com/tensorflow/models.git
```

```
Cloning into 'models'...
remote: Enumerating objects: 71335, done.
remote: Total 71335 (delta 0), reused 0 (delta 0), pack-reused 71335
Receiving objects: 100% (71335/71335), 578.67 MiB | 23.48 MiB/s, done.
Resolving deltas: 100% (50401/50401), done.
```

```
%cd /content/models/research/
!protoc object_detection/protos/*.proto --python_out=.
# Install TensorFlow Object Detection API.
!cp object_detection/packages/tf2/setup.py .
!python -m pip install .
```

```
  Downloading colorama-0.4.4-py2.py3-none-any.whl (16 kB)
Requirement already satisfied: scikit-learn>=0.21.3 in /usr/local/lib/python3.7/dist-packages (from seqeval->tf-mo
Requirement already satisfied: threadpoolctl>=2.0.0 in /usr/local/lib/python3.7/dist-packages (from scikit-learn>=
Requirement already satisfied: joblib>=0.11 in /usr/local/lib/python3.7/dist-packages (from scikit-learn>=0.21.3->
Requirement already satisfied: typeguard>=2.7 in /usr/local/lib/python3.7/dist-packages (from tensorflow-addons->t
Requirement already satisfied: tensorflow-metadata in /usr/local/lib/python3.7/dist-packages (from tensorflow-data
Requirement already satisfied: importlib-resources in /usr/local/lib/python3.7/dist-packages (from tensorflow-data
Requirement already satisfied: future in /usr/local/lib/python3.7/dist-packages (from tensorflow-datasets->tf-mode
Requirement already satisfied: promise in /usr/local/lib/python3.7/dist-packages (from tensorflow-datasets->tf-mod
Requirement already satisfied: attrs>=18.1.0 in /usr/local/lib/python3.7/dist-packages (from tensorflow-datasets->
Building wheels for collected packages: object-detection, py-cpuinfo, dill, avro-python3, seqeval
  Building wheel for object-detection (setup.py) ... done
  Created wheel for object-detection: filename=object_detection-0.1-py3-none-any.whl size=1686423 sha256=806c52a5b
  Stored in directory: /tmp/pip-ephem-wheel-cache-nsf8p78v/wheels/fa/a4/d2/e9a5057e414fd46c8e543d2706cd836d64e1fcd
  Building wheel for py-cpuinfo (setup.py) ... done
  Created wheel for py-cpuinfo: filename=py_cpuinfo-8.0.0-py3-none-any.whl size=22257 sha256=7b979b10e6ee5c358b3ac
  Stored in directory: /root/.cache/pip/wheels/d2/f1/1f/041add21dc9c4220157f1bd2bd6afe1f1a49524c3396b94401
  Building wheel for dill (setup.py) ... done
  Created wheel for dill: filename=dill-0.3.1.1-py3-none-any.whl size=78544 sha256=e47cc5684d6331386bee872dff01bcb
  Stored in directory: /root/.cache/pip/wheels/a4/61/fd/c57e374e580aa78a45ed78d5859b3a44436af17e22ca53284f
  Building wheel for avro-python3 (setup.py) ... done
  Created wheel for avro-python3: filename=avro_python3-1.10.2-py3-none-any.whl size=44010 sha256=7532e2d6a447e7db
  Stored in directory: /root/.cache/pip/wheels/d6/e5/b1/6b151d9b535ee50aaa6ab27d145a0104b6df02e5636f0376da
  Building wheel for seqeval (setup.py) ... done
  Created wheel for seqeval: filename=seqeval-1.2.2-py3-none-any.whl size=16180 sha256=51216665819200d41b02dcbe869
  Stored in directory: /root/.cache/pip/wheels/05/96/ee/7cac4e74f3b19e3158dce26a20a1c86b3533c43ec72a549fd7
Successfully built object-detection py-cpuinfo dill avro-python3 seqeval
Installing collected packages: requests, protobuf, tf-estimator-nightly, portalocker, dill, colorama, tf-slim, ten
  Attempting uninstall: requests
    Found existing installation: requests 2.23.0
    Uninstalling requests-2.23.0:
      Successfully uninstalled requests-2.23.0
  Attempting uninstall: protobuf
    Found existing installation: protobuf 3.17.3
    Uninstalling protobuf-3.17.3:
      Successfully uninstalled protobuf-3.17.3
  Attempting uninstall: dill
    Found existing installation: dill 0.3.4
    Uninstalling dill-0.3.4:
      Successfully uninstalled dill-0.3.4
  Attempting uninstall: pyyaml
    Found existing installation: PyYAML 3.13
    Uninstalling PyYAML-3.13:
      Successfully uninstalled PyYAML-3.13
  Attempting uninstall: pymongo
    Found existing installation: pymongo 4.0.2
    Uninstalling pymongo-4.0.2:
```

