In [ ]:
```
#ls
```

In [ ]:
```
cd 'RUN2'
```

```
/content/drive/My Drive/RUN2
```

In [ ]:
```
#!unzip admset213.zip
```

In [ ]:
```
cd admrun2
```

```
/content/drive/My Drive/RUN2/admrun2
```

In [ ]:
```
ls
```

```
admrun2/        test_images_from_train/  train_sample.csv
admset213.zip   test_sample.csv          validation_images_model/
run2.ipynb      train.csv                validation_sample.csv
test.csv        train_images_model/
```

In [ ]:
```
import numpy as np
import pandas as pd
import sys, requests, shutil, os

data_train=pd.read_csv("train_sample.csv")
data_valid=pd.read_csv("validation_sample.csv")
data_test=pd.read_csv("test_sample.csv")
```

In [ ]:
```
import numpy as np
from tensorflow.keras.preprocessing.image import ImageDataGenerator, im
g_to_array, load_img
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dropout, Flatten, Dense
from tensorflow.keras import applications
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras import optimizers
#from tensorflow.keras.utils.np_utils import to_categorical
from tensorflow.keras.utils import to_categorical

from tensorflow.keras.callbacks import ModelCheckpoint
from tensorflow.keras.models import Model
import csv
import os
#import cv2
from tensorflow.keras.models import load_model
import matplotlib.pyplot as plt
import math
from tensorflow.keras.optimizers import Adam
from sklearn.model_selection import train_test_split
from tensorflow.keras.preprocessing.image import img_to_array
from tensorflow.keras.utils import to_categorical
import matplotlib.pyplot as plt
import numpy as np
import argparse
import random
import tensorflow as tf
import tensorflow.keras
```

In [ ]:

```
'''
        There are few images that are not possible to open because they are corrupted or
    they do exhibit some properties which are not applicable to standard algorithms,
    these may result in algorithm going to infinite loop trying to process it.All those images
    are removed using the function below.
'''
from PIL import Image
import os

def filter_images(dir):
    i = 1000
    count = 0
    while i <= 1000:
        f = str(i)
        for root, dirs, files in os.walk(dir +'/'+ f):
            for pic in files:
                p=dir+'/'+f+'/'+pic
                try:
                    im=Image.open(p)    # if the image opening throws error
                except IOError:
                    count+=1
                    os.remove(p)        # catch it and delete it
            i += 1

filter_images('train_images_model')
filter_images('validation_images_model')
filter_images('test_images_from_train')
```

In [ ]:
```
# This cell counts the total number of train images and validation images in the entire dataset
# It stores the counts of train data 108181 training samples belonging to 1000 classes and
# 19826 test samples in the respective variables nb_train_samples and nb_validation_samples



train_data_dir = 'train_images_model'                    # points to directory having train images
validation_data_dir = 'validation_images_model'          # points to directory having validation images


def count(dir):
    i = 3000
    count = []
    while i <= 4999:
        f = str(i)
        #print (f)
        for root, dirs, files in os.walk(dir +'/'+ f):  # os. walk() is used to iterate through all folders of a directory
            for pic in files:
                count.append(f)
            i += 1
    print (len(count))
    return ([len(count),count])

nb_train_samples = count(train_data_dir)
nb_validation_samples = count(validation_data_dir)
```

```
99724
21400
```

In [ ]:
```
#Importing few other files needed
import pandas as pd
import os
import shutil
from shutil import copyfile
import urllib
```

