CNN-FFA-30E-13L-shift-test-01

March 24, 2021

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

1.1 Testing CNN with Features Further Apart *(30 Epochs - 13 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/FFA-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-FFA-30E-13L-01.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: 2.0648 - accuracy: 0.6683
Accuracy: 66.83%
Loss: 206.48%
```

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' [ 847 ] :
[8001, 8002, 8003, 8004, 8005, 8006, 8007, 8009, 8011, 8012, 8014, 8016, 8017,
8019, 8020, 8021, 8022, 8023, 8024, 8025, 8027, 8028, 8030, 8031, 8032, 8033,
8035, 8036, 8037, 8038, 8039, 8040, 8041, 8043, 8044, 8045, 8046, 8047, 8048,
8049, 8050, 8052, 8053, 8054, 8055, 8056, 8057, 8058, 8060, 8061, 8062, 8063,
8064, 8065, 8066, 8067, 8068, 8069, 8070, 8071, 8072, 8073, 8074, 8075, 8076,
8077, 8079, 8081, 8083, 8084, 8086, 8087, 8088, 8089, 8090, 8091, 8092, 8093,
8094, 8096, 8097, 8099, 8100, 8101, 8102, 8103, 8104, 8105, 8106, 8109, 8110,
8111, 8112, 8113, 8114, 8115, 8116, 8117, 8118, 8119, 8120, 8121, 8122, 8123,
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8312, 8313, 8314, 8317, 8318, 8319, 8320, 8321, 8322, 8323, 8324, 8325, 8326,
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9073, 9074, 9075, 9076, 9077, 9078, 9081, 9083, 9085, 9086, 9087, 9088, 9089,
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```

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9339, 9340, 9341, 9342, 9343, 9344, 9345, 9346, 9347, 9348, 9349, 9350, 9351,
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9386, 9387, 9388, 9389, 9390, 9391, 9392, 9393, 9395, 9396, 9397, 9399, 9400,
9401, 9403, 9405, 9406, 9407, 9408, 9410, 9411, 9412, 9413, 9414, 9415, 9416,
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9473, 9474, 9475, 9476, 9477, 9478, 9479, 9480, 9481, 9482, 9483, 9484, 9485,
9486, 9487, 9488, 9489, 9490, 9491, 9492, 9493, 9494, 9495, 9496, 9497, 9498,
9499, 9500]

Data from class 'no-face', that was wrongly predicted as 'face' [148] :
[8001, 8026, 8048, 8077, 8090, 8105, 8176, 8182, 8193, 8216, 8305, 8338, 8370,
8418, 8445, 8446, 8452, 8473, 8475, 8490, 9001, 9002, 9012, 9016, 9017, 9018,
9019, 9020, 9023, 9030, 9031, 9041, 9042, 9044, 9048, 9049, 9051, 9055, 9059,
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9397, 9410, 9411, 9413, 9415, 9421, 9426, 9428, 9429, 9433, 9438, 9439, 9446,
9448, 9450, 9455, 9456, 9457, 9458, 9461, 9462, 9463, 9476, 9484, 9487, 9488,
9489, 9491, 9493, 9497, 9500]

1.1.7 Confusion matrix

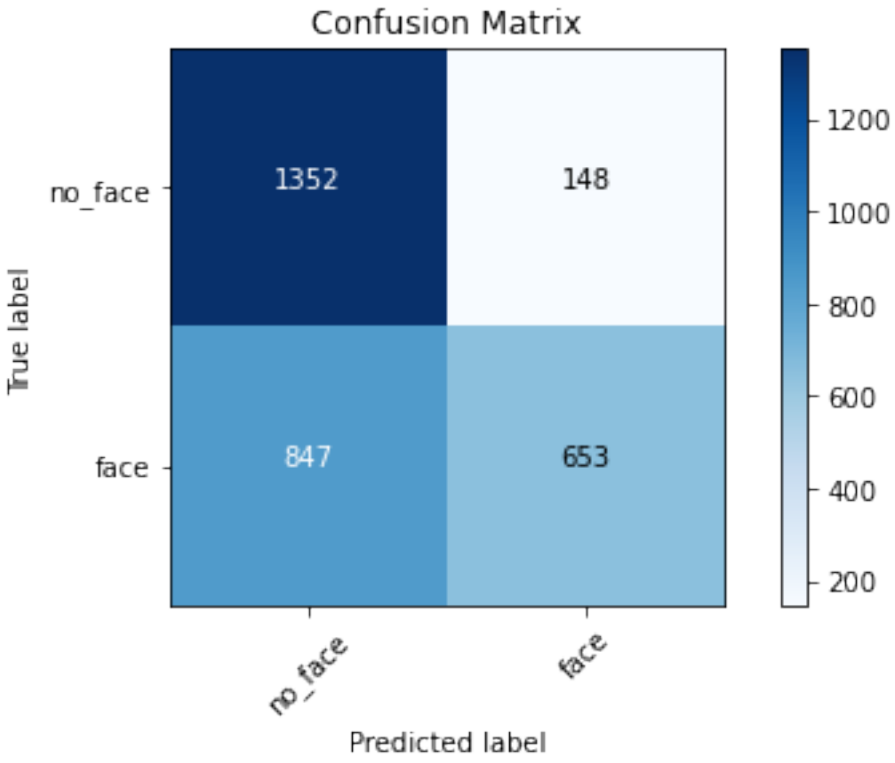
[13]:
```
def plot_confusion_matrix(cm, classes,
                          normalize=False,
                          title='Confusion matrix',
                          cmap=plt.cm.Blues):

    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
[[1352  148]
 [ 847  653]]
```


Confusion Matrix
1352
148
847
653
no_face
face
True label
no_face
face
Predicted label
1200
1000
800
600
400
200