```
      Successfully uninstalled pymongo-4.0.2
  Attempting uninstall: cloudpickle
    Found existing installation: cloudpickle 1.3.0
    Uninstalling cloudpickle-1.3.0:
      Successfully uninstalled cloudpickle-1.3.0
ERROR: pip's dependency resolver does not currently take into account all the packages that are installed. This bel
multiprocess 0.70.12.2 requires dill>=0.3.4, but you have dill 0.3.1.1 which is incompatible.
gym 0.17.3 requires cloudpickle<1.7.0,>=1.2.0, but you have cloudpickle 2.0.0 which is incompatible.
google-colab 1.0.0 requires requests~=2.23.0, but you have requests 2.27.1 which is incompatible.
datascience 0.10.6 requires folium==0.2.1, but you have folium 0.8.3 which is incompatible.
Successfully installed apache-beam-2.37.0 avro-python3-1.10.2 cloudpickle-2.0.0 colorama-0.4.4 dill-0.3.1.1 fastav
```

```
!python /content/models/research/object_detection/builders/model_builder_tf2_test.py
```

```
I0327 19:11:32.303605 140422908086144 efficientnet_model.py:454] Building model efficientnet with params ModelConf
I0327 19:11:32.421308 140422908086144 ssd_efficientnet_bifpn_feature_extractor.py:146] EfficientDet EfficientNet b
I0327 19:11:32.421543 140422908086144 ssd_efficientnet_bifpn_feature_extractor.py:147] EfficientDet BiFPN num filt
I0327 19:11:32.421694 140422908086144 ssd_efficientnet_bifpn_feature_extractor.py:149] EfficientDet BiFPN num iter
I0327 19:11:32.423639 140422908086144 efficientnet_model.py:144] round_filter input=32 output=64
I0327 19:11:32.442593 140422908086144 efficientnet_model.py:144] round_filter input=32 output=64
I0327 19:11:32.442739 140422908086144 efficientnet_model.py:144] round_filter input=16 output=32
I0327 19:11:32.741474 140422908086144 efficientnet_model.py:144] round_filter input=16 output=32
I0327 19:11:32.741655 140422908086144 efficientnet_model.py:144] round_filter input=24 output=48
I0327 19:11:33.415827 140422908086144 efficientnet_model.py:144] round_filter input=24 output=48
I0327 19:11:33.416038 140422908086144 efficientnet_model.py:144] round_filter input=40 output=80
I0327 19:11:34.082597 140422908086144 efficientnet_model.py:144] round_filter input=40 output=80
I0327 19:11:34.082855 140422908086144 efficientnet_model.py:144] round_filter input=80 output=160
I0327 19:11:35.034064 140422908086144 efficientnet_model.py:144] round_filter input=80 output=160
I0327 19:11:35.034307 140422908086144 efficientnet_model.py:144] round_filter input=112 output=224
I0327 19:11:35.969436 140422908086144 efficientnet_model.py:144] round_filter input=112 output=224
I0327 19:11:35.969681 140422908086144 efficientnet_model.py:144] round_filter input=192 output=384
I0327 19:11:37.194621 140422908086144 efficientnet_model.py:144] round_filter input=192 output=384
I0327 19:11:37.194831 140422908086144 efficientnet_model.py:144] round_filter input=320 output=640
I0327 19:11:37.887964 140422908086144 efficientnet_model.py:144] round_filter input=1280 output=2560
I0327 19:11:37.922022 140422908086144 efficientnet_model.py:454] Building model efficientnet with params ModelConf
INFO:tensorflow:time(__main__.ModelBuilderTF2Test.test_create_ssd_models_from_config): 27.06s
I0327 19:11:38.069593 140422908086144 test_util.py:2374] time(__main__.ModelBuilderTF2Test.test_create_ssd_models_
[       OK ] ModelBuilderTF2Test.test_create_ssd_models_from_config
[ RUN      ] ModelBuilderTF2Test.test_invalid_faster_rcnn_batchnorm_update
INFO:tensorflow:time(__main__.ModelBuilderTF2Test.test_invalid_faster_rcnn_batchnorm_update): 0.0s
I0327 19:11:38.076863 140422908086144 test_util.py:2374] time(__main__.ModelBuilderTF2Test.test_invalid_faster_rcn
[       OK ] ModelBuilderTF2Test.test_invalid_faster_rcnn_batchnorm_update
[ RUN      ] ModelBuilderTF2Test.test_invalid_first_stage_nms_iou_threshold
INFO:tensorflow:time(__main__.ModelBuilderTF2Test.test_invalid_first_stage_nms_iou_threshold): 0.0s
I0327 19:11:38.078923 140422908086144 test_util.py:2374] time(__main__.ModelBuilderTF2Test.test_invalid_first_stag
[       OK ] ModelBuilderTF2Test.test_invalid_first_stage_nms_iou_threshold
[ RUN      ] ModelBuilderTF2Test.test_invalid_model_config_proto
INFO:tensorflow:time(__main__.ModelBuilderTF2Test.test_invalid_model_config_proto): 0.0s
I0327 19:11:38.079477 140422908086144 test_util.py:2374] time(__main__.ModelBuilderTF2Test.test_invalid_model_conf
[       OK ] ModelBuilderTF2Test.test_invalid_model_config_proto
[ RUN      ] ModelBuilderTF2Test.test_invalid_second_stage_batch_size
INFO:tensorflow:time(__main__.ModelBuilderTF2Test.test_invalid_second_stage_batch_size): 0.0s
I0327 19:11:38.081333 140422908086144 test_util.py:2374] time(__main__.ModelBuilderTF2Test.test_invalid_second_sta
[       OK ] ModelBuilderTF2Test.test_invalid_second_stage_batch_size
[ RUN      ] ModelBuilderTF2Test.test_session
[  SKIPPED ] ModelBuilderTF2Test.test_session
[ RUN      ] ModelBuilderTF2Test.test_unknown_faster_rcnn_feature_extractor
INFO:tensorflow:time(__main__.ModelBuilderTF2Test.test_unknown_faster_rcnn_feature_extractor): 0.0s
I0327 19:11:38.082973 140422908086144 test_util.py:2374] time(__main__.ModelBuilderTF2Test.test_unknown_faster_rcn
[       OK ] ModelBuilderTF2Test.test_unknown_faster_rcnn_feature_extractor
[ RUN      ] ModelBuilderTF2Test.test_unknown_meta_architecture
INFO:tensorflow:time(__main__.ModelBuilderTF2Test.test_unknown_meta_architecture): 0.0s
I0327 19:11:38.083562 140422908086144 test_util.py:2374] time(__main__.ModelBuilderTF2Test.test_unknown_meta_archi
[       OK ] ModelBuilderTF2Test.test_unknown_meta_architecture
[ RUN      ] ModelBuilderTF2Test.test_unknown_ssd_feature_extractor
INFO:tensorflow:time(__main__.ModelBuilderTF2Test.test_unknown_ssd_feature_extractor): 0.0s
I0327 19:11:38.084745 140422908086144 test_util.py:2374] time(__main__.ModelBuilderTF2Test.test_unknown_ssd_featur
[       OK ] ModelBuilderTF2Test.test_unknown_ssd_feature_extractor
----------------------------------------------------------------------
Ran 24 tests in 38.814s