In [ ]:
```
# here we build the VGG 16 model, which is pretrained using the imagene
t dataset,
# This is achieved by setting weights = 'imagenet' as a parameter while
building the model

img_width, img_height = 96, 96 #dimensions used in the model
top_model_weights_path = 'bottleneck_fc_model.h5' # this is used to sav
e weights in later stages, avoid recomputations
epochs = 5
batch_size = 428 #GCD
def save_bottleneck_features():
    datagen = ImageDataGenerator(rescale=1. / 255,
                                 rotation_range=30,
                                 width_shift_range=0.2,
                                 height_shift_range=0.2,
                                 zoom_range = 0.5,
                                 brightness_range = [0.5,1.5])

    # VGG 16 FramerWork
    model = applications.VGG16(include_top=False, weights='imagenet', i
nput_shape=(96,96,3))
    print ('start1')
    generator = datagen.flow_from_directory(
        train_data_dir,
        target_size=(img_width, img_height),
        batch_size=batch_size,
        class_mode=None,
        shuffle=False)

    print ('start2')
    bottleneck_features_train = model.predict_generator(generator, nb_t
rain_samples[0] // batch_size)
    print ('bottleneck_features_trained')


    with open('bottleneck_features_train.npy', 'wb') as features_train_
file:
        np.save(features_train_file, bottleneck_features_train)
    print ('Train done')


    datagen = ImageDataGenerator(rescale=1. / 255)
    generator = datagen.flow_from_directory(
        validation_data_dir,
        target_size=(img_width, img_height),
        batch_size=batch_size,
        class_mode=None,
        shuffle=False)
    print ('validation predict start')
    bottleneck_features_validation = model.predict_generator(generator,
nb_validation_samples[0] // batch_size)

    with open('bottleneck_features_validation.npy', 'wb') as features_v
alidation_file:
        np.save(features_validation_file, bottleneck_features_validatio
```

```
n)
    print ('validation done')
save_bottleneck_features()
```

```
Downloading data from https://storage.googleapis.com/tensorflow/keras
-applications/vgg16/vgg16_weights_tf_dim_ordering_tf_kernels_notop.h5
58892288/58889256 [==============================] - 2s 0us/step
start1
Found 99724 images belonging to 2000 classes.
start2
WARNING:tensorflow:From <ipython-input-20-cd1ff807f0ca>:27: Model.pre
dict_generator (from tensorflow.python.keras.engine.training) is depr
ecated and will be removed in a future version.
Instructions for updating:
Please use Model.predict, which supports generators.

/usr/local/lib/python3.6/dist-packages/PIL/Image.py:932: UserWarning:
Palette images with Transparency expressed in bytes should be convert
ed to RGBA images
  "Palette images with Transparency expressed in bytes should be "

bottleneck_features_trained
Train done
Found 21400 images belonging to 2000 classes.
validation predict start
validation done
```

In [ ]:
```
# counts of train and validation labels
train_labels = np.array(nb_train_samples[1])
train_labels = [str(int(train_label) - 3000) for train_label in train_l
abels]
print(len(train_labels))
train_data = np.load(open('bottleneck_features_train.npy', 'rb'))
print(len(train_data))
validation_data = np.load(open('bottleneck_features_validation.npy', 'r
b'))
print(len(validation_data))
validation_labels = np.array(nb_validation_samples[1])
print(len(validation_labels))
```

```
99724
99724
21400
21400
```

In [ ]:
```
epochs = 5
batch_size = 428
import numpy as np

def train_top_model():
    train_data = np.load(open('bottleneck_features_train.npy', 'rb'))
    train_labels = np.array(nb_train_samples[1])
    train_labels = [str(int(train_label) - 3000) for train_label in tra
in_labels]
    # we do label-1000, so that class lable starts from 0, as we have l
abels starting from 1000

    validation_data = np.load(open('bottleneck_features_validation.npy
', 'rb'))
    validation_labels = np.array(nb_validation_samples[1])
    validation_labels = [str(int(validation_label) - 3000) for validati
on_label in validation_labels]

    model = Sequential()
    model.add(Flatten(input_shape=train_data.shape[1:]))
    model.add(Dense(256, activation='relu'))
    model.add(Dense(256, activation='relu'))
    n_class = 2000 # max. classes given to the model
    model.add(Dense(n_class, activation='softmax'))
    model.compile(optimizer='rmsprop',
                  loss='categorical_crossentropy', metrics=['accuracy
'])
    train_labels = to_categorical(train_labels, n_class)
    validation_labels = to_categorical(validation_labels, n_class)

    print ('model fit starting')

    model.fit(train_data, train_labels,epochs=epochs,batch_size=batch_s
ize,validation_data=(validation_data, validation_labels))
    model.save_weights(top_model_weights_path)

train_top_model()
```

```
model fit starting
Epoch 1/5
233/233 [==============================] - 4s 17ms/step - loss: 5.155
3 - accuracy: 0.1441 - val_loss: 4.3747 - val_accuracy: 0.2388
Epoch 2/5
233/233 [==============================] - 4s 15ms/step - loss: 4.200
1 - accuracy: 0.2429 - val_loss: 3.8240 - val_accuracy: 0.3244
Epoch 3/5
233/233 [==============================] - 4s 15ms/step - loss: 3.731
1 - accuracy: 0.2988 - val_loss: 3.6022 - val_accuracy: 0.3578
Epoch 4/5
233/233 [==============================] - 4s 15ms/step - loss: 3.417
5 - accuracy: 0.3392 - val_loss: 3.2435 - val_accuracy: 0.4210
Epoch 5/5
233/233 [==============================] - 4s 15ms/step - loss: 3.173
0 - accuracy: 0.3724 - val_loss: 3.3218 - val_accuracy: 0.4196
```

