CNN-FFA-20E-15L-basis-test-03

March 24, 2021

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

1.1 Testing CNN with Features Further Apart *(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/basis-data/middle/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-20E-15L-03.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: 0.8075 - accuracy: 0.9057
Accuracy: 90.57%
Loss: 80.75%
```

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' [ 283 ] :
[8006, 8010, 8011, 8016, 8022, 8041, 8043, 8045, 8051, 8053, 8057, 8061, 8064,
8075, 8079, 8085, 8086, 8088, 8091, 8093, 8094, 8095, 8101, 8107, 8114, 8128,
8131, 8139, 8143, 8161, 8165, 8167, 8170, 8171, 8176, 8178, 8182, 8184, 8186,
8188, 8191, 8193, 8196, 8197, 8200, 8201, 8202, 8209, 8216, 8218, 8220, 8222,
8223, 8224, 8225, 8226, 8232, 8233, 8238, 8247, 8255, 8256, 8281, 8287, 8295,
8304, 8313, 8317, 8320, 8321, 8324, 8325, 8347, 8349, 8357, 8358, 8369, 8371,
8375, 8376, 8388, 8405, 8419, 8426, 8438, 8443, 8446, 8448, 8451, 8452, 8458,
8459, 8461, 8464, 8467, 8475, 8487, 8493, 8498, 8501, 8508, 8510, 8515, 8518,
8527, 8537, 8550, 8557, 8558, 8559, 8566, 8568, 8569, 8575, 8585, 8586, 8588,
8596, 8599, 8604, 8630, 8648, 8650, 8651, 8655, 8668, 8670, 8684, 8689, 8696,
8698, 8699, 8706, 8709, 8715, 8717, 8723, 8725, 8732, 8736, 8737, 8743, 8757,
8760, 8769, 8784, 8787, 8798, 8801, 8805, 8808, 8810, 8811, 8816, 8817, 8823,
8824, 8835, 8836, 8838, 8844, 8846, 8859, 8864, 8868, 8872, 8878, 8880, 8896,
8905, 8908, 8922, 8925, 8929, 8940, 8942, 8943, 8945, 8948, 8957, 8960, 8963,
8971, 8975, 8982, 8987, 8991, 8992, 8998, 8999, 9001, 9002, 9005, 9008, 9016,
9017, 9028, 9032, 9034, 9035, 9059, 9062, 9070, 9080, 9090, 9098, 9101, 9103,
9110, 9117, 9127, 9138, 9168, 9171, 9177, 9178, 9186, 9190, 9194, 9208, 9209,
9215, 9220, 9231, 9247, 9253, 9254, 9258, 9264, 9267, 9274, 9284, 9285, 9308,
9310, 9311, 9313, 9315, 9317, 9324, 9325, 9327, 9331, 9332, 9333, 9334, 9336,
9337, 9340, 9341, 9342, 9343, 9346, 9357, 9358, 9366, 9370, 9371, 9375, 9381,
9384, 9390, 9394, 9395, 9401, 9413, 9424, 9425, 9446, 9447, 9449, 9454, 9455,
9457, 9459, 9461, 9469, 9472, 9476, 9479, 9481, 9484, 9494]
---------------------------------------------------------------------------------
--------------
Data from class 'no-face', that was wrongly predicted as 'face' [ 0 ] :
[]
```

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))
```

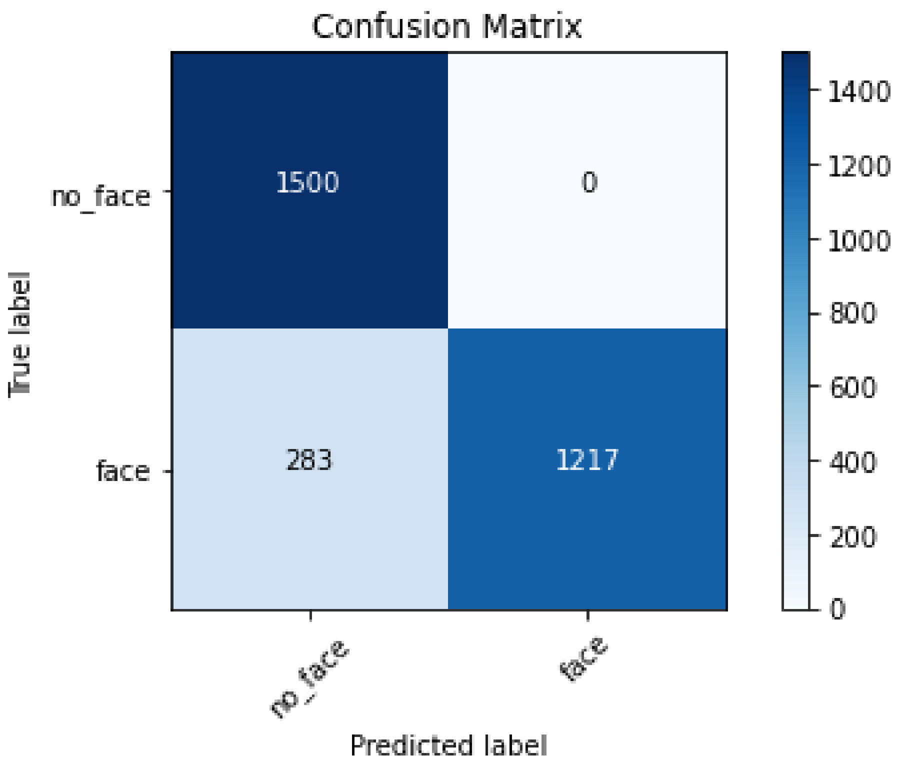
```
    plt.xticks(tick_marks, classes, rotation=45)
    plt.yticks(tick_marks, classes)

    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
[[1500    0]
 [ 283 1217]]
```


Confusion Matrix
True label
no_face
face
Predicted label
no_face
face
1500
0
283
1217
1400
1200
1000
800
600
400
200
0