OK (skipped=1)
```

Add data zip

```
from google.colab import drive
drive.mount('/content/gdrive')
```

```
Drive already mounted at /content/gdrive; to attempt to forcibly remount, call drive.mount("/content/gdrive", force_
```

```
!unzip "/content/gdrive/MyDrive/Data/Obj_Det.zip" -d "/content/data/"
```

```
  inflating: /content/data/Obj_Det/test/3DIMG_12OCT2014_0730_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_17MAY2020_2300_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_25OCT2019_1230_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_25OCT2019_2030_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_25OCT2019_2330_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_01DEC2017_0300_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_01DEC2017_1130_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_02DEC2020_0900_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_03JUN2020_0400_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_06NOV2019_0300_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_06NOV2019_0930_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_06NOV2019_2330_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_09DEC2016_1330_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_09DEC2016_2300_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_09OCT2014_0230_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_09OCT2014_0530_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_09OCT2014_1500_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_09OCT2014_1630_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_09OCT2014_2030_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_09OCT2014_2200_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_11JUN2019_0530_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_11JUN2019_2330_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_12NOV2018_0500_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_13NOV2018_1030_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_15MAY2021_0600_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_15MAY2021_0929_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_15MAY2021_1159_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_16DEC2018_0300_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_16DEC2018_1830_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_16DEC2018_2330_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_29MAY2017_1500_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_29MAY2017_1800_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_29MAY2017_2330_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_01MAY2019_1700_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_02MAY2019_0500_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_02MAY2019_1630_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_02MAY2019_1700_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_18MAY2020_0900_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_18MAY2020_1300_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_27OCT2019_0130_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_27OCT2019_0400_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_02DEC2017_0000_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_02DEC2017_0100_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_02DEC2017_0130_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_02DEC2017_0300_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_02DEC2017_1600_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_08NOV2019_0130_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_08NOV2019_2100_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_09OCT2018_1100_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_10OCT2018_1100_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_10OCT2018_2200_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_11DEC2016_1030_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_12JUN2019_0700_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_14NOV2018_0800_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_14NOV2018_1000_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_14NOV2018_2130_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_15NOV2018_0700_L1B_STD_IR2.jpg
  inflating: /content/data/Obj_Det/test/3DIMG_25NOV2020_0700_L1B_STD_IR2.jpg
```

Converting XML to CSV

```
import os
import glob
import pandas as pd
import xml.etree.ElementTree as ET
def xml_to_csv(path):
    xml_list = []
    for xml_file in glob.glob(path + '/*.xml'):
        tree = ET.parse(xml_file)
        root = tree.getroot()
        for member in root.findall('object'):
            value = (root.find('filename').text,
                     int(root.find('size')[0].text),
                     int(root.find('size')[1].text),
                     member[0].text,
                     int(member[4][0].text),
                     int(member[4][1].text),
                     int(member[4][2].text),
                     int(member[4][3].text)
                     )
```

```
            xml_list.append(value)
    column_name = ['filename', 'width', 'height', 'class', 'xmin', 'ymin', 'xmax', 'ymax']
    xml_df = pd.DataFrame(xml_list, columns=column_name)
    return xml_df


def main():
  for i in ['train','test']:

    image_path = os.path.join(os.getcwd(), '/content/data/Obj_Det/{}'.format(i))
    xml_df = xml_to_csv(image_path)
    xml_df.to_csv('/content/data/Obj_Det/{}_labels.csv'.format(i), index=None)
    print('Successfully converted xml to csv.')