In [ ]:
```
base_model = applications.VGG16(weights='imagenet',include_top= False,i
nput_shape=(96,96,3))
print(base_model.input)
```

```
Tensor("input_2:0", shape=(None, 96, 96, 3), dtype=float32)
```

In [ ]:
```
# This is where we fine tune the pretrained model according to our data set

img_width, img_height = 96, 96
top_model_weights_path = 'bottleneck_fc_model.h5'
train_data_dir = 'train_images_model'
validation_data_dir = 'validation_images_model'
batch_size = 200
epochs = 50
def trainCNN():

    # build the VGG16 network

    base_model = applications.VGG16(weights='imagenet',include_top= False,input_shape=(96,96,3))

    top_model = Sequential()
    top_model.add(Flatten(input_shape=base_model.output_shape[1:]))
    top_model.add(Dense(256, activation='relu'))
    top_model.add(Dense(256, activation='relu'))
    n_class = 2000
    top_model.add(Dense(n_class, activation='softmax'))
    top_model.load_weights(top_model_weights_path) #Load the weights initialized in previous steps


    model = Model(base_model.input, top_model(base_model.output))

    # set the first 16 layers to non-trainable (weights will not be updated)
    # 1 conv layer and three dense layers will be trained
    for layer in model.layers[:16]:
        layer.trainable = False

    model.compile(loss='categorical_crossentropy',
                  optimizer=optimizers.Adam(lr=0.001, beta_1=0.9,beta_2=0.999,epsilon=1e-8, decay=0.0),
                  metrics=['accuracy'])
    print ('Compilation done.')

    train_datagen = ImageDataGenerator(rescale=1. / 255,
                                       rotation_range=90,
                                        width_shift_range=0.2,
                                        height_shift_range=0.2,
                                        zoom_range = 0.5)

    valid_datagen = ImageDataGenerator(rescale=1. / 255)

    train_generator = train_datagen.flow_from_directory(
        train_data_dir,
        target_size=(img_height, img_width),
        batch_size=batch_size,
        class_mode='categorical')

    np.save('class_indices.npy', train_generator.class_indices)
```

```
    validation_generator = valid_datagen.flow_from_directory(
        validation_data_dir,
        target_size=(img_height, img_width),
        batch_size=batch_size,
        class_mode='categorical')

    print ('Model fit begins...')
    model.fit_generator(
        train_generator,
        steps_per_epoch=340,
        epochs=epochs,
        validation_data=validation_generator,
        validation_steps=100,
        callbacks=[ModelCheckpoint(filepath=top_model_weights_path, sav
e_best_only=True, save_weights_only=True)]
        )

    model.save_weights(top_model_weights_path)
    # final weights are saved in bottleneck_fc_model.h5 file

trainCNN()
```

```
Compilation done.
Found 99724 images belonging to 2000 classes.
Found 21400 images belonging to 2000 classes.
Model fit begins...
WARNING:tensorflow:From <ipython-input-24-6b4d59130c1f>:65: Model.fit
_generator (from tensorflow.python.keras.engine.training) is deprecat
ed and will be removed in a future version.
Instructions for updating:
Please use Model.fit, which supports generators.

/usr/local/lib/python3.6/dist-packages/PIL/Image.py:932: UserWarning:
Palette images with Transparency expressed in bytes should be convert
ed to RGBA images
  "Palette images with Transparency expressed in bytes should be "
```

```
Epoch 1/50
340/340 [==============================] - 450s 1s/step - loss: 5.019
1 - accuracy: 0.1338 - val_loss: 4.4888 - val_accuracy: 0.2026
Epoch 2/50
340/340 [==============================] - 411s 1s/step - loss: 4.167
8 - accuracy: 0.2232 - val_loss: 3.9779 - val_accuracy: 0.2918
Epoch 3/50
340/340 [==============================] - 409s 1s/step - loss: 3.801
4 - accuracy: 0.2725 - val_loss: 3.7460 - val_accuracy: 0.3413
Epoch 4/50
340/340 [==============================] - 403s 1s/step - loss: 3.563
2 - accuracy: 0.3087 - val_loss: 3.5531 - val_accuracy: 0.3729
Epoch 5/50
340/340 [==============================] - 394s 1s/step - loss: 3.394
8 - accuracy: 0.3369 - val_loss: 3.4336 - val_accuracy: 0.3968
Epoch 6/50
340/340 [==============================] - 394s 1s/step - loss: 3.267
3 - accuracy: 0.3519 - val_loss: 3.2745 - val_accuracy: 0.4268
Epoch 7/50
