Some preprocessing stuff

```
#Imports the print function from newer versions of python
from __future__ import print_function

%tensorflow_version 1.x
%matplotlib inline
```

```
TensorFlow 1.x selected.
```

```
import numpy as np
```

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

```
Go to this URL in a browser: https://accounts.google.com/o/oauth2/auth?client_id=947318989803-6bn6qk8qdgf4n4g3pfee6491hc0brc4i.a

Enter your authorization code:
··········
Mounted at /content/drive
```

```
zip_path = "/content/drive/My Drive/Object_Detection_from_Satellite_Imagery_Data/SIMD.zip"
!unzip '$zip_path' -d ./data/
!unzip -q 'data/SIMS dataset/images.zip' -d data/
!unzip -q 'data/SIMS dataset/Annotations_in_3_formats.zip' -d data
```

```
Archive:  /content/drive/My Drive/Object_Detection_from_Satellite_Imagery_Data/SIMD.zip
  inflating: ./data/SIMS dataset/test.txt
  inflating: ./data/SIMS dataset/training.txt
  inflating: ./data/SIMS dataset/validation.txt
  inflating: ./data/SIMS dataset/Assignment-2_modified scope.pdf
  inflating: ./data/SIMS dataset/Annotations_in_3_formats.zip
  inflating: ./data/SIMS dataset/images.zip
```

```
import os, csv, PIL

def create_csv(txt_path, output_path, class_mapping):
  """
  Creates a csv file that can be used with keras-retinanet csv generator
  (Dependencies: [os, csv, PIL])
  """
  # A subfunction to read annotations file
  def read_ann(ann_path):
    with open(ann_path, 'r') as f:
      lines = f.readlines()
    return lines

  # A subfunction to convert percentage centre
  # co-ordinates to x1, y1, x2, y2 absolute co-ordinates
  def get_abs_coord(coords, im_w, im_h):
    n_coords = coords.copy()
    n_coords[0] = (coords[0] - (coords[2]/2)) * im_w
    n_coords[2] = n_coords[0] + (coords[2] * im_w)
    n_coords[1] = (coords[1] - (coords[3]/2)) * im_h
    n_coords[3] = n_coords[1] + (coords[3] * im_h)

    return list(map(int, n_coords))

  # Class ID to name mapping
  id_to_name = class_mapping

  # create_csv continues.
  # A bit of mangling with the path
  root = txt_path.split('/')[0]
  # CSV list to keep track of the lines needed to be written to the csv
  csv_list = []
  with open(txt_path, 'r') as f:
    line = f.readline()
    while line:
      # Get images path
      im_path = line.strip()
```

```
        abs_im_path = root + '/' + '/'.join(line.strip().split('/')[1:])
        # Get path of annotations for the image
        im_txt_path = os.path.splitext(abs_im_path)[0] + '.txt'
        # Get the annotations
        anns = read_ann(im_txt_path)
        for ann in anns:
          items = ann.strip().split(' ')
          c_id, bb = int(items[0]), list(map(float, items[1:]))
          # Get the size of the image
          w, h = PIL.Image.open(abs_im_path).size
          # Get absolute co-ordinates
          bb = get_abs_coord(bb, w, h)
          # Row for csv file, converting x,y,w,h to x,y,x1, y1
          csv_list.append([im_path, *bb, id_to_name[c_id]])
        # Read next line
        line = f.readline()

    with open(output_path, 'w', newline="") as f:
      writer = csv.writer(f)
      writer.writerows(csv_list)