main()
```

```
Successfully converted xml to csv.
Successfully converted xml to csv.
```

```
%cd /content
!python generate_tfrecord.py --csv_input=/content/data/Obj_Det/train_labels.csv --output_path=data/train.record --image_
!python generate_tfrecord.py --csv_input=/content/data/Obj_Det/test_labels.csv --output_path=data/test.record --image_di
```

```
/content
Successfully created the TFRecords: /content/data/train.record
Successfully created the TFRecords: /content/data/test.record
```

Choosing the model

Model: SSD MobileNet v2 320x320

```
%cd /content
!wget http://download.tensorflow.org/models/object_detection/classification/tf2/20200710/mobilenet_v2.tar.gz
!tar -xvf mobilenet_v2.tar.gz
!rm mobilenet_v2.tar.gz
```

```
/content
--2022-03-27 20:24:29--  http://download.tensorflow.org/models/object_detection/classification/tf2/20200710/mobilene
Resolving download.tensorflow.org (download.tensorflow.org)... 74.125.133.128, 2a00:1450:400c:c07::80
Connecting to download.tensorflow.org (download.tensorflow.org)|74.125.133.128|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 8404070 (8.0M) [application/x-tar]
Saving to: ‘mobilenet_v2.tar.gz’

mobilenet_v2.tar.gz 100%[===================>]   8.01M  29.6MB/s    in 0.3s

2022-03-27 20:24:30 (29.6 MB/s) - ‘mobilenet_v2.tar.gz’ saved [8404070/8404070]

mobilenet_v2/
mobilenet_v2/mobilenet_v2.ckpt-1.index
mobilenet_v2/checkpoint
mobilenet_v2/mobilenet_v2.ckpt-1.data-00001-of-00002
mobilenet_v2/mobilenet_v2.ckpt-1.data-00000-of-00002
```

```
!wget https://raw.githubusercontent.com/tensorflow/models/master/research/object_detection/configs/tf2/ssd_mobilenet_v2_
!mv ssd_mobilenet_v2_320x320_coco17_tpu-8.config mobilenet_v2.config
```

```
--2022-03-27 20:24:46--  https://raw.githubusercontent.com/tensorflow/models/master/research/object_detection/config
Resolving raw.githubusercontent.com (raw.githubusercontent.com)... 185.199.108.133, 185.199.109.133, 185.199.110.133
Connecting to raw.githubusercontent.com (raw.githubusercontent.com)|185.199.108.133|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 4484 (4.4K) [text/plain]
Saving to: ‘ssd_mobilenet_v2_320x320_coco17_tpu-8.config’

ssd_mobilenet_v2_32 100%[===================>]   4.38K  --.-KB/s    in 0s

2022-03-27 20:24:46 (49.1 MB/s) - ‘ssd_mobilenet_v2_320x320_coco17_tpu-8.config’ saved [4484/4484]
```

Configure Training

```
num_classes = 1
batch_size = 10
num_steps = 100
```

```
num_eval_steps = 50

train_record_path = '/content/data/train.record'
test_record_path = '/content/data/test.record'
model_dir = '/content/training/'
labelmap_path = '/content/labelmap.pbtxt'

pipeline_config_path = '/content/mobilenet_v2.config'
fine_tune_checkpoint = '/content/mobilenet_v2/mobilenet_v2.ckpt-1'
```

```
import re

with open(pipeline_config_path) as f:
    config = f.read()

with open(pipeline_config_path, 'w') as f:

  # Set labelmap path
  config = re.sub('label_map_path: ".*?"',
             'label_map_path: "{}"'.format(labelmap_path), config)

  # Set fine_tune_checkpoint path
  config = re.sub('fine_tune_checkpoint: ".*?"',
                  'fine_tune_checkpoint: "{}"'.format(fine_tune_checkpoint), config)

  # Set train tf-record file path
  config = re.sub('(input_path: ".*?)(PATH_TO_BE_CONFIGURED/train)(.*?")',
                  'input_path: "{}"'.format(train_record_path), config)

  # Set test tf-record file path
  config = re.sub('(input_path: ".*?)(PATH_TO_BE_CONFIGURED/val)(.*?")',
                  'input_path: "{}"'.format(test_record_path), config)

  # Set number of classes.
  config = re.sub('num_classes: [0-9]+',
                  'num_classes: {}'.format(num_classes), config)

  # Set batch size
  config = re.sub('batch_size: [0-9]+',
                  'batch_size: {}'.format(batch_size), config)

  # Set training steps
  config = re.sub('num_steps: [0-9]+',
                  'num_steps: {}'.format(num_steps), config)

  f.write(config)
```

```
!pip install opencv-python-headless==4.1.2.30
```

```
    Requirement already satisfied: opencv-python-headless==4.1.2.30 in /usr/local/lib/python3.7/dist-packages (4.1.2.30)
    Requirement already satisfied: numpy>=1.14.5 in /usr/local/lib/python3.7/dist-packages (from opencv-python-headless=
```