340/340 [==============================] - 390s 1s/step - loss: 3.150
4 - accuracy: 0.3697 - val_loss: 3.0824 - val_accuracy: 0.4572
Epoch 8/50
340/340 [==============================] - 394s 1s/step - loss: 3.079
3 - accuracy: 0.3812 - val_loss: 3.0777 - val_accuracy: 0.4631
Epoch 9/50
340/340 [==============================] - 395s 1s/step - loss: 2.982
9 - accuracy: 0.3991 - val_loss: 2.9978 - val_accuracy: 0.4780
Epoch 10/50
340/340 [==============================] - 396s 1s/step - loss: 2.912
4 - accuracy: 0.4081 - val_loss: 2.9729 - val_accuracy: 0.4827
Epoch 11/50
340/340 [==============================] - 393s 1s/step - loss: 2.857
8 - accuracy: 0.4146 - val_loss: 2.8633 - val_accuracy: 0.5006
Epoch 12/50
340/340 [==============================] - 392s 1s/step - loss: 2.828
3 - accuracy: 0.4186 - val_loss: 2.8531 - val_accuracy: 0.5020
Epoch 13/50
340/340 [==============================] - 396s 1s/step - loss: 2.769
1 - accuracy: 0.4294 - val_loss: 2.8668 - val_accuracy: 0.5047
Epoch 14/50
340/340 [==============================] - 399s 1s/step - loss: 2.734
8 - accuracy: 0.4348 - val_loss: 2.8277 - val_accuracy: 0.5141
Epoch 15/50
340/340 [==============================] - 393s 1s/step - loss: 2.692
7 - accuracy: 0.4423 - val_loss: 2.8393 - val_accuracy: 0.5109
Epoch 16/50
340/340 [==============================] - 391s 1s/step - loss: 2.670
8 - accuracy: 0.4444 - val_loss: 2.7507 - val_accuracy: 0.5239
Epoch 17/50
340/340 [==============================] - 394s 1s/step - loss: 2.631
7 - accuracy: 0.4492 - val_loss: 2.8086 - val_accuracy: 0.5238
Epoch 18/50
340/340 [==============================] - 397s 1s/step - loss: 2.612
7 - accuracy: 0.4548 - val_loss: 2.7775 - val_accuracy: 0.5248
Epoch 19/50
340/340 [==============================] - 393s 1s/step - loss: 2.588
```

```
5 - accuracy: 0.4554 - val_loss: 2.7405 - val_accuracy: 0.5415
Epoch 20/50
340/340 [==============================] - 388s 1s/step - loss: 2.567
6 - accuracy: 0.4613 - val_loss: 2.6432 - val_accuracy: 0.5456
Epoch 21/50
340/340 [==============================] - 382s 1s/step - loss: 2.524
7 - accuracy: 0.4652 - val_loss: 2.6720 - val_accuracy: 0.5534
Epoch 22/50
340/340 [==============================] - 392s 1s/step - loss: 2.505
0 - accuracy: 0.4715 - val_loss: 2.7038 - val_accuracy: 0.5500
Epoch 23/50
340/340 [==============================] - 393s 1s/step - loss: 2.502
7 - accuracy: 0.4702 - val_loss: 2.6991 - val_accuracy: 0.5521
Epoch 24/50
340/340 [==============================] - 403s 1s/step - loss: 2.465
0 - accuracy: 0.4800 - val_loss: 2.6570 - val_accuracy: 0.5636
Epoch 25/50
340/340 [==============================] - 391s 1s/step - loss: 2.454
8 - accuracy: 0.4802 - val_loss: 2.6127 - val_accuracy: 0.5676
Epoch 26/50
340/340 [==============================] - 370s 1s/step - loss: 2.442
8 - accuracy: 0.4799 - val_loss: 2.6527 - val_accuracy: 0.5635
Epoch 27/50
340/340 [==============================] - 440s 1s/step - loss: 2.427
9 - accuracy: 0.4827 - val_loss: 2.6358 - val_accuracy: 0.5607
Epoch 28/50
340/340 [==============================] - 398s 1s/step - loss: 2.412
9 - accuracy: 0.4870 - val_loss: 2.7533 - val_accuracy: 0.5520
Epoch 29/50
340/340 [==============================] - 383s 1s/step - loss: 2.391
9 - accuracy: 0.4908 - val_loss: 2.6785 - val_accuracy: 0.5692
Epoch 30/50
340/340 [==============================] - 366s 1s/step - loss: 2.380
0 - accuracy: 0.4916 - val_loss: 2.6147 - val_accuracy: 0.5724
Epoch 31/50
340/340 [==============================] - 397s 1s/step - loss: 2.363
6 - accuracy: 0.4948 - val_loss: 2.5595 - val_accuracy: 0.5881
Epoch 32/50
340/340 [==============================] - 387s 1s/step - loss: 2.350
6 - accuracy: 0.4975 - val_loss: 2.5713 - val_accuracy: 0.5836
Epoch 33/50
340/340 [==============================] - 382s 1s/step - loss: 2.355
1 - accuracy: 0.4981 - val_loss: 2.5431 - val_accuracy: 0.5883
Epoch 34/50
340/340 [==============================] - 363s 1s/step - loss: 2.342
2 - accuracy: 0.4985 - val_loss: 2.6465 - val_accuracy: 0.5835
Epoch 35/50
340/340 [==============================] - 357s 1s/step - loss: 2.324
4 - accuracy: 0.5001 - val_loss: 2.6128 - val_accuracy: 0.5874
Epoch 36/50
340/340 [==============================] - 350s 1s/step - loss: 2.319
7 - accuracy: 0.5029 - val_loss: 2.6066 - val_accuracy: 0.5829
Epoch 37/50
```