```

```
class_mapping = ['Car', 'Truck', 'Van', 'LongVehicle', 'Bus',
                 'Airliner', 'Propeller Aircraft', 'Trainer Aircraft', 'Chartered Aircraft',
                 'Fighter Aircraft', 'Others', 'Stair Truck', 'Pushback Truck',
                 'Helicopter', 'Boat']
class_mapping = dict(enumerate(class_mapping))

create_csv('data/SIMS dataset/training.txt', 'data/training.csv', class_mapping)
create_csv('data/SIMS dataset/test.txt', 'data/test.csv', class_mapping)
create_csv('data/SIMS dataset/validation.txt', 'data/validation.csv', class_mapping)

class_csv = list(map(lambda x: (x[1], x[0]), class_mapping.items()))

with open('data/classes.csv', 'w', newline="") as f:
  writer = csv.writer(f)
  writer.writerows(class_csv)
```

```
!git clone https://github.com/fizyr/keras-retinanet
!pip install ./keras-retinanet/
!mv keras-retinanet/* .
!rm -r keras-retinanet
!python setup.py build_ext --inplace
```

```
Cloning into 'keras-retinanet'...
remote: Enumerating objects: 6, done.
remote: Counting objects: 100% (6/6), done.
remote: Compressing objects: 100% (6/6), done.
remote: Total 5711 (delta 0), reused 1 (delta 0), pack-reused 5705
Receiving objects: 100% (5711/5711), 13.37 MiB | 14.15 MiB/s, done.
Resolving deltas: 100% (3831/3831), done.
Processing ./keras-retinanet
Requirement already satisfied: keras in /usr/local/lib/python3.6/dist-packages (from keras-retinanet==0.5.1) (2.3.1)
Collecting keras-resnet==0.1.0
  Downloading https://files.pythonhosted.org/packages/05/46/ad0b2d1a05d9497bd80c98a2c3f4d8be38a4601ace69af72814f5fafd851/keras-r
Requirement already satisfied: six in /usr/local/lib/python3.6/dist-packages (from keras-retinanet==0.5.1) (1.12.0)
Requirement already satisfied: scipy in /usr/local/lib/python3.6/dist-packages (from keras-retinanet==0.5.1) (1.4.1)
Requirement already satisfied: cython in /usr/local/lib/python3.6/dist-packages (from keras-retinanet==0.5.1) (0.29.17)
Requirement already satisfied: Pillow in /usr/local/lib/python3.6/dist-packages (from keras-retinanet==0.5.1) (7.0.0)
Requirement already satisfied: opencv-python in /usr/local/lib/python3.6/dist-packages (from keras-retinanet==0.5.1) (4.1.2.30)
Requirement already satisfied: progressbar2 in /usr/local/lib/python3.6/dist-packages (from keras-retinanet==0.5.1) (3.38.0)
Requirement already satisfied: h5py in /usr/local/lib/python3.6/dist-packages (from keras->keras-retinanet==0.5.1) (2.10.0)
Requirement already satisfied: keras-preprocessing>=1.0.5 in /usr/local/lib/python3.6/dist-packages (from keras->keras-retinanet
Requirement already satisfied: numpy>=1.9.1 in /usr/local/lib/python3.6/dist-packages (from keras->keras-retinanet==0.5.1) (1.18
Requirement already satisfied: pyyaml in /usr/local/lib/python3.6/dist-packages (from keras->keras-retinanet==0.5.1) (3.13)
Requirement already satisfied: keras-applications>=1.0.6 in /usr/local/lib/python3.6/dist-packages (from keras->keras-retinanet=
Requirement already satisfied: python-utils>=2.3.0 in /usr/local/lib/python3.6/dist-packages (from progressbar2->keras-retinanet
Building wheels for collected packages: keras-retinanet, keras-resnet
  Building wheel for keras-retinanet (setup.py) ... done
```

```
from keras_retinanet import models
import keras

model = models.backbone('resnet50').retinanet(num_classes=15)
```

```
Using TensorFlow backend.
WARNING:tensorflow:From /tensorflow-1.15.2/python3.6/tensorflow_core/python/ops/resource_variable_ops.py:1630: calling BaseResou
Instructions for updating:
If using Keras pass *_constraint arguments to layers.
WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/keras/backend/tensorflow_backend.py:4070: The name tf.nn.max_pool
```

```
import keras_retinanet
model.compile(
```

```
    loss={
        'regression'    : keras_retinanet.losses.smooth_l1(),
        'classification': keras_retinanet.losses.focal()
    },
    optimizer=keras.optimizers.adam(lr=1e-5, clipnorm=0.001)
)
```

```
WARNING:tensorflow:From /content/keras_retinanet/backend/tensorflow_backend.py:104: where (from tensorflow.python.ops.array_ops)
Instructions for updating:
Use tf.where in 2.0, which has the same broadcast rule as np.where
```

```
model.summary()
```

```
Model: "retinanet"
```

Layer (type)	Output Shape	Param #	Connected to
input_1 (InputLayer)	(None, None, None, 3	0	
padding_conv1 (ZeroPadding2D)	(None, None, None, 3	0	input_1[0][0]
conv1 (Conv2D)	(None, None, None, 6	9408	padding_conv1[0][0]
bn_conv1 (BatchNormalization)	(None, None, None, 6	256	conv1[0][0]
conv1_relu (Activation)	(None, None, None, 6	0	bn_conv1[0][0]
pool1 (MaxPooling2D)	(None, None, None, 6	0	conv1_relu[0][0]
res2a_branch2a (Conv2D)	(None, None, None, 6	4096	pool1[0][0]
bn2a_branch2a (BatchNormalizati	(None, None, None, 6	256	res2a_branch2a[0][0]
res2a_branch2a_relu (Activation	(None, None, None, 6	0	bn2a_branch2a[0][0]
padding2a_branch2b (ZeroPadding	(None, None, None, 6	0	res2a_branch2a_relu[0][0]
res2a_branch2b (Conv2D)	(None, None, None, 6	36864	padding2a_branch2b[0][0]
bn2a_branch2b (BatchNormalizati	(None, None, None, 6	256	res2a_branch2b[0][0]
res2a_branch2b_relu (Activation	(None, None, None, 6	0	bn2a_branch2b[0][0]
res2a_branch2c (Conv2D)	(None, None, None, 2	16384	res2a_branch2b_relu[0][0]
res2a_branch1 (Conv2D)	(None, None, None, 2	16384	pool1[0][0]
bn2a_branch2c (BatchNormalizati	(None, None, None, 2	1024	res2a_branch2c[0][0]
bn2a_branch1 (BatchNormalizatio	(None, None, None, 2	1024	res2a_branch1[0][0]
res2a (Add)	(None, None, None, 2	0	bn2a_branch2c[0][0] bn2a_branch1[0][0]
res2a_relu (Activation)	(None, None, None, 2	0	res2a[0][0]

