CNN-Baseline-30E-13L-shift-test-02

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-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: 2.9729 - accuracy: 0.6743
Accuracy: 67.43%
Loss: 297.29%
```

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' [ 891 ] :
[8001, 8003, 8004, 8005, 8006, 8007, 8008, 8009, 8010, 8011, 8012, 8013, 8014,
8015, 8016, 8018, 8022, 8023, 8024, 8025, 8026, 8027, 8028, 8029, 8030, 8031,
8032, 8033, 8034, 8035, 8036, 8038, 8040, 8042, 8043, 8045, 8046, 8047, 8048,
8049, 8051, 8052, 8053, 8054, 8055, 8056, 8057, 8058, 8059, 8060, 8061, 8062,
8063, 8064, 8065, 8066, 8067, 8068, 8069, 8070, 8071, 8072, 8073, 8074, 8076,
8078, 8079, 8080, 8081, 8082, 8083, 8084, 8086, 8087, 8088, 8089, 8091, 8092,
8093, 8094, 8096, 8097, 8098, 8099, 8100, 8101, 8102, 8103, 8104, 8105, 8106,
8107, 8108, 8109, 8110, 8111, 8112, 8113, 8114, 8115, 8117, 8118, 8119, 8121,
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9048, 9049, 9050, 9051, 9052, 9053, 9054, 9055, 9056, 9057, 9058, 9059, 9060,
```

```
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9194, 9196, 9197, 9198, 9199, 9200, 9201, 9202, 9203, 9204, 9205, 9206, 9207,
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9263, 9264, 9265, 9266, 9267, 9269, 9270, 9271, 9272, 9273, 9274, 9276, 9277,
9278, 9279, 9280, 9281, 9282, 9283, 9284, 9285, 9286, 9288, 9289, 9290, 9291,
9292, 9293, 9294, 9295, 9297, 9298, 9299, 9301, 9302, 9303, 9304, 9305, 9306,
9308, 9309, 9310, 9311, 9312, 9313, 9314, 9315, 9316, 9317, 9318, 9319, 9320,
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9364, 9365, 9366, 9367, 9368, 9369, 9370, 9371, 9372, 9373, 9375, 9376, 9377,
9379, 9380, 9381, 9382, 9384, 9385, 9386, 9387, 9388, 9389, 9390, 9391, 9392,
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9412, 9413, 9414, 9415, 9416, 9417, 9419, 9420, 9421, 9422, 9423, 9424, 9425,
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9480, 9481, 9482, 9483, 9484, 9485, 9486, 9487, 9489, 9490, 9491, 9492, 9493,
9494, 9495, 9496, 9497, 9498, 9499, 9500]
--------------------------------------------------------------------------------
--------------
Data from class 'no-face', that was wrongly predicted as 'face' [ 86 ] :
[8007, 8124, 8177, 8180, 8193, 8215, 8217, 8288, 8292, 8294, 8312, 8346, 8387,
8395, 8401, 8413, 8430, 8436, 8440, 8444, 8487, 9001, 9009, 9015, 9016, 9024,
9031, 9034, 9039, 9047, 9049, 9064, 9067, 9079, 9083, 9106, 9121, 9126, 9140,
9146, 9150, 9152, 9173, 9180, 9185, 9219, 9223, 9224, 9249, 9250, 9266, 9267,
9269, 9271, 9276, 9287, 9295, 9303, 9308, 9314, 9318, 9319, 9321, 9322, 9329,
9345, 9348, 9355, 9357, 9369, 9370, 9372, 9401, 9402, 9411, 9423, 9425, 9442,
9444, 9445, 9453, 9455, 9480, 9481, 9492, 9495]
```

1.1.7 Confusion matrix

[13]:
```
def plot_confusion_matrix(cm, classes,
                          normalize=False,
                          title='Confusion matrix',
```

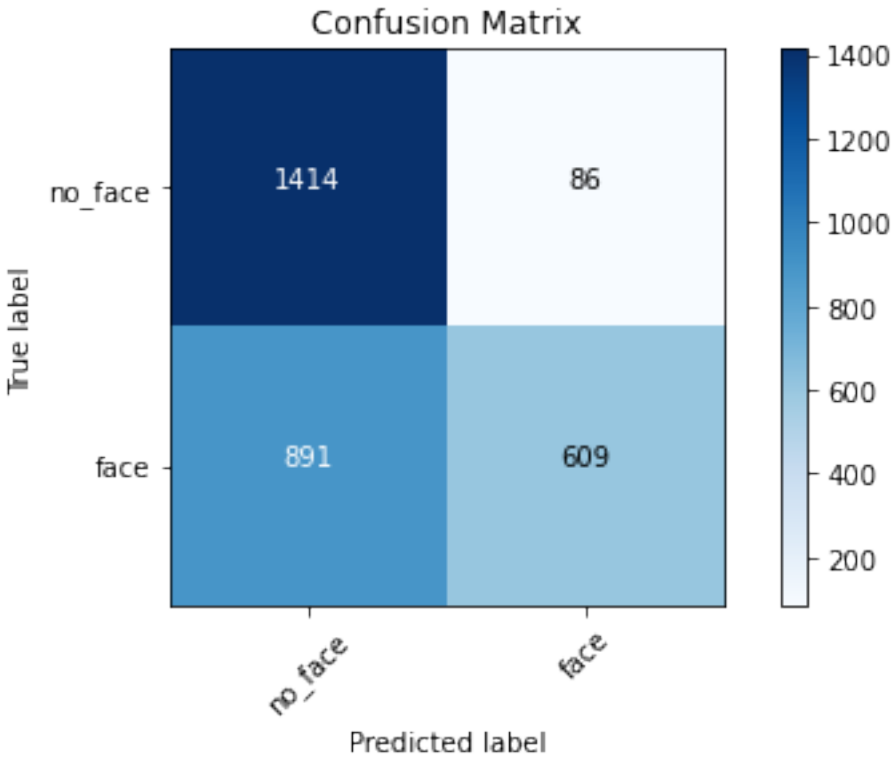
```
                          cmap=plt.cm.Blues):

    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
[[1414   86]
 [ 891  609]]
```


Confusion Matrix
1414
86
891
609
no_face
face
True label
no_face
face
Predicted label
1400
1200
1000
800
600
400
200