image-quality-prediction

May 11, 2020

[1]:
```
# This Python 3 environment comes with many helpful analytics libraries␣
 ↪installed
# It is defined by the kaggle/python Docker image: https://github.com/kaggle/
 ↪docker-python
# For example, here's several helpful packages to load

import numpy as np # linear algebra
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)
import cv2
import matplotlib.pyplot as plt
import math
from keras.layers import␣
 ↪Dense,Input,Conv2D,MaxPooling2D,Dropout,BatchNormalization,Flatten,GlobalAveragePooling2D
from keras.models import Model
from keras.callbacks import␣
 ↪EarlyStopping,ReduceLROnPlateau,ModelCheckpoint,CSVLogger
from keras.optimizers import Adam
from keras.preprocessing.image import ImageDataGenerator
from keras.utils import plot_model
import keras.backend as K
from keras.utils import to_categorical
from keras.applications.inception_resnet_v2 import InceptionResNetV2
from keras.applications.inception_resnet_v2 import preprocess_input
from sklearn.metrics import confusion_matrix
import gc
import tqdm
from sklearn.metrics import confusion_matrix,accuracy_score
from keras.preprocessing.image import load_img
from skimage.transform import resize
from skimage.io import imread
from sklearn.metrics import mean_absolute_error



# Input data files are available in the read-only "../input/" directory
# For example, running this (by clicking run or pressing Shift+Enter) will list␣
 ↪all files under the input directory
```

```
# You can write up to 5GB to the current directory (/kaggle/working/) that gets␣
↪preserved as output when you create a version using "Save & Run All"
# You can also write temporary files to /kaggle/temp/, but they won't be saved␣
↪outside of the current session
```

```
Using TensorFlow backend.
```

[2]:
```
np.set_printoptions(suppress=True)

PATH = '/kaggle/input/'
TRAIN_PATH = PATH+'distorted_images/'
BATCH_SIZE = 16
lr = 0.001
W,H = 254,254
EPOCH = 25
```

[3]:
```
df = pd.read_csv(PATH+'mos_with_names.txt',sep='\s',header=None,engine='python')
# Read data details from official page to know the reason
df.rename({0:'Score',1:'Image Name'},axis=1,inplace=True)
df = df[['Image Name','Score']]
df = df.sample(frac=1.0)
df.head()
```

[3]:

	Image Name	Score
2916	i25_08_2.bmp	5.05556
1031	i09_15_2.bmp	3.06061
96	i01_20_2.bmp	5.83333
1545	i13_22_1.bmp	5.42857
1656	i14_20_2.bmp	5.59459

[4]:
```
df['Score'].nunique()
```

[4]:
```
1457
```

[5]:
```
df['Round Class'] = df['Score'].apply(lambda x: round(x))
df['Ceil Class'] = df['Score'].apply(lambda x: math.ceil(x))
df.describe()
```

[5]:

	Score	Round Class	Ceil Class
count	3000.000000	3000.000000	3000.000000
mean	4.474657	4.489667	4.956667
std	1.239880	1.285474	1.272004
min	0.242420	0.000000	1.000000
25%	3.611110	4.000000	4.000000
50%	4.600000	5.000000	5.000000
75%	5.526320	6.000000	6.000000
max	7.214290	7.000000	8.000000