res2b_branch2a (Conv2D)	(None, None, None, 6	16384	res2a_relu[0][0]
bn2b_branch2a (BatchNormalizati	(None, None, None, 6	256	res2b_branch2a[0][0]
res2b_branch2a_relu (Activation	(None, None, None, 6	0	bn2b_branch2a[0][0]
padding2b_branch2b (ZeroPadding	(None, None, None, 6	0	res2b_branch2a_relu[0][0]
res2b_branch2b (Conv2D)	(None, None, None, 6	36864	padding2b_branch2b[0][0]
bn2b_branch2b (BatchNormalizati	(None, None, None, 6	256	res2b_branch2b[0][0]
res2b_branch2b_relu (Activation	(None, None, None, 6	0	bn2b_branch2b[0][0]
res2b_branch2c (Conv2D)	(None, None, None, 2	16384	res2b_branch2b_relu[0][0]
bn2b_branch2c (BatchNormalizati	(None, None, None, 2	1024	res2b_branch2c[0][0]
res2b (Add)	(None, None, None, 2	0	bn2b_branch2c[0][0] res2a_relu[0][0]
res2b_relu (Activation)	(None, None, None, 2	0	res2b[0][0]
res2c_branch2a (Conv2D)	(None, None, None, 6	16384	res2b_relu[0][0]
bn2c_branch2a (BatchNormalizati	(None, None, None, 6	256	res2c_branch2a[0][0]
res2c_branch2a_relu (Activation	(None, None, None, 6	0	bn2c_branch2a[0][0]
padding2c_branch2b (ZeroPadding	(None, None, None, 6	0	res2c_branch2a_relu[0][0]
res2c_branch2b (Conv2D)	(None, None, None, 6	36864	padding2c_branch2b[0][0]
bn2c_branch2b (BatchNormalizati	(None, None, None, 6	256	res2c_branch2b[0][0]
res2c_branch2b_relu (Activation	(None, None, None, 6	0	bn2c_branch2b[0][0]
res2c_branch2c (Conv2D)	(None, None, None, 2	16384	res2c_branch2b_relu[0][0]
bn2c_branch2c (BatchNormalizati	(None, None, None, 2	1024	res2c_branch2c[0][0]

res2c (Add)	(None, None, None, 2	0	bn2c_branch2c[0][0] res2b_relu[0][0]
res2c_relu (Activation)	(None, None, None, 2	0	res2c[0][0]
res3a_branch2a (Conv2D)	(None, None, None, 1	32768	res2c_relu[0][0]
bn3a_branch2a (BatchNormalizati	(None, None, None, 1	512	res3a_branch2a[0][0]
res3a_branch2a_relu (Activation	(None, None, None, 1	0	bn3a_branch2a[0][0]
padding3a_branch2b (ZeroPadding	(None, None, None, 1	0	res3a_branch2a_relu[0][0]
res3a_branch2b (Conv2D)	(None, None, None, 1	147456	padding3a_branch2b[0][0]
bn3a_branch2b (BatchNormalizati	(None, None, None, 1	512	res3a_branch2b[0][0]
res3a_branch2b_relu (Activation	(None, None, None, 1	0	bn3a_branch2b[0][0]
res3a_branch2c (Conv2D)	(None, None, None, 5	65536	res3a_branch2b_relu[0][0]
res3a_branch1 (Conv2D)	(None, None, None, 5	131072	res2c_relu[0][0]
bn3a_branch2c (BatchNormalizati	(None, None, None, 5	2048	res3a_branch2c[0][0]
bn3a_branch1 (BatchNormalizatio	(None, None, None, 5	2048	res3a_branch1[0][0]
res3a (Add)	(None, None, None, 5	0	bn3a_branch2c[0][0] bn3a_branch1[0][0]
res3a_relu (Activation)	(None, None, None, 5	0	res3a[0][0]
res3b_branch2a (Conv2D)	(None, None, None, 1	65536	res3a_relu[0][0]
bn3b_branch2a (BatchNormalizati	(None, None, None, 1	512	res3b_branch2a[0][0]
res3b_branch2a_relu (Activation	(None, None, None, 1	0	bn3b_branch2a[0][0]
padding3b_branch2b (ZeroPadding	(None, None, None, 1	0	res3b_branch2a_relu[0][0]
res3b_branch2b (Conv2D)	(None, None, None, 1	147456	padding3b_branch2b[0][0]

bn3b_branch2b (BatchNormalizati	(None, None, None, 1	512	res3b_branch2b[0][0]
res3b_branch2b_relu (Activation	(None, None, None, 1	0	bn3b_branch2b[0][0]
res3b_branch2c (Conv2D)	(None, None, None, 5	65536	res3b_branch2b_relu[0][0]
bn3b_branch2c (BatchNormalizati	(None, None, None, 5	2048	res3b_branch2c[0][0]
res3b (Add)	(None, None, None, 5	0	bn3b_branch2c[0][0] res3a_relu[0][0]
res3b_relu (Activation)	(None, None, None, 5	0	res3b[0][0]
res3c_branch2a (Conv2D)	(None, None, None, 1	65536	res3b_relu[0][0]
bn3c_branch2a (BatchNormalizati	(None, None, None, 1	512	res3c_branch2a[0][0]
res3c_branch2a_relu (Activation	(None, None, None, 1	0	bn3c_branch2a[0][0]
padding3c_branch2b (ZeroPadding	(None, None, None, 1	0	res3c_branch2a_relu[0][0]
res3c_branch2b (Conv2D)	(None, None, None, 1	147456	padding3c_branch2b[0][0]
bn3c_branch2b (BatchNormalizati	(None, None, None, 1	512	res3c_branch2b[0][0]
res3c_branch2b_relu (Activation	(None, None, None, 1	0	bn3c_branch2b[0][0]
res3c_branch2c (Conv2D)	(None, None, None, 5	65536	res3c_branch2b_relu[0][0]
bn3c_branch2c (BatchNormalizati	(None, None, None, 5	2048	res3c_branch2c[0][0]
res3c (Add)	(None, None, None, 5	0	bn3c_branch2c[0][0] res3b_relu[0][0]
res3c_relu (Activation)	(None, None, None, 5	0	res3c[0][0]
res3d_branch2a (Conv2D)	(None, None, None, 1	65536	res3c_relu[0][0]
bn3d_branch2a (BatchNormalizati	(None, None, None, 1	512	res3d_branch2a[0][0]
res3d_branch2a_relu (Activation	(None, None, None, 1	0	bn3d_branch2a[0][0]