```
!python /content/TensorFlow/models/research/object_detection/model_main_tf2.py \
    --pipeline_config_path={pipeline_config_path} \
    --model_dir={model_dir} \
    --alsologtostderr \
    --num_train_steps={num_steps} \
    --sample_1_of_n_eval_examples=1 \
    --num_eval_steps={num_eval_steps}
```

```
    WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/tensorflow/python/util/dispatch.py:1082: to_float (f
    Instructions for updating:
    Use `tf.cast` instead.
    W0327 20:37:29.673106 140500707542912 deprecation.py:343] From /usr/local/lib/python3.7/dist-packages/tensorflow/py
    Instructions for updating:
    Use `tf.cast` instead.
    /usr/local/lib/python3.7/dist-packages/keras/backend.py:450: UserWarning: `tf.keras.backend.set_learning_phase` is
      warnings.warn('``tf.keras.backend.set_learning_phase` is deprecated and '
    INFO:tensorflow:depth of additional conv before box predictor: 0
    I0327 20:37:41.574888 140495938365184 convolutional_keras_box_predictor.py:154] depth of additional conv before bo
    INFO:tensorflow:depth of additional conv before box predictor: 0
    I0327 20:37:41.575284 140495938365184 convolutional_keras_box_predictor.py:154] depth of additional conv before bo
    INFO:tensorflow:depth of additional conv before box predictor: 0
    I0327 20:37:41.575537 140495938365184 convolutional_keras_box_predictor.py:154] depth of additional conv before bo
    INFO:tensorflow:depth of additional conv before box predictor: 0
    I0327 20:37:41.575808 140495938365184 convolutional_keras_box_predictor.py:154] depth of additional conv before bo
    INFO:tensorflow:depth of additional conv before box predictor: 0
    I0327 20:37:41.576092 140495938365184 convolutional_keras_box_predictor.py:154] depth of additional conv before bo
    INFO:tensorflow:depth of additional conv before box predictor: 0
    I0327 20:37:41.576311 140495938365184 convolutional_keras_box_predictor.py:154] depth of additional conv before bo
```

```
INFO:tensorflow:Reduce to /job:localhost/replica:0/task:0/device:CPU:0 then broadcast to ('/job:localhost/replica:
I0327 20:38:02.001319 140500707542912 cross_device_ops.py:618] Reduce to /job:localhost/replica:0/task:0/device:CP
INFO:tensorflow:Reduce to /job:localhost/replica:0/task:0/device:CPU:0 then broadcast to ('/job:localhost/replica:
I0327 20:38:02.002920 140500707542912 cross_device_ops.py:618] Reduce to /job:localhost/replica:0/task:0/device:CP
INFO:tensorflow:Reduce to /job:localhost/replica:0/task:0/device:CPU:0 then broadcast to ('/job:localhost/replica:
I0327 20:38:02.005774 140500707542912 cross_device_ops.py:618] Reduce to /job:localhost/replica:0/task:0/device:CP
INFO:tensorflow:Reduce to /job:localhost/replica:0/task:0/device:CPU:0 then broadcast to ('/job:localhost/replica:
I0327 20:38:02.006946 140500707542912 cross_device_ops.py:618] Reduce to /job:localhost/replica:0/task:0/device:CP
INFO:tensorflow:Reduce to /job:localhost/replica:0/task:0/device:CPU:0 then broadcast to ('/job:localhost/replica:
I0327 20:38:02.009833 140500707542912 cross_device_ops.py:618] Reduce to /job:localhost/replica:0/task:0/device:CP
INFO:tensorflow:Reduce to /job:localhost/replica:0/task:0/device:CPU:0 then broadcast to ('/job:localhost/replica:
I0327 20:38:02.011017 140500707542912 cross_device_ops.py:618] Reduce to /job:localhost/replica:0/task:0/device:CP
INFO:tensorflow:Reduce to /job:localhost/replica:0/task:0/device:CPU:0 then broadcast to ('/job:localhost/replica:
I0327 20:38:02.013794 140500707542912 cross_device_ops.py:618] Reduce to /job:localhost/replica:0/task:0/device:CP
INFO:tensorflow:Reduce to /job:localhost/replica:0/task:0/device:CPU:0 then broadcast to ('/job:localhost/replica:
I0327 20:38:02.014950 140500707542912 cross_device_ops.py:618] Reduce to /job:localhost/replica:0/task:0/device:CP
INFO:tensorflow:Reduce to /job:localhost/replica:0/task:0/device:CPU:0 then broadcast to ('/job:localhost/replica:
I0327 20:38:02.017668 140500707542912 cross_device_ops.py:618] Reduce to /job:localhost/replica:0/task:0/device:CP
INFO:tensorflow:Reduce to /job:localhost/replica:0/task:0/device:CPU:0 then broadcast to ('/job:localhost/replica:
I0327 20:38:02.019003 140500707542912 cross_device_ops.py:618] Reduce to /job:localhost/replica:0/task:0/device:CP
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/tensorflow/python/util/deprecation.py:616: calling
Instructions for updating:
Use fn_output_signature instead
W0327 20:38:02.767456 140495955150592 deprecation.py:547] From /usr/local/lib/python3.7/dist-packages/tensorflow/p
Instructions for updating:
Use fn_output_signature instead
INFO:tensorflow:Step 100 per-step time 0.690s
I0327 20:39:11.512683 140500707542912 model_lib_v2.py:707] Step 100 per-step time 0.690s
INFO:tensorflow:{'Loss/classification_loss': 0.760719,
 'Loss/localization_loss': 0.5578395,
 'Loss/regularization_loss': 1.9322553,
 'Loss/total_loss': 3.2508137,
 'learning_rate': 0.1666635}
I0327 20:39:11.513133 140500707542912 model_lib_v2.py:708] {'Loss/classification_loss': 0.760719,
 'Loss/localization_loss': 0.5578395,
 'Loss/regularization_loss': 1.9322553,
 'Loss/total_loss': 3.2508137,
 'learning_rate': 0.1666635}
```

