CNN-FCT-20E-15L-shift-test-02

March 24, 2021

1 Are Relations Relevant in CNNs? *A Study Based on a Facial Dataset*

1.1 Testing CNN with Features Closer Together *(20 Epochs - 15 Layers)*

1.1.1 Imports, Seed, GPU integration

[1]:
```
import numpy as np
import random
import tensorflow as tf
```

[2]:
```
# Seeds for better reproducibility
seed = 42
np.random.seed(seed)
random.seed(seed)
tf.random.set_seed(seed)
```

[3]:
```
from tensorflow.keras.models import load_model
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from sklearn.metrics import confusion_matrix
import itertools
import matplotlib.pyplot as plt
import warnings
warnings.simplefilter(action='ignore', category=FutureWarning)
%matplotlib inline
```

[4]:
```
physical_devices = tf.config.experimental.list_physical_devices('GPU')
print("Num GPUs Available: ", len(physical_devices))
tf.config.experimental.set_memory_growth(physical_devices[0], True)
```

```
Num GPUs Available:  1
```

1.1.2 Data preparation

[5]:
```
test_path = '../../../picasso_dataset/FCT-data/shifted/test'
```

[6]:
```
test_batches = ImageDataGenerator(preprocessing_function=tf.keras.applications.
 ↪vgg16.preprocess_input) \
```

```
    .flow_from_directory(directory=test_path, target_size=(224,224),␣
↪classes=['no_face', 'face'], batch_size=10, shuffle=False)
```

```
Found 3000 images belonging to 2 classes.
```

[7]:
```
assert test_batches.n == 3000
assert test_batches.num_classes == 2
```

1.1.3 Loading the trained CNN

[8]:
```
filename='../models/CNN-FCT-20E-15L-02.h5'
loaded_model = load_model(filename)
```

1.1.4 Accuracy and loss of the trained model

[9]:
```
scores = loaded_model.evaluate(test_batches, verbose=2)
print("Accuracy: %.2f%%" % (scores[1]*100))
print("Loss: %.2f%%" % (scores[0]*100))
```

```
300/300 - 7s - loss: 0.2156 - accuracy: 0.9153
Accuracy: 91.53%
Loss: 21.56%
```

1.1.5 Testing the CNN

[10]:
```
predictions = loaded_model.predict(x=test_batches, steps=len(test_batches),␣
↪verbose=0)
```

1.1.6 Index of wrongly predicted pictures

[11]:
```
y_true=test_batches.classes
y_pred=np.argmax(predictions, axis=-1)
cm = confusion_matrix(y_true = y_true, y_pred = y_pred)
```

[12]:
```
face_but_predicted_no_face=[]
no_face_but_predicted_face=[]

for i in range(len(predictions)):
        if y_true[i] != y_pred[i]:
            if y_true[i] == 1:
                face_but_predicted_no_face.append(i+8001-1500) #Index of file␣
↪on disk
            else:
                no_face_but_predicted_face.append(i+8001) #Index of file on disk
```

```
print("Data from class 'face', that was wrongly predicted as 'no-face' [",␣
 ↪len(face_but_predicted_no_face), "] :")
print(face_but_predicted_no_face)
print("-------------------------------------------------------------------------------
print("Data from class 'no-face', that was wrongly predicted as 'face' [",␣
 ↪len(no_face_but_predicted_face), "] :")
print(no_face_but_predicted_face)
```

```
Data from class 'face', that was wrongly predicted as 'no-face' [ 221 ] :
[8005, 8010, 8012, 8020, 8023, 8034, 8035, 8039, 8054, 8056, 8095, 8108, 8113,
8120, 8133, 8136, 8137, 8146, 8153, 8160, 8179, 8194, 8197, 8200, 8207, 8217,
8225, 8238, 8246, 8266, 8291, 8293, 8295, 8302, 8304, 8309, 8318, 8324, 8326,
8331, 8343, 8354, 8362, 8366, 8370, 8375, 8382, 8402, 8406, 8409, 8411, 8434,
8435, 8440, 8449, 8476, 8478, 8487, 8490, 8494, 8496, 9002, 9005, 9008, 9009,
9014, 9016, 9019, 9020, 9023, 9024, 9025, 9029, 9032, 9033, 9034, 9035, 9038,
9045, 9049, 9053, 9058, 9066, 9072, 9075, 9078, 9080, 9085, 9088, 9095, 9098,
9100, 9101, 9102, 9104, 9106, 9108, 9113, 9114, 9115, 9116, 9118, 9119, 9120,
9121, 9130, 9135, 9136, 9142, 9145, 9151, 9155, 9158, 9168, 9170, 9173, 9174,
9176, 9181, 9183, 9184, 9194, 9200, 9202, 9208, 9210, 9211, 9218, 9220, 9223,
9232, 9236, 9239, 9243, 9248, 9250, 9251, 9253, 9259, 9261, 9263, 9264, 9265,
9266, 9269, 9270, 9272, 9273, 9275, 9277, 9279, 9280, 9281, 9282, 9283, 9284,
9295, 9299, 9300, 9302, 9304, 9307, 9311, 9314, 9320, 9321, 9322, 9324, 9326,
9333, 9338, 9342, 9346, 9357, 9364, 9366, 9368, 9369, 9376, 9377, 9378, 9379,
9383, 9384, 9385, 9386, 9387, 9388, 9392, 9397, 9399, 9402, 9403, 9404, 9426,
9429, 9430, 9432, 9435, 9442, 9444, 9445, 9447, 9449, 9450, 9453, 9454, 9459,
9460, 9463, 9464, 9472, 9473, 9474, 9476, 9478, 9482, 9484, 9490, 9498, 9499]
-------------------------------------------------------------------------------
--------------
Data from class 'no-face', that was wrongly predicted as 'face' [ 33 ] :
[8018, 8021, 8023, 8077, 8084, 8102, 8126, 8130, 8154, 8164, 8202, 8297, 8301,
8325, 8328, 8354, 8380, 8452, 8454, 8479, 8487, 9046, 9133, 9139, 9190, 9239,
9262, 9268, 9280, 9290, 9304, 9436, 9447]
```