padding3d_branch2b (ZeroPadding	(None, None, None, 1	0	res3d_branch2a_relu[0][0]
res3d_branch2b (Conv2D)	(None, None, None, 1	147456	padding3d_branch2b[0][0]
bn3d_branch2b (BatchNormalizati	(None, None, None, 1	512	res3d_branch2b[0][0]
res3d_branch2b_relu (Activation	(None, None, None, 1	0	bn3d_branch2b[0][0]
res3d_branch2c (Conv2D)	(None, None, None, 5	65536	res3d_branch2b_relu[0][0]
bn3d_branch2c (BatchNormalizati	(None, None, None, 5	2048	res3d_branch2c[0][0]
res3d (Add)	(None, None, None, 5	0	bn3d_branch2c[0][0] res3c_relu[0][0]
res3d_relu (Activation)	(None, None, None, 5	0	res3d[0][0]
res4a_branch2a (Conv2D)	(None, None, None, 2	131072	res3d_relu[0][0]
bn4a_branch2a (BatchNormalizati	(None, None, None, 2	1024	res4a_branch2a[0][0]
res4a_branch2a_relu (Activation	(None, None, None, 2	0	bn4a_branch2a[0][0]
padding4a_branch2b (ZeroPadding	(None, None, None, 2	0	res4a_branch2a_relu[0][0]
res4a_branch2b (Conv2D)	(None, None, None, 2	589824	padding4a_branch2b[0][0]
bn4a_branch2b (BatchNormalizati	(None, None, None, 2	1024	res4a_branch2b[0][0]
res4a_branch2b_relu (Activation	(None, None, None, 2	0	bn4a_branch2b[0][0]
res4a_branch2c (Conv2D)	(None, None, None, 1	262144	res4a_branch2b_relu[0][0]
res4a_branch1 (Conv2D)	(None, None, None, 1	524288	res3d_relu[0][0]
bn4a_branch2c (BatchNormalizati	(None, None, None, 1	4096	res4a_branch2c[0][0]
bn4a_branch1 (BatchNormalizatio	(None, None, None, 1	4096	res4a_branch1[0][0]
res4a (Add)	(None, None, None, 1	0	bn4a_branch2c[0][0] bn4a_branch1[0][0]

res4a_relu (Activation)	(None, None, None, 1	0	res4a[0][0]
res4b_branch2a (Conv2D)	(None, None, None, 2	262144	res4a_relu[0][0]
bn4b_branch2a (BatchNormalizati	(None, None, None, 2	1024	res4b_branch2a[0][0]
res4b_branch2a_relu (Activation	(None, None, None, 2	0	bn4b_branch2a[0][0]
padding4b_branch2b (ZeroPadding	(None, None, None, 2	0	res4b_branch2a_relu[0][0]
res4b_branch2b (Conv2D)	(None, None, None, 2	589824	padding4b_branch2b[0][0]
bn4b_branch2b (BatchNormalizati	(None, None, None, 2	1024	res4b_branch2b[0][0]
res4b_branch2b_relu (Activation	(None, None, None, 2	0	bn4b_branch2b[0][0]
res4b_branch2c (Conv2D)	(None, None, None, 1	262144	res4b_branch2b_relu[0][0]
bn4b_branch2c (BatchNormalizati	(None, None, None, 1	4096	res4b_branch2c[0][0]
res4b (Add)	(None, None, None, 1	0	bn4b_branch2c[0][0] res4a_relu[0][0]
res4b_relu (Activation)	(None, None, None, 1	0	res4b[0][0]
res4c_branch2a (Conv2D)	(None, None, None, 2	262144	res4b_relu[0][0]
bn4c_branch2a (BatchNormalizati	(None, None, None, 2	1024	res4c_branch2a[0][0]
res4c_branch2a_relu (Activation	(None, None, None, 2	0	bn4c_branch2a[0][0]
padding4c_branch2b (ZeroPadding	(None, None, None, 2	0	res4c_branch2a_relu[0][0]
res4c_branch2b (Conv2D)	(None, None, None, 2	589824	padding4c_branch2b[0][0]
bn4c_branch2b (BatchNormalizati	(None, None, None, 2	1024	res4c_branch2b[0][0]
res4c_branch2b_relu (Activation	(None, None, None, 2	0	bn4c_branch2b[0][0]
res4c_branch2c (Conv2D)	(None, None, None, 1	262144	res4c_branch2b_relu[0][0]
bn4c_branch2c (BatchNormalizati	(None, None, None, 1	4096	res4c_branch2c[0][0]

res4c (Add)	(None, None, None, 1	0	bn4c_branch2c[0][0] res4b_relu[0][0]
res4c_relu (Activation)	(None, None, None, 1	0	res4c[0][0]
res4d_branch2a (Conv2D)	(None, None, None, 2	262144	res4c_relu[0][0]
bn4d_branch2a (BatchNormalizati	(None, None, None, 2	1024	res4d_branch2a[0][0]
res4d_branch2a_relu (Activation	(None, None, None, 2	0	bn4d_branch2a[0][0]
padding4d_branch2b (ZeroPadding	(None, None, None, 2	0	res4d_branch2a_relu[0][0]
res4d_branch2b (Conv2D)	(None, None, None, 2	589824	padding4d_branch2b[0][0]
bn4d_branch2b (BatchNormalizati	(None, None, None, 2	1024	res4d_branch2b[0][0]
res4d_branch2b_relu (Activation	(None, None, None, 2	0	bn4d_branch2b[0][0]
res4d_branch2c (Conv2D)	(None, None, None, 1	262144	res4d_branch2b_relu[0][0]
bn4d_branch2c (BatchNormalizati	(None, None, None, 1	4096	res4d_branch2c[0][0]
res4d (Add)	(None, None, None, 1	0	bn4d_branch2c[0][0] res4c_relu[0][0]
res4d_relu (Activation)	(None, None, None, 1	0	res4d[0][0]
res4e_branch2a (Conv2D)	(None, None, None, 2	262144	res4d_relu[0][0]
bn4e_branch2a (BatchNormalizati	(None, None, None, 2	1024	res4e_branch2a[0][0]
res4e_branch2a_relu (Activation	(None, None, None, 2	0	bn4e_branch2a[0][0]
padding4e_branch2b (ZeroPadding	(None, None, None, 2	0	res4e_branch2a_relu[0][0]
res4e_branch2b (Conv2D)	(None, None, None, 2	589824	padding4e_branch2b[0][0]
bn4e_branch2b (BatchNormalizati	(None, None, None, 2	1024	res4e_branch2b[0][0]
res4e_branch2b_relu (Activation	(None, None, None, 2	0	bn4e_branch2b[0][0]