In [ ]:
```
from tensorflow.python.platform import app
import argparse
import os
import sys
import time
from time import *
import io
import tensorflow as tf
```

In [ ]:
```
ls
```

```
admset213.zip                       test.csv
bottleneck_fc_model.h5              test_images_from_train/
bottleneck_features_train.npy       test_sample.csv
bottleneck_features_validation.npy  train.csv
class_indices.npy                   train_images_model/
result.csv                          train_sample.csv
RUN/                                validation_images_model/
run2.ipynb                          validation_sample.csv
```

In [ ]:
```
top_model_weights_path = 'bottleneck_fc_model.h5'       # final weights
of the model
train_data_dir = 'train_images_model'
testfile = 'test_images_from_train'
subfile = 'result.csv'                                  # predictions o
f the model
```

In [ ]:
```
from keras import backend as K
import cv2
top_model_weights_path = 'bottleneck_fc_model.h5'       # final weights
of the model
train_data_dir = 'train_images_model'
testfile = 'test_images_from_train'
subfile = 'result2.csv'                                  # predictions
of the model
def predict(image_path):
    print ('starting')
    path, dirs, files = next(os.walk(image_path))
    file_len = len(files)
    print('Number of Testimages:', file_len)
    #train_datagen = ImageDataGenerator(rescale=1. / 255)
    #generator = train_datagen.flow_from_directory(train_data_dir, batc
h_size=batch_size)
    #label_map = (generator.class_indices)
    label_map={}
    for i in range(2000):
      label_map[str(3000+i)]=i
    n_class = 2000
    base_model = applications.VGG16(weights='imagenet', include_top=Fal
se, input_shape=(96, 96, 3))
    top_model = Sequential()
    top_model.add(Flatten(input_shape=base_model.output_shape[1:]))
    top_model.add(Dense(256, activation='relu'))
    top_model.add(Dense(256, activation='relu'))
    top_model.add(Dense(n_class, activation='softmax'))
    model = Model(base_model.input,top_model(base_model.output))
    model.load_weights(top_model_weights_path)
    with open(subfile, 'w') as csvfile:
        newFileWriter = csv.writer(csvfile)
        newFileWriter.writerow(['id', 'landmarks','confidence'])
        file_counter = 0
        for root, dirs, files in os.walk(image_path):  # loop through s
tartfolders
            i=0
            for pic in files:
                i+=1
                #loop folder and convert image
                path = image_path + '/' + pic


                orig = cv2.imread(path)
                image = load_img(path, target_size=(96, 96))
                image = img_to_array(image)

                # important! otherwise the predictions will be '0'
                image = image / 255

                image = np.expand_dims(image, axis=0)

                #classify landmark
```

```
                prediction = model.predict(image)


                class_predicted = prediction.argmax(axis=1)
                #class_predicted = np.argmax(prediction,axis=1)
                #print (pic, class_predicted)


                inID = class_predicted[0]
                #print inID

                inv_map = {v: k for k, v in label_map.items()}
                #print class_dictionary
                label = inv_map[inID]
                score = max(prediction[0])
                scor = "{:.2f}".format(score)
                #out = str(label) + ' '+ scor
                print (i,score,label)
                newFileWriter.writerow([os.path.splitext(pic)[0], int(l
abel),scor])

predict(testfile)
```

```
starting
Number of Testimages: 5168
1 0.806817 3274
2 0.38527328 3868
3 0.70156777 3130
4 0.20947924 4124
5 0.3060793 3619
6 0.43088424 4644
7 0.9930876 4352
8 0.19401854 3563
9 0.38142994 4645
10 1.0 3518
11 0.99997365 4352
12 0.7042313 3459
13 0.3953463 3770
14 0.32648245 3924
15 0.93806136 3249
16 0.67641515 3130
17 0.9309056 4352
18 0.39596814 3804
19 0.1562511 4124
20 0.24131607 3518
21 0.3486548 4987
22 0.9271772 4869
23 0.74781805 4352
24 0.17166659 3924
25 0.9999989 3410
26 0.998386 3987
27 0.22848599 3849
28 0.97179776 4873
29 0.4345432 3130
30 0.71738034 3924
31 0.27359554 4388
32 0.7881216 4210
33 0.23062392 4240
34 0.68312335 3332
35 0.35648656 3872
36 0.9986785 4352
37 0.30351555 4987
38 0.22536306 3924
39 0.83417654 4115
40 0.19560361 4737
41 0.37565538 4340
42 0.9993303 3829
43 0.9462506 4352
44 0.3475381 3096
45 0.58318764 3039
46 0.45394483 4493
47 0.37547228 3228
48 0.16636014 4981
49 0.9943416 4353
50 0.54943645 3144
51 0.9983333 4352
52 0.9999883 4352
53 0.99891794 3020
54 1.0 3497
```

```
55 0.998978 3394
56 0.72804266 4898
57 0.99703467 4210
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61 0.46326792 4697
62 0.9990746 3497
63 0.038116533 4987
```

```
/usr/local/lib/python3.6/dist-packages/PIL/Image.py:932: UserWarning:
Palette images with Transparency expressed in bytes should be convert
ed to RGBA images
  "Palette images with Transparency expressed in bytes should be "
```

Streaming output truncated to the last 5000 lines.