```
!python /content/TensorFlow/models/research/object_detection/model_main_tf2.py \
    --pipeline_config_path={pipeline_config_path} \
    --model_dir={model_dir} \
    --checkpoint_dir={model_dir}
```

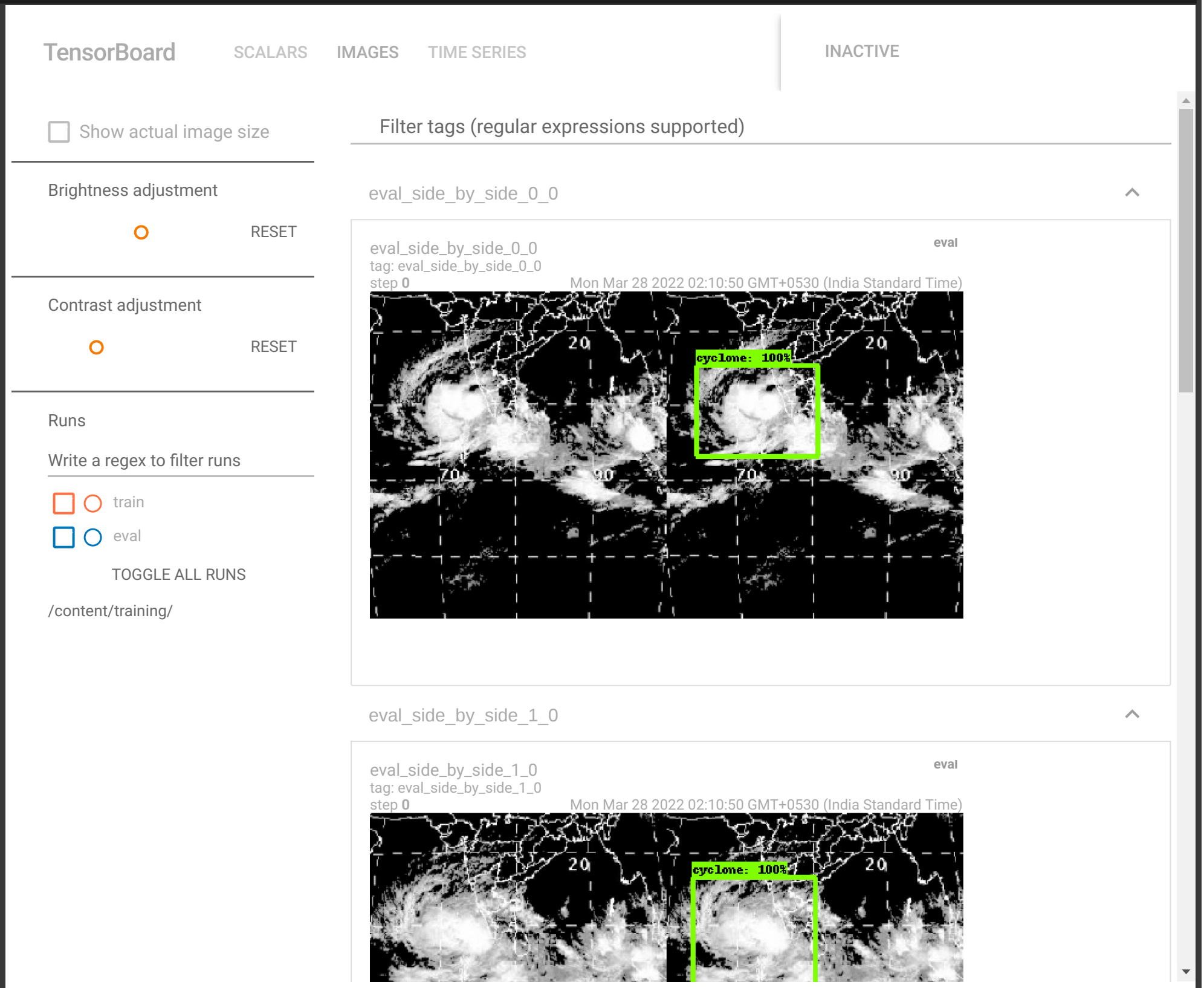
```
I0327 20:41:05.568551 140045593294720 model_lib_v2.py:1018]     + DetectionBoxes_Precision/mAP: 0.002959
INFO:tensorflow:        + DetectionBoxes_Precision/mAP@.50IOU: 0.020460
I0327 20:41:05.570450 140045593294720 model_lib_v2.py:1018]     + DetectionBoxes_Precision/mAP@.50IOU: 0.020460
INFO:tensorflow:        + DetectionBoxes_Precision/mAP@.75IOU: 0.000011
I0327 20:41:05.572565 140045593294720 model_lib_v2.py:1018]     + DetectionBoxes_Precision/mAP@.75IOU: 0.000011
INFO:tensorflow:        + DetectionBoxes_Precision/mAP (small): 0.000398
I0327 20:41:05.574148 140045593294720 model_lib_v2.py:1018]     + DetectionBoxes_Precision/mAP (small): 0.000398
INFO:tensorflow:        + DetectionBoxes_Precision/mAP (medium): 0.003467
I0327 20:41:05.575789 140045593294720 model_lib_v2.py:1018]     + DetectionBoxes_Precision/mAP (medium): 0.003467
INFO:tensorflow:        + DetectionBoxes_Precision/mAP (large): 0.000338
I0327 20:41:05.577712 140045593294720 model_lib_v2.py:1018]     + DetectionBoxes_Precision/mAP (large): 0.000338
INFO:tensorflow:        + DetectionBoxes_Recall/AR@1: 0.010714
I0327 20:41:05.579202 140045593294720 model_lib_v2.py:1018]     + DetectionBoxes_Recall/AR@1: 0.010714
INFO:tensorflow:        + DetectionBoxes_Recall/AR@10: 0.041667
I0327 20:41:05.581034 140045593294720 model_lib_v2.py:1018]     + DetectionBoxes_Recall/AR@10: 0.041667
INFO:tensorflow:        + DetectionBoxes_Recall/AR@100: 0.157143
I0327 20:41:05.582678 140045593294720 model_lib_v2.py:1018]     + DetectionBoxes_Recall/AR@100: 0.157143
INFO:tensorflow:        + DetectionBoxes_Recall/AR@100 (small): 0.100000