res4e_branch2c (Conv2D)	(None, None, None, 1	262144	res4e_branch2b_relu[0][0]
bn4e_branch2c (BatchNormalizati	(None, None, None, 1	4096	res4e_branch2c[0][0]
res4e (Add)	(None, None, None, 1	0	bn4e_branch2c[0][0] res4d_relu[0][0]
res4e_relu (Activation)	(None, None, None, 1	0	res4e[0][0]
res4f_branch2a (Conv2D)	(None, None, None, 2	262144	res4e_relu[0][0]
bn4f_branch2a (BatchNormalizati	(None, None, None, 2	1024	res4f_branch2a[0][0]
res4f_branch2a_relu (Activation	(None, None, None, 2	0	bn4f_branch2a[0][0]
padding4f_branch2b (ZeroPadding	(None, None, None, 2	0	res4f_branch2a_relu[0][0]
res4f_branch2b (Conv2D)	(None, None, None, 2	589824	padding4f_branch2b[0][0]
bn4f_branch2b (BatchNormalizati	(None, None, None, 2	1024	res4f_branch2b[0][0]
res4f_branch2b_relu (Activation	(None, None, None, 2	0	bn4f_branch2b[0][0]
res4f_branch2c (Conv2D)	(None, None, None, 1	262144	res4f_branch2b_relu[0][0]
bn4f_branch2c (BatchNormalizati	(None, None, None, 1	4096	res4f_branch2c[0][0]
res4f (Add)	(None, None, None, 1	0	bn4f_branch2c[0][0] res4e_relu[0][0]
res4f_relu (Activation)	(None, None, None, 1	0	res4f[0][0]
res5a_branch2a (Conv2D)	(None, None, None, 5	524288	res4f_relu[0][0]
bn5a_branch2a (BatchNormalizati	(None, None, None, 5	2048	res5a_branch2a[0][0]
res5a_branch2a_relu (Activation	(None, None, None, 5	0	bn5a_branch2a[0][0]
padding5a_branch2b (ZeroPadding	(None, None, None, 5	0	res5a_branch2a_relu[0][0]
res5a_branch2b (Conv2D)	(None, None, None, 5	2359296	padding5a_branch2b[0][0]

bn5a_branch2b (BatchNormalizati	(None, None, None, 5	2048	res5a_branch2b[0][0]
res5a_branch2b_relu (Activation	(None, None, None, 5	0	bn5a_branch2b[0][0]
res5a_branch2c (Conv2D)	(None, None, None, 2	1048576	res5a_branch2b_relu[0][0]
res5a_branch1 (Conv2D)	(None, None, None, 2	2097152	res4f_relu[0][0]
bn5a_branch2c (BatchNormalizati	(None, None, None, 2	8192	res5a_branch2c[0][0]
bn5a_branch1 (BatchNormalizatio	(None, None, None, 2	8192	res5a_branch1[0][0]
res5a (Add)	(None, None, None, 2	0	bn5a_branch2c[0][0] bn5a_branch1[0][0]
res5a_relu (Activation)	(None, None, None, 2	0	res5a[0][0]
res5b_branch2a (Conv2D)	(None, None, None, 5	1048576	res5a_relu[0][0]
bn5b_branch2a (BatchNormalizati	(None, None, None, 5	2048	res5b_branch2a[0][0]
res5b_branch2a_relu (Activation	(None, None, None, 5	0	bn5b_branch2a[0][0]
padding5b_branch2b (ZeroPadding	(None, None, None, 5	0	res5b_branch2a_relu[0][0]
res5b_branch2b (Conv2D)	(None, None, None, 5	2359296	padding5b_branch2b[0][0]
bn5b_branch2b (BatchNormalizati	(None, None, None, 5	2048	res5b_branch2b[0][0]
res5b_branch2b_relu (Activation	(None, None, None, 5	0	bn5b_branch2b[0][0]
res5b_branch2c (Conv2D)	(None, None, None, 2	1048576	res5b_branch2b_relu[0][0]
bn5b_branch2c (BatchNormalizati	(None, None, None, 2	8192	res5b_branch2c[0][0]
res5b (Add)	(None, None, None, 2	0	bn5b_branch2c[0][0] res5a_relu[0][0]
res5b_relu (Activation)	(None, None, None, 2	0	res5b[0][0]
res5c_branch2a (Conv2D)	(None, None, None, 5	1048576	res5b_relu[0][0]