1.1.7 Confusion matrix

[13]:
```
def plot_confusion_matrix(cm, classes,
                          normalize=False,
                          title='Confusion matrix',
                          cmap=plt.cm.Blues):

    plt.imshow(cm, interpolation='nearest', cmap=cmap)
    plt.title(title)
    plt.colorbar()
    tick_marks = np.arange(len(classes))
    plt.xticks(tick_marks, classes, rotation=45)
    plt.yticks(tick_marks, classes)
```

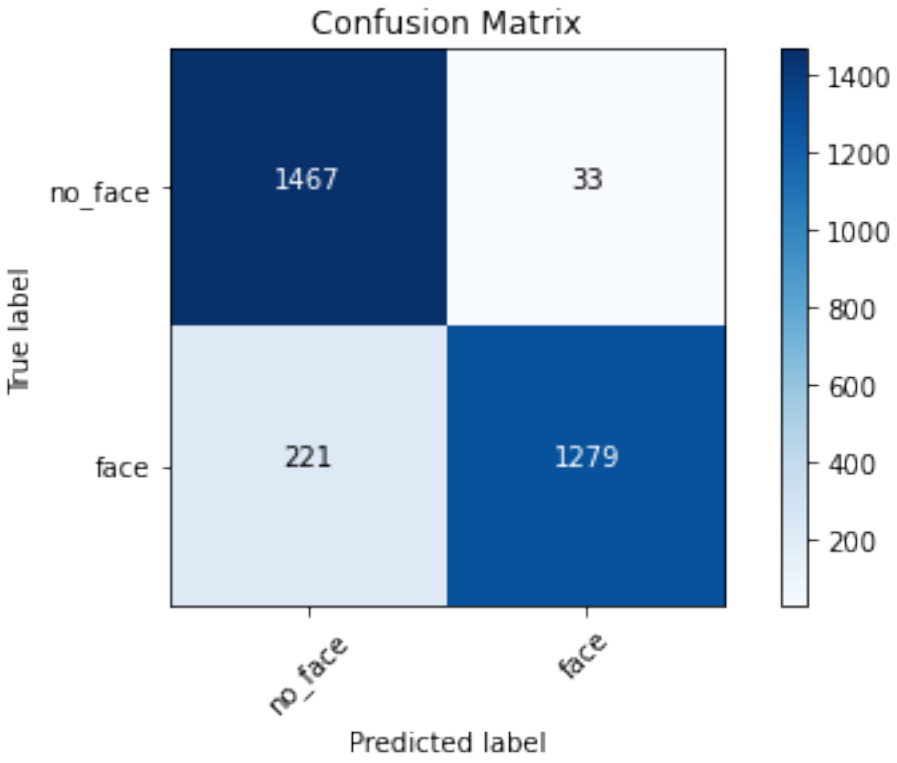
```
    if normalize:
        cm = cm.astype('float') / cm.sum(axis=1)[:, np.newaxis]
        print("Normalized confusion matrix")
    else:
        print('Confusion matrix, without normalization')

    print(cm)

    thresh = cm.max() / 2.
    for i, j in itertools.product(range(cm.shape[0]), range(cm.shape[1])):
        plt.text(j, i, cm[i, j],
                 horizontalalignment="center",
                 color="white" if cm[i, j] > thresh else "black")

    plt.tight_layout()
    plt.ylabel('True label')
    plt.xlabel('Predicted label')
```

[14]:
```
test_batches.class_indices
```

[14]:
```
{'no_face': 0, 'face': 1}
```

[15]:
```
cm_plot_labels = ['no_face','face']
plot_confusion_matrix(cm=cm, classes=cm_plot_labels, title='Confusion Matrix')
```

```
Confusion matrix, without normalization
[[1467   33]
 [ 221 1279]]
```


Confusion Matrix
1467
33
221
1279
no_face
face
True label
no_face
face
Predicted label
1400
1200
1000
800
600
400
200