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4576 0.9393419 4585
4577 0.03191987 4352
4578 0.18879063 3977
4579 0.4586443 4949
4580 0.2811105 3981
4581 0.15158643 4370
4582 0.61296207 4954
4583 0.8722586 4352
4584 0.12961276 4352
4585 0.1803137 3695
4586 0.4743068 4085
4587 0.9346085 3938
4588 0.6720288 3216
4589 0.9902687 4547
4590 0.9240426 4734
4591 0.17592809 3713
4592 0.73577684 3942
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4593 0.13393994 4919
4594 0.993255 4352
4595 0.17439398 4340
4596 0.17597634 4898
4597 0.62731963 4827
4598 0.99999857 3645
4599 0.9925328 3804
4600 0.09145522 4724
4601 0.45363757 4573
4602 0.23466071 4168
4603 0.7039007 3096
4604 0.25243562 4390
4605 0.6241807 4352
4606 0.99552697 4821
4607 0.83726466 4352
4608 0.6347679 3283
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4610 0.117096715 3924
4611 0.99999344 3065
4612 0.2710102 4686
4613 0.99999905 4352
4614 0.47922602 3096
4615 0.9386375 3868
4616 0.10946941 3114
4617 0.21834819 4714
4618 0.5628923 3201
4619 0.9940043 4385
4620 0.917478 4981
4621 0.17726767 4981
4622 0.3054326 3962
4623 0.99770063 4372
4624 0.1788799 3155
4625 0.99886024 4737
4626 0.55311126 3820
4627 0.09542676 3148
4628 0.0903214 3283
4629 0.5976831 4352
4630 0.83872604 3252
4631 0.4474883 4330
4632 0.98156184 4624
4633 0.9207139 3705
4634 0.99943465 3078
4635 0.9215053 3898
4636 0.060678013 4221
4637 0.2117508 3977
4638 0.64228904 3103
4639 0.9996499 3654
4640 0.99604887 4987
4641 0.1507397 3924
4642 0.8657591 3497
4643 0.9999652 4210
4644 0.99057627 3185
4645 0.24034534 4262
4646 0.119173884 4217
4647 0.9120951 3942
4648 0.058572818 3962
```

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4649 0.14047156 3457
4650 0.12300426 4267
4651 0.45893818 3063
4652 0.94120497 4829
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4654 0.99718034 3623
4655 0.6514907 3586
4656 0.96190524 4936
4657 0.9983285 4829
4658 0.5714692 3426
4659 0.25605097 3586
4660 0.37131193 4128
4661 0.8841232 4987
4662 0.993913 4605
4663 0.3910516 4926
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4665 0.06522595 3079
4666 0.9974005 3924
4667 0.5784121 3997
4668 0.21246365 4126
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4679 0.72447425 4894
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4683 0.15537992 3283
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4685 0.058572818 3962
4686 0.3533549 4771
4687 0.6805687 3409
4688 0.13359325 4644
4689 0.7527253 3296
4690 0.7899314 4558
4691 0.47630075 3283
4692 0.27141583 3332
4693 0.1021362 3030
4694 0.17026502 4352
4695 0.91292244 4987
4696 0.99962795 3654
4697 0.49833107 3457
4698 0.32752794 3664
4699 0.08506651 3317
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4702 0.7754371 3804
4703 0.24556735 4275
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4729 0.18507658 3347
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4737 0.84366596 3888
4738 0.7354576 3077
4739 0.19134527 3439
4740 0.76348656 3114
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4742 0.99237 4987
4743 0.566334 4266
4744 0.97243 3898
4745 0.42129976 4240
4746 0.9333011 4643
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4748 0.74936897 3025
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4750 0.23566869 3259
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4755 0.41935757 4793
4756 0.98789376 4404
4757 0.6506685 3114
4758 0.09650955 4980
4759 0.41740927 4327
4760 0.93635523 4353
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4765 0.19773512 4352