I0327 20:41:05.584300 140045593294720 model_lib_v2.py:1018]     + DetectionBoxes_Recall/AR@100 (small): 0.100000
INFO:tensorflow:        + DetectionBoxes_Recall/AR@100 (medium): 0.161842
I0327 20:41:05.585823 140045593294720 model_lib_v2.py:1018]     + DetectionBoxes_Recall/AR@100 (medium): 0.161842
INFO:tensorflow:        + DetectionBoxes_Recall/AR@100 (large): 0.120000
I0327 20:41:05.587559 140045593294720 model_lib_v2.py:1018]     + DetectionBoxes_Recall/AR@100 (large): 0.120000
INFO:tensorflow:        + Loss/localization_loss: 0.759945
I0327 20:41:05.588862 140045593294720 model_lib_v2.py:1018]     + Loss/localization_loss: 0.759945
INFO:tensorflow:        + Loss/classification_loss: 3.471977
I0327 20:41:05.590113 140045593294720 model_lib_v2.py:1018]     + Loss/classification_loss: 3.471977
INFO:tensorflow:        + Loss/regularization_loss: 0.609053
I0327 20:41:05.591351 140045593294720 model_lib_v2.py:1018]     + Loss/regularization_loss: 0.609053
INFO:tensorflow:        + Loss/total_loss: 4.840975
I0327 20:41:05.592602 140045593294720 model_lib_v2.py:1018]     + Loss/total_loss: 4.840975
INFO:tensorflow:Waiting for new checkpoint at /content/training/
I0327 20:45:23.760091 140045593294720 checkpoint_utils.py:136] Waiting for new checkpoint at /content/training/
Traceback (most recent call last):
  File "/usr/local/lib/python3.7/dist-packages/absl/app.py", line 312, in run
    _run_main(main, args)
  File "/usr/local/lib/python3.7/dist-packages/absl/app.py", line 258, in _run_main
    sys.exit(main(argv))
  File "/content/TensorFlow/models/research/object_detection/model_main_tf2.py", line 90, in main
    wait_interval=300, timeout=FLAGS.eval_timeout)
  File "/usr/local/lib/python3.7/dist-packages/object_detection/model_lib_v2.py", line 1137, in eval_continuously
    checkpoint_dir, timeout=timeout, min_interval_secs=wait_interval):
```