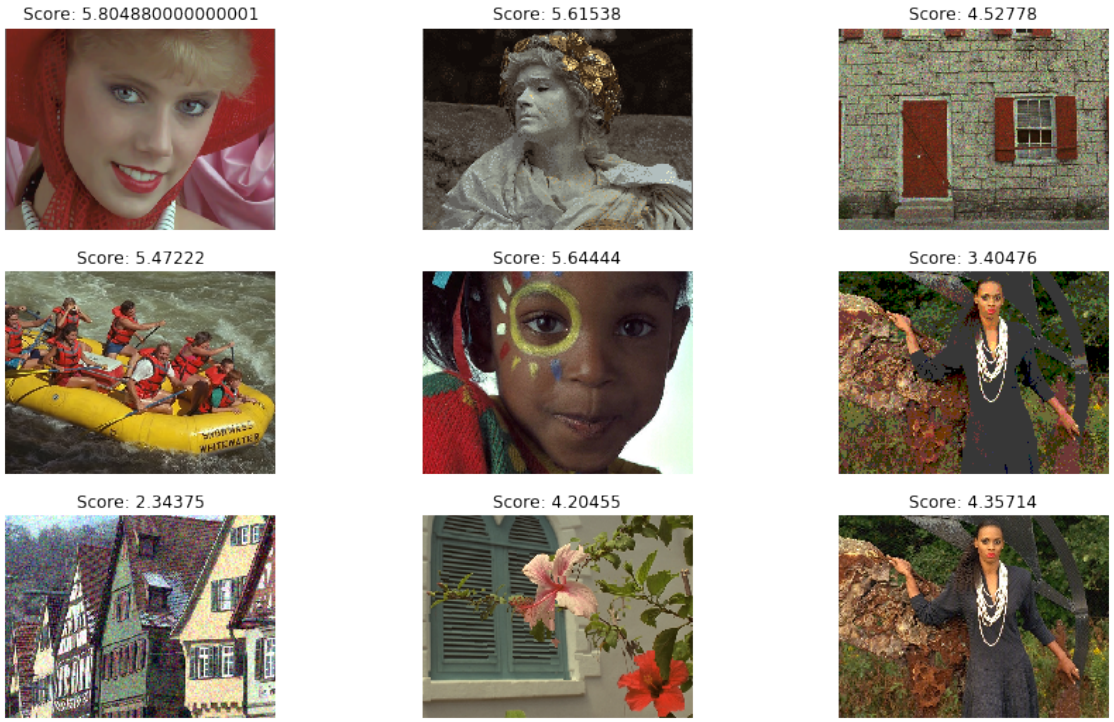
Max score given is 7.2 and minimum is 0.2

[6]:
```
y = to_categorical(df['Round Class']) # because mean is close to original and␣
 ↪std is close to ceil
# y.shape
```

[7]:
```
df['Label'] = df['Round Class'].apply(lambda x: str(x))
#df['Label'] = to_categorical(df['Round Class'])

# because ImageDataGenerator accepts strings as categorical
```

0.1 Plot Random samples from data

[8]:
```
f,ax = plt.subplots(3,3,figsize=(15,9))
ax = ax.ravel()
sample_df = df.sample(9)

for i,index in enumerate(sample_df.index):
    ax[i].imshow(plt.imread(TRAIN_PATH+sample_df.loc[index,'Image Name']))
    ax[i].set_title(f'Score: {sample_df.loc[index,"Score"]}')
    ax[i].axis('off')

plt.savefig('random_images.png')
```



0.2 Images with Minimum and Maximum Scores

[9]:
```
f,ax = plt.subplots(1,2,figsize=(10,5))
ax = ax.ravel()
max_min = [df['Score'].idxmax(),df['Score'].idxmin()]
for i,index in enumerate(max_min):
    ax[i].imshow(plt.imread(TRAIN_PATH+df.iloc[index,0]))
    ax[i].set_title(f'Score: {df.iloc[index,1]}')
    ax[i].axis('off')

plt.savefig('min_max_score_images.png')
```

0.3 ResNet Transfer Learning

[10]:
```
base_model = InceptionResNetV2(input_shape=(W,H,␣
↪3),include_top=False,pooling='avg',weights='imagenet')
# Do not train any of the layers so that weights are optimized as they were in␣
↪imagenet compitition
for layer in base_model.layers:
    layer.trainable = False

# x = GlobalAveragePooling2D(basemodel.output) # we have used pooling='avg' so␣
↪no need
x = Dropout(0.69)(base_model.output)
out = Dense(y.shape[1],activation='softmax')(x)

model = Model(base_model.input,out)
```

```
Downloading data from https://github.com/fchollet/deep-learning-models/releases/
download/v0.7/inception_resnet_v2_weights_tf_dim_ordering_tf_kernels_notop.h5
219062272/219055592 [==============================] - 6s 0us/step
```

[11]:
```
optimizer = Adam(lr=0.05) # high lr for burn-in period for the last layer to␣
↪get used to the weights.
# Reduce later after hitting pleateau using callback

model.compile(optimizer,loss='categorical_crossentropy',metrics=['acc'])
```