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4768 0.59947896 4122
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4770 0.6981717 4284
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4773 0.99064344 4936
4774 0.99980575 3804
4775 0.5965643 4699
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4779 0.67457044 4936
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4784 0.86240214 4894
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4786 0.9986933 3544
4787 0.82786745 3130
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4790 0.9901902 4954
4791 0.6328994 4949
4792 0.2413655 4430
4793 0.971144 3748
4794 0.9809529 3638
4795 0.99999225 3283
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4797 0.9999436 4987
4798 0.34079018 4352
4799 0.9999982 3497
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4806 0.70885223 4705
4807 0.26190746 3987
4808 0.99923325 4352
4809 0.96462595 3748
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4813 0.3143012 4436
4814 0.86753565 3166
4815 0.98170435 3878
4816 0.79158664 4697
```

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4820 0.5911683 3457
4821 0.23437452 3090
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4823 0.995074 3898
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4837 0.10555993 3111
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4839 0.48655403 4352
4840 0.9999999 3238
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4854 0.86873585 4124
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4856 0.8903896 3122
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4873 0.13010691 4221
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4883 0.99934477 3804
4884 0.1878032 4936
4885 0.7449366 3975
4886 0.058572818 3962
4887 0.99940753 4987
4888 0.39613688 4124
4889 0.96437854 3426
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4897 0.8899369 4809
4898 0.40280935 3296
4899 0.7016321 4436
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4903 0.9951349 3130
4904 0.31584066 4255
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4907 0.29870465 4283
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4918 0.058572818 3962
4919 0.13527067 3997
4920 0.24097511 3144
4921 0.32504597 3296
4922 0.9985922 4987
4923 0.8596905 3937
4924 1.0 4300
4925 0.9999995 4352
4926 0.48715267 4919
4927 0.24776135 3804
4928 0.99878305 3924
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4929 0.14095755 3431
4930 0.57824504 4596
4931 0.9942866 3731
4932 0.27221358 4793
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4934 0.78770787 4573
4935 0.22991475 3130
4936 0.7867112 4980
4937 0.580007 4954
4938 0.14208265 3015
4939 0.55470663 4390
4940 0.11820198 4340
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4947 0.999995 4987
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4950 0.8652836 3924
4951 0.883496 4954
4952 0.4104976 4815
4953 0.3001049 3278
4954 0.9955967 4987
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4958 0.4413204 3924
4959 0.03191987 4352
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4962 0.9977005 4949
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4966 0.08902419 4386
4967 0.38772798 4694
4968 0.999453 3497
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4971 0.17583129 3695
4972 0.44089717 3997
4973 0.18140413 4040
4974 0.8076206 4450
4975 0.4483657 3574
4976 0.15286796 4561
4977 0.43339294 4352
4978 0.34410858 3349
4979 0.2472633 4372
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4981 0.2800905 3704
4982 0.7965915 3228
4983 0.06332776 3958
4984 0.094155446 3926
```

```
4985 0.542086 4190
4986 0.13051532 3573
4987 0.83337826 3985
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4990 0.9795761 4427
4991 0.77948284 4149
4992 0.47100762 4898
4993 0.30508113 4085
4994 0.41147593 3987
4995 0.13118565 3055
4996 0.23399329 3898
4997 0.07162837 3942
4998 0.2423405 3635
4999 1.0 3497
5000 0.95891625 3829
5001 0.45409983 3695
5002 0.04972598 3544
5003 0.88459563 3464
5004 1.0 4404
5005 0.84086853 4385
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5007 0.93913645 4987
5008 0.8589551 3924
5009 0.673047 3114
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5011 0.29508972 4494
5012 0.999997 3748
5013 0.30915245 4010
5014 0.9991497 4190
5015 0.7095015 4981
5016 0.9867786 3148
5017 0.9959675 3924
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5019 0.2008628 4626
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5021 0.9992348 3544
5022 0.1957519 4379
5023 0.8699526 3888
5024 0.53894436 3888
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5030 0.44492707 4697
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5034 0.6140623 4981
5035 0.03191987 4352
5036 0.6103789 3130
5037 0.93073463 4190
5038 0.7351202 4210
5039 0.38163346 4352
5040 0.95640206 3497
```

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5041 0.0444458 4352
5042 1.0 4987
5043 0.87085235 4352
5044 0.99003863 4987
5045 0.18385182 4943
5046 0.9727518 4300
5047 0.5535339 3063
5048 0.45763335 4124
5049 0.9906158 3296
5050 0.9976427 3518
5051 0.2516073 3103
5052 0.98162246 4860
5053 0.3105572 4981
5054 0.062411517 3496
5055 0.44368038 3385
5056 0.38794062 4724
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5059 0.48020044 4149
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5061 0.9858263 4737
5062 0.9992636 4352
5063 0.94764453 3258
5064 0.9862168 3924
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5068 0.54245514 3804
5069 0.63838696 3499
5070 0.8939211 3707
5071 0.64900017 4954
5072 0.03191987 4352
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5075 0.9067657 4644
5076 0.404324 4003
5077 0.8252218 4613
5078 0.6533076 3924
5079 0.9711231 4644
5080 0.270069 4352
5081 0.16682546 4885
5082 0.21220809 3962
5083 0.96232 4987
5084 0.5788705 4330
5085 0.27073637 4430
5086 0.99996805 3426
```

In [ ]:
```
#result = pd.read_csv('result.csv')     # predicted values
```

In [ ]:
```
#test = pd.read_csv('test_sample.csv')  # ground truth
```

In [ ]:
```
# final accuracy of the model as tested on test dataset
import pandas as pd
def test_accuracy(pred,truth):
    result=pd.read_csv(pred)
    #print(result.head(20))
    test=pd.read_csv(truth)
    count=0
    for i in result["id"]:
        a=result.loc[result['id'] == i, "landmarks"]
        b=a.values
        #b=list(b[0].split(" "))
        b[0]=int(b[0])
        if i in test.id.values:
          c=test.loc[test['id'] == i, "landmark_id"]
          d=c.values
          if b[0]==d[0]:
              count+=1
    print(count/len(result))
    return count/len(result)
test_accuracy("result2.csv","test_sample.csv")
```

```
0.6106811145510835
```

Out[ ]:
```
0.6106811145510835
```

In [ ]:
```
# This call calulates the Global Average Precision Metric
#
import pandas as pd
def GAP_metric(path):
    result=pd.read_csv(path)
    test=pd.read_csv("test_sample.csv")
    result=result.sort_values(by='confidence', ascending=False)
    M=0
    true=0
    total=0
    s=0
    relevance=0
    for i in result['id']:
        total+=1
        a=result.loc[result['id'] == i, "landmarks"]
        b=a.values
        #if i in test['id']:
        if i in test.id.values:
          M+=1
          c=test.loc[test['id'] == i, "landmark_id"]
          d=c.values
          if b[0]==d[0]:
              true+=1
              relevance=1
        s+=(true/total)*relevance
        relevance=0
    print(M,s,total,true)
    print(s/M)
    return s/M
GAP_metric("result2.csv")
```

```
5168 2947.5271513731795 5168 3156
0.5703419410551818
```

Out[ ]:
```
0.5703419410551818
```

In [ ]:
```
#GAP_metric('result.csv')
```

In [ ]:
```

```