

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

March 26, 2021

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

1.1 Testing Baseline CNN (*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/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-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: 0.7658 - accuracy: 0.7767  
Accuracy: 77.67%  
Loss: 76.58%
```

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' [663] :

[8001, 8002, 8003, 8005, 8006, 8007, 8009, 8011, 8013, 8014, 8020, 8021, 8022, 8025, 8027, 8028, 8030, 8031, 8032, 8037, 8038, 8040, 8043, 8045, 8050, 8051, 8053, 8055, 8056, 8057, 8058, 8062, 8065, 8066, 8067, 8069, 8073, 8074, 8075, 8076, 8077, 8079, 8083, 8087, 8088, 8089, 8090, 8091, 8092, 8093, 8094, 8096, 8097, 8099, 8101, 8102, 8103, 8104, 8105, 8106, 8109, 8111, 8112, 8116, 8117, 8120, 8121, 8122, 8123, 8124, 8125, 8127, 8129, 8131, 8133, 8135, 8136, 8137, 8138, 8143, 8146, 8149, 8151, 8152, 8156, 8157, 8158, 8160, 8161, 8162, 8163, 8166, 8168, 8170, 8171, 8172, 8173, 8175, 8178, 8179, 8180, 8182, 8184, 8186, 8190, 8194, 8197, 8198, 8199, 8202, 8207, 8209, 8210, 8212, 8214, 8217, 8219, 8221, 8224, 8227, 8230, 8231, 8234, 8237, 8239, 8241, 8242, 8243, 8244, 8245, 8248, 8251, 8252, 8254, 8257, 8258, 8261, 8262, 8266, 8269, 8270, 8271, 8275, 8276, 8278, 8285, 8286, 8287, 8288, 8289, 8290, 8293, 8294, 8295, 8296, 8297, 8299, 8301, 8302, 8303, 8304, 8305, 8306, 8307, 8308, 8309, 8310, 8314, 8322, 8327, 8329, 8334, 8337, 8338, 8341, 8345, 8348, 8349, 8353, 8354, 8355, 8357, 8359, 8363, 8365, 8369, 8370, 8371, 8372, 8374, 8375, 8380, 8382, 8383, 8384, 8385, 8388, 8390, 8391, 8392, 8395, 8400, 8401, 8403, 8406, 8407, 8408, 8409, 8410, 8415, 8416, 8417, 8421, 8422, 8424, 8425, 8427, 8430, 8433, 8436, 8437, 8438, 8439, 8445, 8446, 8448, 8455, 8458, 8459, 8461, 8462, 8463, 8465, 8466, 8467, 8469, 8476, 8477, 8479, 8481, 8482, 8483, 8484, 8487, 8488, 8491, 8494, 8495, 8499, 9001, 9003, 9004, 9005, 9006, 9007, 9008, 9009, 9010, 9011, 9012, 9014, 9015, 9017, 9018, 9019, 9020, 9021, 9022, 9023, 9024, 9025, 9026, 9027, 9028, 9030, 9031, 9032, 9033, 9034, 9035, 9037, 9038, 9039, 9040, 9041, 9043, 9045, 9046, 9050, 9051, 9052, 9053, 9054, 9055, 9056, 9058, 9059, 9060, 9061, 9062, 9063, 9064, 9065, 9067, 9068, 9069, 9070, 9071, 9073, 9074, 9075, 9076, 9077, 9078, 9079, 9081, 9082, 9083, 9085, 9086, 9087, 9088, 9090, 9091, 9092, 9093, 9094, 9095, 9096, 9097, 9098, 9099, 9100, 9101, 9102, 9103, 9104, 9105, 9106, 9107, 9108, 9109, 9110, 9111, 9112, 9113, 9114, 9115, 9116, 9117, 9118, 9119, 9120, 9121, 9122, 9124, 9125, 9126, 9127, 9128, 9129, 9130, 9131, 9133, 9134, 9136, 9138, 9140, 9141, 9143, 9145, 9146, 9147, 9148, 9149, 9150, 9151, 9153, 9154, 9155, 9157, 9159, 9161, 9163, 9164, 9165, 9166, 9167, 9168, 9170, 9171, 9172, 9173, 9174, 9175, 9177, 9178, 9179, 9180, 9181, 9182, 9183, 9185, 9186, 9187, 9188, 9189, 9190, 9191, 9192, 9193, 9194, 9195, 9196, 9198, 9199, 9200, 9201, 9202, 9203, 9204, 9205, 9207, 9209, 9211, 9214, 9215, 9216, 9217, 9218, 9220, 9221, 9222, 9223, 9226, 9227, 9228, 9229, 9230, 9231, 9232, 9233, 9234, 9236, 9237, 9238, 9239, 9240, 9241, 9243, 9246, 9247, 9248, 9249, 9250, 9251, 9252, 9254, 9255, 9256, 9257, 9258, 9259, 9260, 9262, 9263, 9264, 9265, 9266, 9267, 9268, 9269, 9270, 9271, 9272, 9273, 9275, 9277, 9278, 9279, 9280, 9282, 9283, 9284, 9286, 9287, 9288, 9289, 9290, 9292, 9293, 9294, 9295, 9297,

```

9298, 9300, 9301, 9303, 9304, 9305, 9306, 9307, 9308, 9309, 9310, 9311, 9312,
9313, 9314, 9315, 9316, 9317, 9318, 9319, 9320, 9322, 9324, 9325, 9326, 9327,
9329, 9331, 9332, 9333, 9334, 9335, 9337, 9338, 9339, 9340, 9341, 9344, 9346,
9347, 9349, 9350, 9351, 9352, 9353, 9354, 9356, 9358, 9359, 9360, 9362, 9363,
9364, 9365, 9366, 9367, 9368, 9370, 9371, 9373, 9374, 9375, 9376, 9377, 9378,
9379, 9381, 9382, 9385, 9386, 9387, 9388, 9389, 9390, 9391, 9392, 9395, 9397,
9399, 9400, 9401, 9402, 9403, 9404, 9405, 9406, 9407, 9408, 9410, 9411, 9412,
9413, 9414, 9415, 9417, 9418, 9419, 9420, 9421, 9422, 9423, 9424, 9425, 9426,
9427, 9429, 9430, 9431, 9432, 9433, 9434, 9435, 9436, 9437, 9438, 9439, 9440,
9441, 9442, 9443, 9444, 9446, 9447, 9448, 9449, 9450, 9451, 9454, 9456, 9457,
9458, 9459, 9460, 9461, 9462, 9463, 9464, 9466, 9467, 9468, 9469, 9470, 9471,
9472, 9473, 9474, 9475, 9476, 9477, 9478, 9480, 9481, 9482, 9483, 9484, 9485,
9486, 9487, 9488, 9489, 9490, 9491, 9492, 9493, 9494, 9496, 9497, 9499, 9500]
-----
-----

```

Data from class 'no-face', that was wrongly predicted as 'face' [7] :
[8077, 8139, 8217, 8338, 8418, 8473, 8475]

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

```
[[1493    7]
 [ 663   837]]
```

