

In [1]:

```
# data augmentation test: rotate different degree (pay attention to adjustable filename etc.)
```

```
import numpy as np
import matplotlib.pyplot as plt
import tensorflow as tf
from tensorflow.python.keras.layers import Dense, GlobalAveragePooling2D
from tensorflow.python.keras.models import Model
from tensorflow.python.keras import layers, Sequential, losses, metrics
```

```
image_height = 48
image_width = 48
emotions_count = 8
emotion_labels = ['neutral', 'happiness', 'surprise', 'sadness',
                  'anger', 'disgust', 'fear', 'contempt']
```

```
# !!! change sample size
samples = 99109 # 2~99110
training_samples = 28317*3 # (Training)
validation_samples = 3541*3 # (PublicTest)
test_samples = 3535 # (PrivateTest)
```

```
# !!! change npy folder name
image_path = "./dataset_r10/images.npy"
emotion_multi_path = "./dataset_r10/emotions_multi.npy"
emotion_single_path = "./dataset_r10/emotions_single.npy"
images = np.load(image_path)
emotions_multi = np.load(emotion_multi_path)
emotions_single = np.load(emotion_single_path)
```

```
# !!! change s/m dataset
#emotions = emotions_single
emotions = emotions_multi
```

```
print(images.shape)
print(emotions_multi.shape)
print(emotions_single.shape)
```

```
(99109, 48, 48, 1)
(99109, 8)
(99109, 8)
```

In [2]:

```
cce = losses.CategoricalCrossentropy()
mse = losses.MeanSquaredError()
```

```

tf.config.run_functions_eagerly(True)
def model_acc(y_true, y_pred):
    size = y_true.shape[0]
    acc = 0
    for i in range(size):
        true = y_true[i]
        pred = y_pred[i]
        index_max = tf.argmax(pred).numpy()
        if true[index_max].numpy() == tf.reduce_max(true).numpy():
            acc += 1
    return acc/size

```

In [3]:

```

images = tf.convert_to_tensor(images)
#images = tf.image.grayscale_to_rgb(images)
emotions = tf.convert_to_tensor(emotions)
#images = tf.image.resize(images, [224,224])
images = layers.Rescaling(1./127.5, offset= -1)(images)

training_size = training_samples + validation_samples
test_size = test_samples

training_images = images[:training_size]
test_images = images[training_size:]
training_emotions = emotions[:training_size]
test_emotions = emotions[training_size:]

print("training_images shape:", training_images.shape)
print("training_emotions shape:", training_emotions.shape)
print("test_images shape:", test_images.shape)
print("test_emotions shape:", test_emotions.shape)

```

```

training_images shape: (95574, 48, 48, 1)
training_emotions shape: (95574, 8)
test_images shape: (3535, 48, 48, 1)
test_emotions shape: (3535, 8)

```

In [4]:

```

from tensorflow.python.keras.applications import vgg16, resnet_v2
from tensorflow.python.keras import optimizers
from tensorflow.python.keras.optimizer_v2 import adam

```

In [5]:

```

base_model = vgg16.VGG16(include_top=False,
                          weights="imagenet",

```

```

        input_shape=(48,48,3))
base_model.trainable=True
model = Sequential([
    base_model,
    layers.GlobalAveragePooling2D(),
    layers.Dense(4096, activation='relu'),
    layers.Dense(4096, activation='relu'),
    layers.Dense(emotions_count, activation='softmax'),
])

model.compile(optimizer=adam.Adam(learning_rate=1e-4),
              loss=mse,
              metrics = [model_acc])

model.fit(x=tf.image.grayscale_to_rgb(training_images),
          y=training_emotions,
          batch_size=32,
          epochs=40,
          validation_data=(tf.image.grayscale_to_rgb(test_images), test_emotions))

```

C:\Users\Dark1\anaconda3\lib\site-packages\tensorflow\python\data\ops\dataset_ops.py:3703: UserWarning: Even though the `tf.config.experimental_run_functions_eagerly` option is set, this option does not apply to tf.data functions. To force eager execution of tf.data functions, please use `tf.data.experimental.enable_debug_mode()`.

```

warnings.warn(
Epoch 1/40
2987/2987 [=====] - 208s 69ms/step - loss: 0.0238 - model_acc: 0.7347 - val_loss: 0.0188 -
val_model_acc: 0.7709
Epoch 2/40
2987/2987 [=====] - 199s 67ms/step - loss: 0.0138 - model_acc: 0.8312 - val_loss: 0.0154 -
val_model_acc: 0.8148
Epoch 3/40
2987/2987 [=====] - 200s 67ms/step - loss: 0.0101 - model_acc: 0.8728 - val_loss: 0.0143 -
val_model_acc: 0.8216
Epoch 4/40
2987/2987 [=====] - 199s 67ms/step - loss: 0.0077 - model_acc: 0.9006 - val_loss: 0.0142 -
val_model_acc: 0.8211
Epoch 5/40
2987/2987 [=====] - 196s 66ms/step - loss: 0.0061 - model_acc: 0.9216 - val_loss: 0.0148 -
val_model_acc: 0.8236
Epoch 6/40
2987/2987 [=====] - 197s 66ms/step - loss: 0.0049 - model_acc: 0.9364 - val_loss: 0.0135 -
val_model_acc: 0.8360
Epoch 7/40
2987/2987 [=====] - 198s 66ms/step - loss: 0.0041 - model_acc: 0.9458 - val_loss: 0.0130 -
val_model_acc: 0.8377

```

```
Epoch 8/40
2987/2987 [=====] - 197s 66ms/step - loss: 0.0035 - model_acc: 0.9536 - val_loss: 0.0125 -
val_model_acc: 0.8402
Epoch 9/40
2987/2987 [=====] - 195s 65ms/step - loss: 0.0030 - model_acc: 0.9601 - val_loss: 0.0126 -
val_model_acc: 0.8394
Epoch 10/40
2987/2987 [=====] - 195s 65ms/step - loss: 0.0027 - model_acc: 0.9636 - val_loss: 0.0127 -
val_model_acc: 0.8439
Epoch 11/40
2987/2987 [=====] - 196s 66ms/step - loss: 0.0024 - model_acc: 0.9670 - val_loss: 0.0128 -
val_model_acc: 0.8434
Epoch 12/40
2987/2987 [=====] - 202s 68ms/step - loss: 0.0021 - model_acc: 0.9715 - val_loss: 0.0129 -
val_model_acc: 0.8430
Epoch 13/40
2987/2987 [=====] - 202s 68ms/step - loss: 0.0021 - model_acc: 0.9704 - val_loss: 0.0131 -
val_model_acc: 0.8411
Epoch 14/40
2987/2987 [=====] - 202s 68ms/step - loss: 0.0017 - model_acc: 0.9762 - val_loss: 0.0124 -
val_model_acc: 0.8501
Epoch 15/40
2987/2987 [=====] - 203s 68ms/step - loss: 0.0016 - model_acc: 0.9772 - val_loss: 0.0125 -
val_model_acc: 0.8431
Epoch 16/40
2987/2987 [=====] - 203s 68ms/step - loss: 0.0014 - model_acc: 0.9803 - val_loss: 0.0128 -
val_model_acc: 0.8450
Epoch 17/40
2987/2987 [=====] - 201s 67ms/step - loss: 0.0015 - model_acc: 0.9784 - val_loss: 0.0133 -
val_model_acc: 0.8423
Epoch 18/40
2987/2987 [=====] - 198s 66ms/step - loss: 0.0012 - model_acc: 0.9836 - val_loss: 0.0125 -
val_model_acc: 0.8487
Epoch 19/40
2987/2987 [=====] - 199s 66ms/step - loss: 0.0013 - model_acc: 0.9812 - val_loss: 0.0132 -
val_model_acc: 0.8402
Epoch 20/40
2987/2987 [=====] - 199s 67ms/step - loss: 9.7343e-04 - model_acc: 0.9865 - val_loss: 0.012
7 - val_model_acc: 0.8459
Epoch 21/40
2987/2987 [=====] - 198s 66ms/step - loss: 0.0014 - model_acc: 0.9800 - val_loss: 0.0124 -
val_model_acc: 0.8433
Epoch 22/40
2987/2987 [=====] - 198s 66ms/step - loss: 9.0545e-04 - model_acc: 0.9881 - val_loss: 0.012
5 - val_model_acc: 0.8442
Epoch 23/40
```

2987/2987 [=====] - 200s 67ms/step - loss: 7.8465e-04 - model_acc: 0.9900 - val_loss: 0.0126 - val_model_acc: 0.8483
Epoch 24/40
2987/2987 [=====] - 199s 67ms/step - loss: 0.0012 - model_acc: 0.9823 - val_loss: 0.0134 - val_model_acc: 0.8430
Epoch 25/40
2987/2987 [=====] - 199s 67ms/step - loss: 9.3472e-04 - model_acc: 0.9864 - val_loss: 0.0139 - val_model_acc: 0.8337
Epoch 26/40
2987/2987 [=====] - 202s 68ms/step - loss: 7.6120e-04 - model_acc: 0.9898 - val_loss: 0.0125 - val_model_acc: 0.8487
Epoch 27/40
2987/2987 [=====] - 207s 69ms/step - loss: 8.1026e-04 - model_acc: 0.9886 - val_loss: 0.0130 - val_model_acc: 0.8467
Epoch 28/40
2987/2987 [=====] - 213s 71ms/step - loss: 7.8657e-04 - model_acc: 0.9890 - val_loss: 0.0136 - val_model_acc: 0.8417
Epoch 29/40
2987/2987 [=====] - 214s 72ms/step - loss: 9.2160e-04 - model_acc: 0.9864 - val_loss: 0.0136 - val_model_acc: 0.8425
Epoch 30/40
2987/2987 [=====] - 213s 71ms/step - loss: 9.8166e-04 - model_acc: 0.9852 - val_loss: 0.0136 - val_model_acc: 0.8374
Epoch 31/40
2987/2987 [=====] - 213s 71ms/step - loss: 8.5637e-04 - model_acc: 0.9882 - val_loss: 0.0140 - val_model_acc: 0.8323
Epoch 32/40
2987/2987 [=====] - 213s 71ms/step - loss: 5.7727e-04 - model_acc: 0.9925 - val_loss: 0.0133 - val_model_acc: 0.8388
Epoch 33/40
2987/2987 [=====] - 209s 70ms/step - loss: 7.9152e-04 - model_acc: 0.9889 - val_loss: 0.0153 - val_model_acc: 0.8270
Epoch 34/40
2987/2987 [=====] - 209s 70ms/step - loss: 8.0347e-04 - model_acc: 0.9883 - val_loss: 0.0140 - val_model_acc: 0.8346
Epoch 35/40
2987/2987 [=====] - 209s 70ms/step - loss: 4.6966e-04 - model_acc: 0.9939 - val_loss: 0.0133 - val_model_acc: 0.8428
Epoch 36/40
2987/2987 [=====] - 213s 71ms/step - loss: 7.9721e-04 - model_acc: 0.9882 - val_loss: 0.0136 - val_model_acc: 0.8430
Epoch 37/40
2987/2987 [=====] - 213s 71ms/step - loss: 5.4535e-04 - model_acc: 0.9926 - val_loss: 0.0135 - val_model_acc: 0.8473
Epoch 38/40
2987/2987 [=====] - 212s 71ms/step - loss: 6.5141e-04 - model_acc: 0.9912 - val_loss: 0.014

```
2 - val_model_acc: 0.8405
Epoch 39/40
2987/2987 [=====] - 213s 71ms/step - loss: 5.9280e-04 - model_acc: 0.9919 - val_loss: 0.013
4 - val_model_acc: 0.8509
Epoch 40/40
2987/2987 [=====] - 213s 71ms/step - loss: 4.0672e-04 - model_acc: 0.9954 - val_loss: 0.013
5 - val_model_acc: 0.8458
Out[5]: <tensorflow.python.keras.callbacks.History at 0x29380966370>
```