

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

March 24, 2021

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

1.1 Testing Baseline CNN (*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/basis-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-B-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: 2.3982 - accuracy: 0.6867

Accuracy: 68.67%

Loss: 239.82%

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' [ 810 ] :
[8001, 8003, 8004, 8005, 8006, 8007, 8008, 8009, 8010, 8011, 8012, 8013, 8014,
8015, 8016, 8018, 8022, 8024, 8025, 8027, 8028, 8029, 8030, 8031, 8032, 8033,
8034, 8035, 8036, 8038, 8040, 8042, 8043, 8045, 8046, 8047, 8048, 8049, 8051,
8052, 8053, 8055, 8056, 8057, 8058, 8060, 8061, 8062, 8063, 8064, 8065, 8066,
8067, 8069, 8070, 8072, 8073, 8074, 8076, 8078, 8079, 8080, 8081, 8082, 8083,
8084, 8086, 8087, 8090, 8092, 8094, 8096, 8097, 8098, 8099, 8100, 8102, 8103,
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9105, 9106, 9109, 9110, 9111, 9112, 9115, 9116, 9117, 9119, 9120, 9121, 9122, 9123, 9124, 9125, 9126, 9127, 9128, 9129, 9130, 9132, 9133, 9134, 9135, 9136, 9137, 9139, 9140, 9142, 9144, 9145, 9146, 9148, 9149, 9150, 9151, 9152, 9154, 9156, 9157, 9158, 9159, 9160, 9161, 9162, 9164, 9165, 9166, 9167, 9168, 9169, 9171, 9172, 9173, 9174, 9177, 9179, 9180, 9181, 9182, 9183, 9184, 9185, 9186, 9188, 9189, 9190, 9191, 9192, 9193, 9194, 9196, 9198, 9199, 9201, 9202, 9203, 9205, 9206, 9207, 9208, 9209, 9210, 9212, 9214, 9215, 9216, 9217, 9219, 9220, 9221, 9222, 9223, 9224, 9225, 9226, 9227, 9228, 9229, 9230, 9233, 9234, 9235, 9237, 9238, 9239, 9240, 9241, 9243, 9244, 9245, 9246, 9247, 9248, 9249, 9251, 9252, 9253, 9254, 9255, 9256, 9257, 9258, 9259, 9260, 9261, 9262, 9263, 9265, 9266, 9267, 9269, 9272, 9273, 9277, 9278, 9279, 9280, 9281, 9282, 9283, 9284, 9285, 9286, 9288, 9289, 9290, 9291, 9292, 9293, 9294, 9295, 9297, 9298, 9299, 9301, 9302, 9303, 9305, 9306, 9308, 9309, 9310, 9311, 9312, 9313, 9314, 9316, 9318, 9321, 9323, 9324, 9325, 9326, 9327, 9328, 9329, 9330, 9332, 9333, 9335, 9337, 9338, 9339, 9340, 9341, 9342, 9343, 9344, 9345, 9350, 9351, 9352, 9353, 9354, 9356, 9357, 9359, 9360, 9361, 9362, 9363, 9364, 9365, 9366, 9367, 9368, 9369, 9370, 9371, 9372, 9373, 9375, 9376, 9377, 9379, 9380, 9381, 9382, 9384, 9385, 9386, 9388, 9389, 9390, 9392, 9394, 9395, 9396, 9397, 9398, 9400, 9403, 9404, 9405, 9407, 9409, 9410, 9412, 9413, 9414, 9415, 9416, 9417, 9420, 9421, 9422, 9423, 9425, 9426, 9427, 9429, 9430, 9431, 9432, 9433, 9434, 9435, 9436, 9437, 9438, 9439, 9440, 9441, 9442, 9443, 9444, 9445, 9447, 9449, 9451, 9452, 9453, 9454, 9455, 9456, 9458, 9459, 9460, 9461, 9462, 9463, 9464, 9465, 9466, 9467, 9468, 9469, 9470, 9471, 9472, 9473, 9474, 9476, 9477, 9478, 9479, 9480, 9481, 9482, 9483, 9485, 9486, 9487, 9489, 9490, 9491, 9492, 9493, 9494, 9496, 9497, 9498, 9499, 9500]

Data from class 'no-face', that was wrongly predicted as 'face' [130] :
[8007, 8124, 8125, 8148, 8157, 8177, 8180, 8193, 8215, 8217, 8283, 8288, 8292, 8294, 8312, 8346, 8387, 8401, 8413, 8444, 8445, 8487, 8498, 9001, 9002, 9007, 9009, 9010, 9012, 9015, 9016, 9024, 9026, 9030, 9031, 9034, 9039, 9047, 9049, 9058, 9061, 9064, 9067, 9079, 9083, 9088, 9104, 9106, 9121, 9124, 9126, 9140, 9144, 9146, 9149, 9150, 9151, 9152, 9153, 9167, 9172, 9173, 9180, 9183, 9185, 9193, 9202, 9216, 9219, 9220, 9223, 9224, 9225, 9249, 9250, 9256, 9266, 9267, 9269, 9270, 9271, 9272, 9276, 9287, 9295, 9299, 9303, 9308, 9314, 9318, 9319, 9321, 9322, 9329, 9331, 9345, 9348, 9350, 9355, 9357, 9363, 9369, 9370, 9372, 9383, 9384, 9385, 9393, 9395, 9401, 9402, 9411, 9421, 9423, 9425, 9431, 9442, 9444, 9445, 9453, 9455, 9461, 9480, 9481, 9483, 9491, 9492, 9494, 9495, 9497]

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
[[1370  130]
 [ 810 690]]

```