bn5c_branch2a (BatchNormalizati	(None, None, None, 5	2048	res5c_branch2a[0][0]
res5c_branch2a_relu (Activation	(None, None, None, 5	0	bn5c_branch2a[0][0]
padding5c_branch2b (ZeroPadding	(None, None, None, 5	0	res5c_branch2a_relu[0][0]
res5c_branch2b (Conv2D)	(None, None, None, 5	2359296	padding5c_branch2b[0][0]
bn5c_branch2b (BatchNormalizati	(None, None, None, 5	2048	res5c_branch2b[0][0]
res5c_branch2b_relu (Activation	(None, None, None, 5	0	bn5c_branch2b[0][0]
res5c_branch2c (Conv2D)	(None, None, None, 2	1048576	res5c_branch2b_relu[0][0]
bn5c_branch2c (BatchNormalizati	(None, None, None, 2	8192	res5c_branch2c[0][0]
res5c (Add)	(None, None, None, 2	0	bn5c_branch2c[0][0] res5b_relu[0][0]
res5c_relu (Activation)	(None, None, None, 2	0	res5c[0][0]
C5_reduced (Conv2D)	(None, None, None, 2	524544	res5c_relu[0][0]
P5_upsampled (UpsampleLike)	(None, None, None, 2	0	C5_reduced[0][0] res4f_relu[0][0]
C4_reduced (Conv2D)	(None, None, None, 2	262400	res4f_relu[0][0]
P4_merged (Add)	(None, None, None, 2	0	P5_upsampled[0][0] C4_reduced[0][0]
P4_upsampled (UpsampleLike)	(None, None, None, 2	0	P4_merged[0][0] res3d_relu[0][0]
C3_reduced (Conv2D)	(None, None, None, 2	131328	res3d_relu[0][0]
P6 (Conv2D)	(None, None, None, 2	4718848	res5c_relu[0][0]
P3_merged (Add)	(None, None, None, 2	0	P4_upsampled[0][0] C3_reduced[0][0]
C6_relu (Activation)	(None, None, None, 2	0	P6[0][0]

P3 (Conv2D)	(None, None, None, 2	590080	P3_merged[0][0]
P4 (Conv2D)	(None, None, None, 2	590080	P4_merged[0][0]
P5 (Conv2D)	(None, None, None, 2	590080	C5_reduced[0][0]
P7 (Conv2D)	(None, None, None, 2	590080	C6_relu[0][0]
regression_submodel (Model)	(None, None, 4)	2443300	P3[0][0] P4[0][0] P5[0][0] P6[0][0] P7[0][0]
classification_submodel (Model)	(None, None, 15)	2671495	P3[0][0] P4[0][0] P5[0][0] P6[0][0] P7[0][0]
regression (Concatenate)	(None, None, 4)	0	regression_submodel[1][0] regression_submodel[2][0] regression_submodel[3][0] regression_submodel[4][0] regression_submodel[5][0]
classification (Concatenate)	(None, None, 15)	0	classification_submodel[1][0] classification_submodel[2][0] classification_submodel[3][0] classification_submodel[4][0]

```
from keras_retinanet.preprocessing import csv_generator
TrainGenerator = csv_generator.CSVGenerator('data/training.csv', 'data/classes.csv')
TestGenerator = csv_generator.CSVGenerator('data/test.csv', 'data/classes.csv')
ValidationGenerator = csv_generator.CSVGenerator('data/validation.csv', 'data/classes.csv')
```

```
history = model.fit_generator(TrainGenerator)
```

```
Epoch 1/1
 616/3233 [====>.........................] - ETA: 9:29 - loss: 3.6989 - regression_loss: 2.7275 - classification_loss: 0.9714/cc
  annotations['bboxes'][invalid_indices, :]
1048/3233 [========>.....................] - ETA: 7:54 - loss: 3.5236 - regression_loss: 2.6160 - classification_loss: 0.9076/cc
  annotations['bboxes'][invalid_indices, :]
3233/3233 [==============================] - 702s 217ms/step - loss: 3.0909 - regression_loss: 2.2930 - classification_loss: 0.7
```

```
 from keras_retinanet.callbacks.eval import Evaluate

mAP_callback = Evaluate(ValidationGenerator)
callbacks = [mAP_callback]
callbacks
```

```
[<keras_retinanet.callbacks.eval.Evaluate at 0x7f4653f7a4a8>]
```

```
from keras_retinanet.utils.eval import evaluate

evaluate(TestGenerator, model)
```

```
model.save('m.h5')
```

```
!keras_retinanet/bin/convert_model.py m.h5 m_i.h5
```

```
Using TensorFlow backend.
WARNING:tensorflow:From /tensorflow-1.15.2/python3.6/tensorflow_core/python/ops/resource_variable_ops.py:1630: calling BaseResou
Instructions for updating:
If using Keras pass *_constraint arguments to layers.
WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/keras/backend/tensorflow_backend.py:4070: The name tf.nn.max_pool

2020-05-14 18:00:28.095491: I tensorflow/stream_executor/platform/default/dso_loader.cc:44] Successfully opened dynamic library
2020-05-14 18:00:28.098082: E tensorflow/stream_executor/cuda/cuda_driver.cc:318] failed call to cuInit: CUDA_ERROR_NO_DEVICE: n
2020-05-14 18:00:28.098146: I tensorflow/stream_executor/cuda/cuda_diagnostics.cc:169] retrieving CUDA diagnostic information fo
2020-05-14 18:00:28.098168: I tensorflow/stream_executor/cuda/cuda_diagnostics.cc:176] hostname: 40ad8cc6ee5f
2020-05-14 18:00:28.098275: I tensorflow/stream_executor/cuda/cuda_diagnostics.cc:200] libcuda reported version is: 418.67.0
2020-05-14 18:00:28.098386: I tensorflow/stream_executor/cuda/cuda_diagnostics.cc:204] kernel reported version is: 418.67.0
2020-05-14 18:00:28.098424: I tensorflow/stream_executor/cuda/cuda_diagnostics.cc:310] kernel version seems to match DSO: 418.67
2020-05-14 18:00:28.103469: I tensorflow/core/platform/profile_utils/cpu_utils.cc:94] CPU Frequency: 2300000000 Hz
2020-05-14 18:00:28.103663: I tensorflow/compiler/xla/service/service.cc:168] XLA service 0xe9f1500 initialized for platform Hos
2020-05-14 18:00:28.103722: I tensorflow/compiler/xla/service/service.cc:176]   StreamExecutor device (0): Host, Default Version
2020-05-14 18:00:29.023258: W tensorflow/core/framework/cpu_allocator_impl.cc:81] Allocation of 18874368 exceeds 10% of system m
WARNING:tensorflow:From keras_retinanet/bin/../../keras_retinanet/backend/tensorflow_backend.py:104: where (from tensorflow.pyth
Instructions for updating:
```

```
# show images inline
%matplotlib inline

# automatically reload modules when they have changed
%load_ext autoreload
%autoreload 2

# import keras
import keras

# import keras_retinanet
from keras_retinanet import models
from keras_retinanet.utils.image import read_image_bgr, preprocess_image, resize_image
from keras_retinanet.utils.visualization import draw_box, draw_caption
from keras_retinanet.utils.colors import label_color
from keras_retinanet.utils.gpu import setup_gpu

# import miscellaneous modules
import matplotlib.pyplot as plt
import cv2
```

```
import os
import numpy as np
import time
```

```
model_path = os.path.join('m_i.h5')

# load retinanet model
model_ = models.load_model(model_path, backbone_name='resnet50')
```

