CNN_shallow

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```
In [1]: import numpy as np
        from keras.models import Sequential
        from keras.layers import Dense , Activation , Dropout ,Flatten
        from keras.layers.convolutional import Conv2D
        from keras.layers.convolutional import MaxPooling2D
        from keras.metrics import categorical_accuracy
        from keras.models import save_model, load_model
        from keras.optimizers import *
        from keras.layers.normalization import BatchNormalization
        from keras.preprocessing.image import ImageDataGenerator
        from sklearn.model_selection import train_test_split

        # get the data from kaggle compitition
        filename = 'fer2013.csv'
        # 7 labels in our data in the form of 0,1,2,3,4,5,6,7
        label_map = ['Anger', 'Disgust', 'Fear', 'Happy', 'Sad', 'Surprise', 'Neutral']
```

```
/home/hfahad/anaconda3/lib/python3.6/site-packages/h5py/__init__.py:36: FutureWarning: Conversio
  from ._conv import register_converters as _register_converters
Using TensorFlow backend.
```

```
In [2]: def getData(filename):
            # image sizes are 48x48
            Y = []
            X = []
            first = True
            for line in open(filename):
                if first:
                    first = False
                else:
                    row = line.split(',')
                    Y.append(int(row[0]))
                    X.append([int(p) for p in row[1].split()])

            X, Y = np.array(X) / 255.0, np.array(Y)
            return X, Y
```

```
        X, Y = getData(filename)
        num_class = len(set(Y))

        # To see number of training data point available for each label
        def count_by_class(Y):
            count={}
            for i in range(len(set(Y))):
                temp=Y
                b=np.logical_and(temp==i,temp==i)
                count[i]=len(temp[b])
            return count

        balance = count_by_class(Y)

        N, D = X.shape
        X = X.reshape(N, 48, 48, 1)


        # Split in  training set : validation set :
        X_train, X_test, y_train, y_test = train_test_split(X, Y, test_size=0.1, random_state=0)
        y_train = (np.arange(num_class) == y_train[:, None]).astype(np.float32)
        y_test = (np.arange(num_class) == y_test[:, None]).astype(np.float32)

In [3]: batch_size = 128
        epochs = 50

        #datagen for Data Augmentation
        datagen=ImageDataGenerator(horizontal_flip=True,rotation_range=30,width_shift_range=0.2,

        # CNN model with three Convolution layer & one fully connected layer
        def CNN_Model():
            # Initialising the CNN
            model = Sequential()

            # Set 1
            ## 1 Convolution layer
            model.add(Conv2D(64,(3,3), border_mode='same', input_shape=(48, 48,1)))
            model.add(Activation('relu'))
            model.add(BatchNormalization())
            model.add(MaxPooling2D(pool_size=(2, 2)))
            model.add(Dropout(0.25))

            # 2nd Convolution layer
            model.add(Conv2D(128,(3,3), border_mode='same'))
            model.add(Activation('relu'))
            model.add(BatchNormalization())
            model.add(MaxPooling2D(pool_size=(2, 2)))
            model.add(Dropout(0.25))
            # 3rd Convolution layer
            model.add(Conv2D(256,(3,3), border_mode='same'))
            model.add(Activation('relu'))
            model.add(BatchNormalization())
            model.add(MaxPooling2D(pool_size=(2, 2)))
            model.add(Dropout(0.25))

            # Flattening
            model.add(Flatten())

            # 1st Fully connected layer
            model.add(Dense(512))
            model.add(BatchNormalization())
            model.add(Activation('relu'))
            model.add(Dropout(0.25))

            model.add(Dense(num_class, activation='softmax'))

            adam=Adam(lr=0.001, beta_1=0.9, beta_2=0.999, epsilon=None, decay=0.0, amsgrad=False
            model.compile(optimizer=adam, loss='categorical_crossentropy', metrics=['categorical
            return model

In [4]: def CNN_Model_Saved():
            #load weights from h5 file
            model=load_model("Cnn_shallow.h5")
            return model
        # if you use a save model then turn it True ,otherwise if you run the whole code turn it
        is_model_saved = True


        # If model is not saved train model then use this function
        if(is_model_saved==False ):
            # Train model
            model = CNN_Model()
            # Note : Augmenting Data Generator
            datagen.fit(X_train,seed=0)
            steps_per_epoch=len(X_train)/batch_size
            model.fit_generator(datagen.flow(X_train,y_train,batch_size=batch_size,seed=0),
                                steps_per_epoch=steps_per_epoch ,
                                epochs=epochs ,
                                verbose=1)
            #save our model
            model.save("Cnn_shallow.h5")
            print("Saved model to disk")

        # if you use the save train model
        else:
```

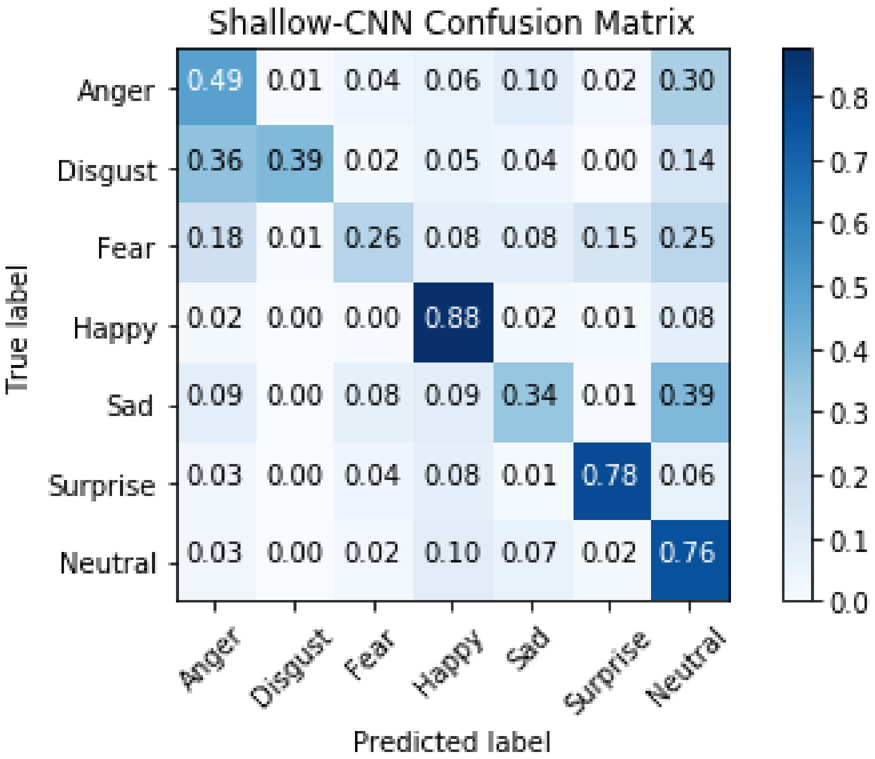
```python
        # Load the trained model
        print("Load model from disk")
        model = CNN_Model_Saved()


    # Model will predict the probability values for 7 labels for a test image
    score = model.predict(X_test)
    print (model.summary())
    results = model.evaluate(X_test, y_test, verbose=1)
    print('loss data:', results[0])
    print('Accuracy on a test data:', results[1])
```

```
Load model from disk
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d_2 (Conv2D)            (None, 48, 48, 64)        640
_________________________________________________________________
activation_1 (Activation)    (None, 48, 48, 64)        0
_________________________________________________________________
batch_normalization_1 (Batch (None, 48, 48, 64)        256
_________________________________________________________________
max_pooling2d_1 (MaxPooling2 (None, 24, 24, 64)        0
_________________________________________________________________
dropout_1 (Dropout)          (None, 24, 24, 64)        0
_________________________________________________________________
conv2d_3 (Conv2D)            (None, 24, 24, 128)       73856
_________________________________________________________________
activation_2 (Activation)    (None, 24, 24, 128)       0
_________________________________________________________________
batch_normalization_2 (Batch (None, 24, 24, 128)       512
_________________________________________________________________
max_pooling2d_2 (MaxPooling2 (None, 12, 12, 128)       0
_________________________________________________________________
dropout_2 (Dropout)          (None, 12, 12, 128)       0
_________________________________________________________________
conv2d_4 (Conv2D)            (None, 12, 12, 256)       295168
_________________________________________________________________
activation_3 (Activation)    (None, 12, 12, 256)       0
_________________________________________________________________
batch_normalization_3 (Batch (None, 12, 12, 256)       1024
_________________________________________________________________
max_pooling2d_3 (MaxPooling2 (None, 6, 6, 256)         0
_________________________________________________________________
dropout_3 (Dropout)          (None, 6, 6, 256)         0
_________________________________________________________________
flatten_1 (Flatten)          (None, 9216)              0
_________________________________________________________________
```

```
dense_1 (Dense)              (None, 512)               4719104
_________________________________________________________________
batch_normalization_4 (Batch (None, 512)               2048
_________________________________________________________________
activation_4 (Activation)    (None, 512)               0
_________________________________________________________________
dropout_4 (Dropout)          (None, 512)               0
_________________________________________________________________
dense_2 (Dense)              (None, 7)                 3591
=================================================================
Total params: 5,096,199
Trainable params: 5,094,279
Non-trainable params: 1,920
_________________________________________________________________
None
3589/3589 [==============================] - 9s 2ms/step
loss data: 1.0652522765417622
Accuracy on a test data: 0.6110337141597129
```

```
In [7]: import itertools
        import numpy as np
        import matplotlib.pyplot as plt
        from sklearn.metrics import confusion_matrix


        def plot_confusion_matrix(cm, classes,
                                  normalize=False,
                                  title='Confusion matrix',
                                  cmap=plt.cm.Blues):
            """
            This function prints and plots the confusion matrix.
            Normalization can be applied by setting `normalize=True`.
            """
            if normalize:
                cm = cm.astype('float') / cm.sum(axis=1)[:, np.newaxis]
                print("Normalized confusion matrix")
            else:
                print('Confusion matrix, without normalization')

            print(cm)

            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)
            fmt = '.2f' if normalize else 'd'
            thresh = cm.max() / 2.
            for i, j in itertools.product(range(cm.shape[0]), range(cm.shape[1])):
                plt.text(j, i, format(cm[i, j], fmt),
                         horizontalalignment="center",
                         color="white" if cm[i, j] > thresh else "black")

            plt.tight_layout()
            plt.ylabel('True label')
            plt.xlabel('Predicted label')


        new_X = [ np.argmax(item) for item in score ]
        y_test2 = [ np.argmax(item) for item in y_test]
        # Compute confusion matrix
        cnf_matrix =confusion_matrix(y_test2,new_X, labels=None, sample_weight=None)
        np.set_printoptions(precision=2)
        class_names = ['Anger', 'Disgust', 'Fear', 'Happy', 'Sad', 'Surprise', 'Neutral']


        plt.figure()
        plot_confusion_matrix(cnf_matrix, classes=class_names, normalize=True,
                              title='Shallow-CNN Confusion Matrix')

        plt.show()
```

```
Normalized confusion matrix
[[0.49 0.01 0.04 0.06 0.1  0.02 0.3 ]
 [0.36 0.39 0.02 0.05 0.04 0.   0.14]
 [0.18 0.01 0.26 0.08 0.08 0.15 0.25]
 [0.02 0.   0.   0.88 0.02 0.01 0.08]
 [0.09 0.   0.08 0.09 0.34 0.01 0.39]
 [0.03 0.   0.04 0.08 0.01 0.78 0.06]
 [0.03 0.   0.02 0.1  0.07 0.02 0.76]]
```



```
In [6]: from sklearn.metrics import precision_recall_fscore_support
        precision_recall_fscore_support(y_test2,new_X)

Out[6]: (array([0.53, 0.69, 0.57, 0.79, 0.58, 0.76, 0.42]),
         array([0.49, 0.39, 0.26, 0.88, 0.34, 0.78, 0.76]),
         array([0.51, 0.5 , 0.36, 0.83, 0.43, 0.77, 0.55]),
         array([484,  56, 502, 920, 599, 442, 586]))
```