[12]:
```
# model.summary()
```

[13]:
```
es = EarlyStopping(monitor='val_loss',min_delta=0.
↪01,mode='min',patience=8,verbose=1,restore_best_weights=True)

rlp = ReduceLROnPlateau(monitor='val_loss', factor=0.3, patience=3, verbose=1,␣
↪min_delta=0.01,min_lr=0.0001,
                        mode='min',cooldown=1)

csv_logger = CSVLogger('training.log')

callbacks = [es,rlp,csv_logger]
```

0.3.1 Train, validation, test split

[14]:
```
split = int(len(df)*0.89)

train_df = df.iloc[:split,:]
test_df = df.iloc[split:,:]


gen=ImageDataGenerator(validation_split=0.
↪11,preprocessing_function=preprocess_input)

train = gen.flow_from_dataframe(train_df,TRAIN_PATH,x_col='Image␣
↪Name',y_col='Label',subset='training',
                                ␣
↪target_size=(W,H),batch_size=BATCH_SIZE,class_mode='categorical')

val = gen.flow_from_dataframe(train_df,TRAIN_PATH,x_col='Image␣
↪Name',y_col='Label',subset='validation',
                              ␣
↪target_size=(W,H),batch_size=BATCH_SIZE,class_mode='categorical')
```

```
Found 2377 validated image filenames belonging to 8 classes.
Found 293 validated image filenames belonging to 8 classes.
```

[15]:
```
history_inc = model.fit_generator(train,steps_per_epoch=train.n//
↪BATCH_SIZE,epochs=EPOCH,callbacks=callbacks,
```

```
                                validation_data=val,validation_steps=val.n//
↪BATCH_SIZE,)
```

```
Epoch 1/25
148/148 [==============================] - 40s 270ms/step - loss: 9.7092 - acc:
0.2431 - val_loss: 12.2095 - val_acc: 0.2674
Epoch 2/25
148/148 [==============================] - 20s 138ms/step - loss: 11.9067 - acc:
0.2804 - val_loss: 26.1637 - val_acc: 0.2671
Epoch 3/25
148/148 [==============================] - 20s 134ms/step - loss: 13.7634 - acc:
0.3041 - val_loss: 14.8661 - val_acc: 0.2852
Epoch 4/25
148/148 [==============================] - 20s 134ms/step - loss: 14.1691 - acc:
0.2804 - val_loss: 14.6019 - val_acc: 0.2635

Epoch 00004: ReduceLROnPlateau reducing learning rate to 0.015000000223517418.
Epoch 5/25
148/148 [==============================] - 20s 135ms/step - loss: 12.4813 - acc:
0.2965 - val_loss: 14.8585 - val_acc: 0.2744
Epoch 6/25
148/148 [==============================] - 20s 135ms/step - loss: 10.8070 - acc:
0.2965 - val_loss: 13.7962 - val_acc: 0.2888
Epoch 7/25
148/148 [==============================] - 20s 133ms/step - loss: 9.8388 - acc:
0.2910 - val_loss: 7.6870 - val_acc: 0.2599
Epoch 8/25
148/148 [==============================] - 20s 136ms/step - loss: 8.9748 - acc:
0.2982 - val_loss: 6.0691 - val_acc: 0.2852
Epoch 9/25
148/148 [==============================] - 20s 133ms/step - loss: 7.9542 - acc:
0.2956 - val_loss: 9.7964 - val_acc: 0.2996
Epoch 10/25
148/148 [==============================] - 20s 133ms/step - loss: 6.8730 - acc:
0.3181 - val_loss: 17.6800 - val_acc: 0.3249
Epoch 11/25
148/148 [==============================] - 20s 133ms/step - loss: 6.7832 - acc:
0.3083 - val_loss: 13.3771 - val_acc: 0.2310

Epoch 00011: ReduceLROnPlateau reducing learning rate to 0.004500000178813934.
Epoch 12/25
148/148 [==============================] - 20s 134ms/step - loss: 5.8598 - acc:
0.3198 - val_loss: 8.7522 - val_acc: 0.2852
Epoch 13/25
148/148 [==============================] - 20s 133ms/step - loss: 5.5249 - acc:
0.3184 - val_loss: 8.4466 - val_acc: 0.3069
Epoch 14/25
```

```
148/148 [==============================] - 20s 133ms/step - loss: 5.2206 - acc:
0.3148 - val_loss: 3.4700 - val_acc: 0.3646
Epoch 15/25
148/148 [==============================] - 20s 133ms/step - loss: 4.6837 - acc:
0.3266 - val_loss: 3.8571 - val_acc: 0.2924
Epoch 16/25
148/148 [==============================] - 20s 132ms/step - loss: 4.4704 - acc:
0.3270 - val_loss: 5.8046 - val_acc: 0.2491
Epoch 17/25
148/148 [==============================] - 20s 134ms/step - loss: 4.2765 - acc:
0.3198 - val_loss: 10.7175 - val_acc: 0.2708

Epoch 00017: ReduceLROnPlateau reducing learning rate to 0.0013500000815838576.
Epoch 18/25
148/148 [==============================] - 20s 134ms/step - loss: 3.8478 - acc:
0.3338 - val_loss: 5.0593 - val_acc: 0.3394
Epoch 19/25
148/148 [==============================] - 20s 132ms/step - loss: 3.7452 - acc:
0.3376 - val_loss: 2.1760 - val_acc: 0.3249
Epoch 20/25
148/148 [==============================] - 20s 134ms/step - loss: 3.8346 - acc:
0.3269 - val_loss: 7.0706 - val_acc: 0.3229
Epoch 21/25
148/148 [==============================] - 20s 133ms/step - loss: 3.5373 - acc:
0.3169 - val_loss: 5.8318 - val_acc: 0.3357
Epoch 22/25
148/148 [==============================] - 20s 133ms/step - loss: 3.5277 - acc:
0.3371 - val_loss: 6.4562 - val_acc: 0.3177

Epoch 00022: ReduceLROnPlateau reducing learning rate to 0.0004050000105053186.
Epoch 23/25
148/148 [==============================] - 20s 134ms/step - loss: 3.2722 - acc:
0.3520 - val_loss: 8.1386 - val_acc: 0.2960
Epoch 24/25
148/148 [==============================] - 20s 133ms/step - loss: 3.3148 - acc:
0.3418 - val_loss: 5.2576 - val_acc: 0.3430
Epoch 25/25
148/148 [==============================] - 20s 132ms/step - loss: 3.4831 - acc:
0.3236 - val_loss: 5.1623 - val_acc: 0.3321

Epoch 00025: ReduceLROnPlateau reducing learning rate to 0.00012149999965913593.
```