```
  File "/usr/local/lib/python3.7/dist-packages/tensorflow/python/training/checkpoint_utils.py", line 195, in check
    checkpoint_dir, checkpoint_path, timeout=timeout)
  File "/usr/local/lib/python3.7/dist-packages/tensorflow/python/training/checkpoint_utils.py", line 143, in wait_
    time.sleep(seconds_to_sleep)
KeyboardInterrupt

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "/content/TensorFlow/models/research/object_detection/model_main_tf2.py", line 115, in <module>
    tf.compat.v1.app.run()
  File "/usr/local/lib/python3.7/dist-packages/tensorflow/python/platform/app.py", line 36, in run
    _run(main=main, argv=argv, flags_parser=_parse_flags_tolerate_undef)
  File "/usr/local/lib/python3.7/dist-packages/absl/app.py", line 312, in run
    _run_main(main, args)
KeyboardInterrupt
```

```
%load_ext tensorboard
%tensorboard --logdir '/content/training/'
```



Exporting the model

We're going to convert the training checkpoints to a `protobuf (pb)` file.

```
%cd ~
%cd ../usr/local/lib/python3.6/dist-packages/
%ls
```

```
/root
/usr/local/lib/python3.6/dist-packages
```

```
output_directory = '/content/inference_graph'
```

```
!python /content/TensorFlow/models/research/object_detection/exporter_main_v2.py \
    --trained_checkpoint_dir {model_dir} \
    --output_directory {output_directory} \
    --pipeline_config_path {pipeline_config_path}
```

```
2022-03-27 21:09:01.384013: W tensorflow/core/common_runtime/gpu/gpu_bfc_allocator.cc:39] Overriding allow_growth se
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/tensorflow/python/autograph/impl/api.py:458: calling
Instructions for updating:
back_prop=False is deprecated. Consider using tf.stop_gradient instead.
Instead of:
results = tf.map_fn(fn, elems, back_prop=False)
Use:
results = tf.nest.map_structure(tf.stop_gradient, tf.map_fn(fn, elems))
W0327 21:09:01.570372 139642281445248 deprecation.py:615] From /usr/local/lib/python3.7/dist-packages/tensorflow/pyt
Instructions for updating:
back_prop=False is deprecated. Consider using tf.stop_gradient instead.
Instead of:
results = tf.map_fn(fn, elems, back_prop=False)
Use:
results = tf.nest.map_structure(tf.stop_gradient, tf.map_fn(fn, elems))
INFO:tensorflow:depth of additional conv before box predictor: 0
I0327 21:09:08.559246 139642281445248 convolutional_keras_box_predictor.py:154] depth of additional conv before box
INFO:tensorflow:depth of additional conv before box predictor: 0
I0327 21:09:08.559678 139642281445248 convolutional_keras_box_predictor.py:154] depth of additional conv before box
INFO:tensorflow:depth of additional conv before box predictor: 0
I0327 21:09:08.559911 139642281445248 convolutional_keras_box_predictor.py:154] depth of additional conv before box
INFO:tensorflow:depth of additional conv before box predictor: 0
I0327 21:09:08.560140 139642281445248 convolutional_keras_box_predictor.py:154] depth of additional conv before box
INFO:tensorflow:depth of additional conv before box predictor: 0
I0327 21:09:08.560373 139642281445248 convolutional_keras_box_predictor.py:154] depth of additional conv before box
INFO:tensorflow:depth of additional conv before box predictor: 0
I0327 21:09:08.560613 139642281445248 convolutional_keras_box_predictor.py:154] depth of additional conv before box
2022-03-27 21:09:19.517758: W tensorflow/python/util/util.cc:368] Sets are not currently considered sequences, but t
WARNING:tensorflow:Skipping full serialization of Keras layer <object_detection.meta_architectures.ssd_meta_arch.SSD
W0327 21:09:22.438024 139642281445248 save_impl.py:72] Skipping full serialization of Keras layer <object_detection.
W0327 21:09:45.594650 139642281445248 save.py:265] Found untraced functions such as BoxPredictor_layer_call_fn, BoxP
INFO:tensorflow:Assets written to: /content/inference_graph/saved_model/assets
I0327 21:09:52.560478 139642281445248 builder_impl.py:780] Assets written to: /content/inference_graph/saved_model/a
INFO:tensorflow:Writing pipeline config file to /content/inference_graph/pipeline.config
I0327 21:09:53.226432 139642281445248 config_util.py:254] Writing pipeline config file to /content/inference_graph/p
```

```
!zip -r /content/saved_model.zip /content/inference_graph/saved_model/
```

```
  adding: content/inference_graph/saved_model/ (stored 0%)
  adding: content/inference_graph/saved_model/assets/ (stored 0%)
  adding: content/inference_graph/saved_model/saved_model.pb (deflated 92%)
  adding: content/inference_graph/saved_model/variables/ (stored 0%)
  adding: content/inference_graph/saved_model/variables/variables.index (deflated 77%)
  adding: content/inference_graph/saved_model/variables/variables.data-00000-of-00001 (deflated 8%)
```

```
from google.colab import files
files.download("/content/saved_model.zip")
```

Testing the trained model

```
!wget https://raw.githubusercontent.com/hugozanini/object-detection/master/inferenceutils.py
from inferenceutils import *
```

```
--2022-03-27 21:29:18--  https://raw.githubusercontent.com/hugozanini/object-detection/master/inferenceutils.py
Resolving raw.githubusercontent.com (raw.githubusercontent.com)... 185.199.108.133, 185.199.109.133, 185.199.110.133
Connecting to raw.githubusercontent.com (raw.githubusercontent.com)|185.199.108.133|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 2219 (2.2K) [text/plain]
Saving to: ‘inferenceutils.py.1’

inferenceutils.py.1 100%[===================>]   2.17K  --.-KB/s    in 0s

2022-03-27 21:29:19 (31.1 MB/s) - ‘inferenceutils.py.1’ saved [2219/2219]
```

✓ 0s completed at 2:59 AM