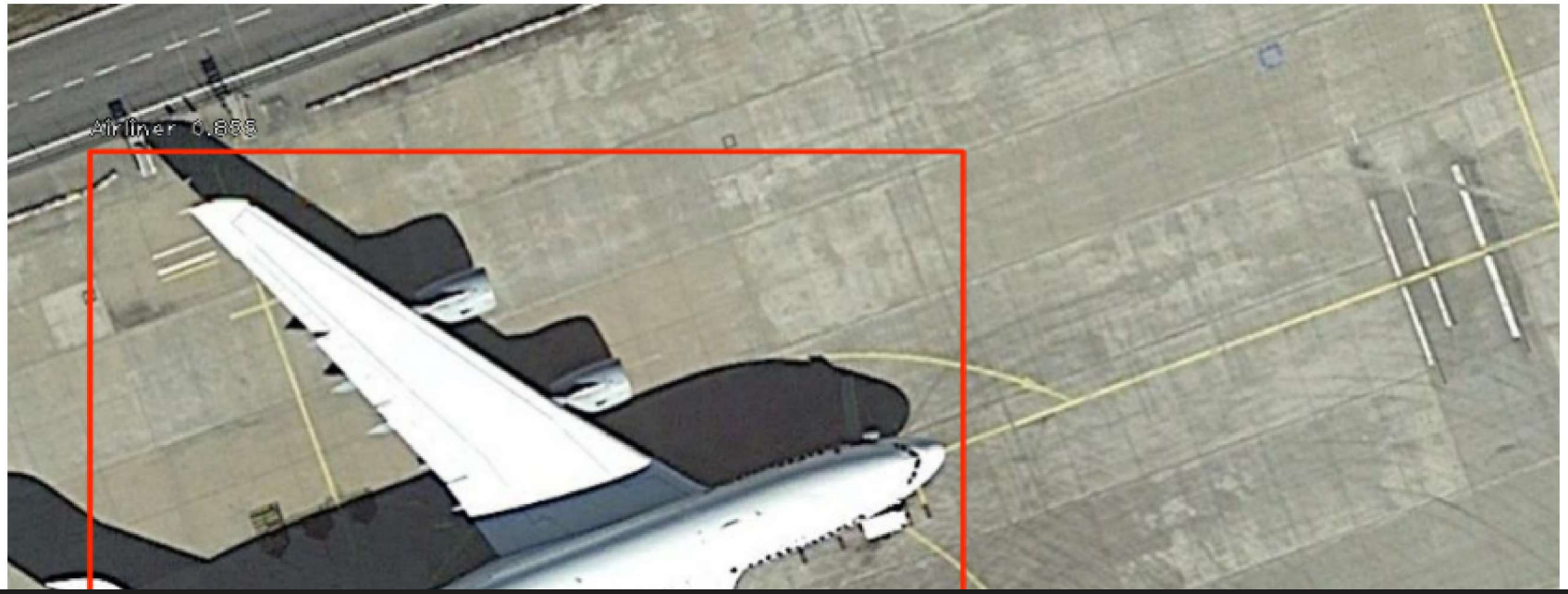
```
tracking <tf.Variable 'Variable:0' shape=(9, 4) dtype=float32> anchors
tracking <tf.Variable 'Variable_1:0' shape=(9, 4) dtype=float32> anchors
tracking <tf.Variable 'Variable_2:0' shape=(9, 4) dtype=float32> anchors
tracking <tf.Variable 'Variable_3:0' shape=(9, 4) dtype=float32> anchors
tracking <tf.Variable 'Variable_4:0' shape=(9, 4) dtype=float32> anchors
/usr/local/lib/python3.6/dist-packages/keras/engine/saving.py:341: UserWarning: No training configuration found in save file: th
  warnings.warn('No training configuration found in save file: '
```

```
labels_to_names=class_mapping
```

```
# load image
image = read_image_bgr('data/./images/1532.jpg')

# copy to draw on
draw = image.copy()
draw = cv2.cvtColor(draw, cv2.COLOR_BGR2RGB)

# preprocess image for network
image = preprocess_image(image)
image, scale = resize_image(image)

# process image
start = time.time()
boxes, scores, labels = model_.predict_on_batch(np.expand_dims(image, axis=0))
print("processing time: ", time.time() - start)

# correct for image scale
boxes /= scale
```

```
boxes /= scale

# visualize detections
for box, score, label in zip(boxes[0], scores[0], labels[0]):
    # scores are sorted so we can break
    if score < 0.5:
        break

    color = label_color(label)

    b = box.astype(int)
    draw_box(draw, b, color=color)

    caption = "{} {:.3f}".format(labels_to_names[label], score)
    draw_caption(draw, b, caption)

plt.figure(figsize=(15, 15))
plt.axis('off')
plt.imshow(draw)
plt.show()
```

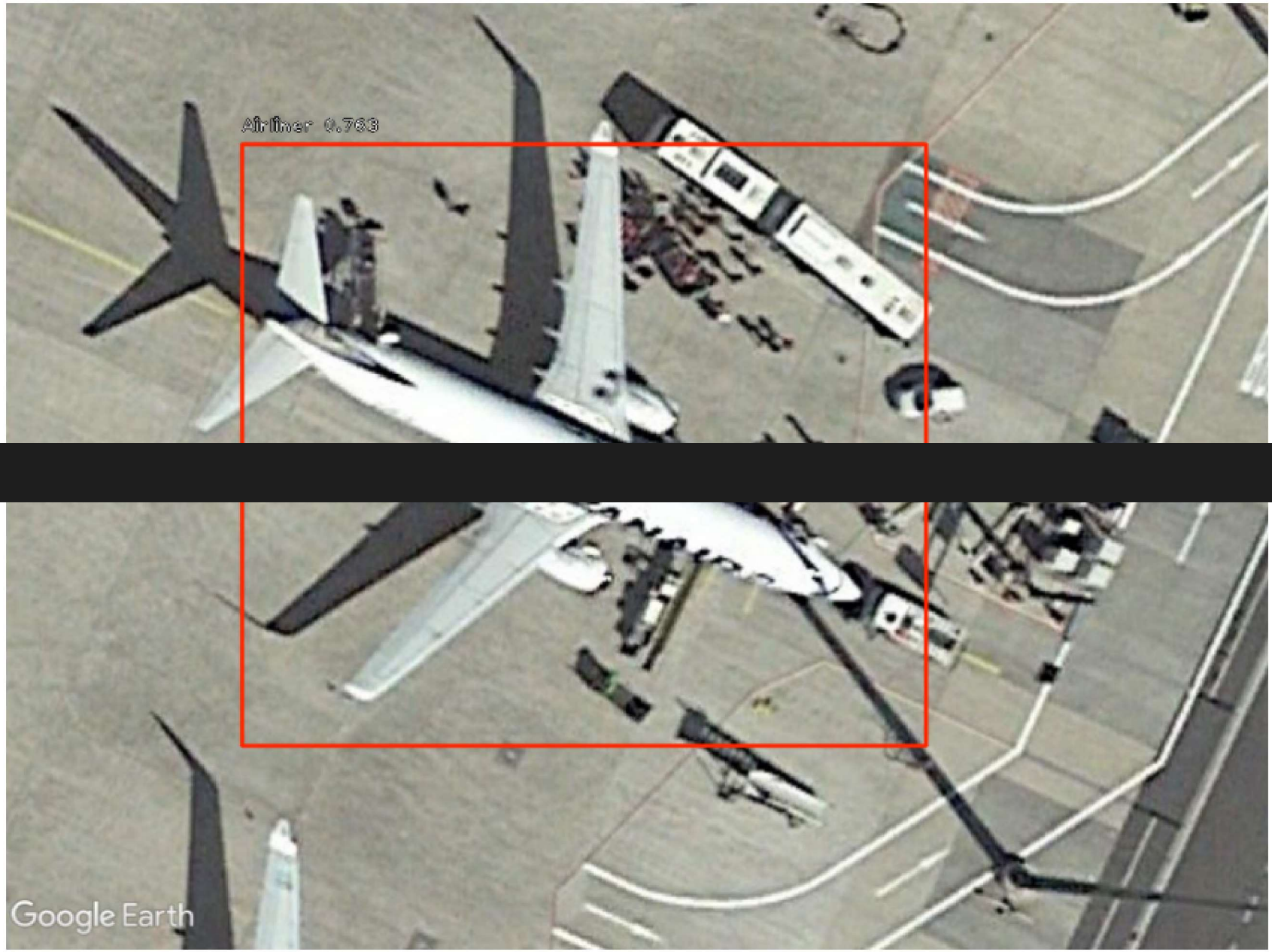
```
processing time:  0.0777273178100586
```




```
# load image
image = read_image_bgr('data/./images/1555.jpg')

# copy to draw on
draw = image.copy()
draw = cv2.cvtColor(draw, cv2.COLOR_BGR2RGB)

# preprocess image for network
image = preprocess_image(image)
image, scale = resize_image(image)

# process image
start = time.time()
boxes, scores, labels = model_.predict_on_batch(np.expand_dims(image, axis=0))
print("processing time: ", time.time() - start)

# correct for image scale
boxes /= scale

```

```
# visualize detections
for box, score, label in zip(boxes[0], scores[0], labels[0]):
    # scores are sorted so we can break
    if score < 0.5:
        break

    color = label_color(label)

    b = box.astype(int)
    draw_box(draw, b, color=color)

    caption = "{} {:.3f}".format(labels_to_names[label], score)
    draw_caption(draw, b, caption)

plt.figure(figsize=(15, 15))
plt.axis('off')
plt.imshow(draw)
plt.show()
```

```
processing time:  0.07439827919006348
```




```
1
```

Could not connect to the reCAPTCHA service. Please check your internet connection and reload to get a reCAPTCHA challenge.