0.4 Predictions

[16]:
```
def open_preprocess_image(filepath,W=W,H=H):
    image = imread(filepath)
    image = resize(image,(W,H,3))
    image = preprocess_input(image)

    return image


def get_image_batch(test_df):
    images = []
    for i in range(len(test_df)):
        filepath = TRAIN_PATH+test_df.iloc[i,0]
        image = open_preprocess_image(filepath)
        images.append(image)

    return np.array(images)


def get_predictions(images):
    pred_scores = []
    lis = range(y.shape[1])

    class_probs = model.predict(images)
    for prob in class_probs:
        score = sum([prob[i]*i for i in lis])
        pred_scores.append(score)

    return pred_scores
```

[17]:
```
images = get_image_batch(test_df)
pred_scores = get_predictions(images)
test_df['Pred Score'] = pred_scores
print(f'Model has MAE of: {mean_absolute_error(test_df["Score"],pred_scores)}')
```

```
Model has MAE of: 1.0068192102305358
```

```
/opt/conda/lib/python3.7/site-packages/ipykernel_launcher.py:3:
SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  This is separate from the ipykernel package so we can avoid doing imports
until
```

[18]:
```
f,ax = plt.subplots(3,3,figsize=(15,9))
ax = ax.ravel()
sample_df = test_df.sample(9)

for i,index in enumerate(sample_df.index):
    ax[i].imshow(plt.imread(TRAIN_PATH+sample_df.loc[index,'Image Name']))
    ax[i].set_title(f'Actual: {round(sample_df.loc[index,"Score"],2)} ␣
 ↪Predicted: {round(sample_df.loc[index,"Pred Score"],2)}')
    ax[i].axis('off')

plt.savefig('Actual vs Predicted Scores.png')
```

[ ]: