

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_r20/images.npy"
emotion_multi_path = "./dataset_r20/emotions_multi.npy"
emotion_single_path = "./dataset_r20/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 [=====] - 205s 68ms/step - loss: 0.0276 - model_acc: 0.6992 - val_loss: 0.0185 -
val_model_acc: 0.7767
Epoch 2/40
2987/2987 [=====] - 193s 65ms/step - loss: 0.0161 - model_acc: 0.8073 - val_loss: 0.0154 -
val_model_acc: 0.8092
Epoch 3/40
2987/2987 [=====] - 201s 67ms/step - loss: 0.0124 - model_acc: 0.8450 - val_loss: 0.0144 -
val_model_acc: 0.8233
Epoch 4/40
2987/2987 [=====] - 194s 65ms/step - loss: 0.0099 - model_acc: 0.8733 - val_loss: 0.0141 -
val_model_acc: 0.8188
Epoch 5/40
2987/2987 [=====] - 203s 68ms/step - loss: 0.0081 - model_acc: 0.8961 - val_loss: 0.0138 -
val_model_acc: 0.8320
Epoch 6/40
2987/2987 [=====] - 207s 69ms/step - loss: 0.0067 - model_acc: 0.9135 - val_loss: 0.0134 -
val_model_acc: 0.8340
Epoch 7/40
2987/2987 [=====] - 203s 68ms/step - loss: 0.0058 - model_acc: 0.9258 - val_loss: 0.0130 -
val_model_acc: 0.8368

```

Epoch 8/40  
2987/2987 [=====] - 203s 68ms/step - loss: 0.0049 - model\_acc: 0.9370 - val\_loss: 0.0125 - val\_model\_acc: 0.8422  
Epoch 9/40  
2987/2987 [=====] - 204s 68ms/step - loss: 0.0043 - model\_acc: 0.9436 - val\_loss: 0.0131 - val\_model\_acc: 0.8351  
Epoch 10/40  
2987/2987 [=====] - 205s 69ms/step - loss: 0.0038 - model\_acc: 0.9496 - val\_loss: 0.0125 - val\_model\_acc: 0.8349  
Epoch 11/40  
2987/2987 [=====] - 204s 68ms/step - loss: 0.0034 - model\_acc: 0.9551 - val\_loss: 0.0123 - val\_model\_acc: 0.8430  
Epoch 12/40  
2987/2987 [=====] - 204s 68ms/step - loss: 0.0030 - model\_acc: 0.9592 - val\_loss: 0.0123 - val\_model\_acc: 0.8492  
Epoch 13/40  
2987/2987 [=====] - 203s 68ms/step - loss: 0.0028 - model\_acc: 0.9620 - val\_loss: 0.0122 - val\_model\_acc: 0.8504  
Epoch 14/40  
2987/2987 [=====] - 206s 69ms/step - loss: 0.0025 - model\_acc: 0.9661 - val\_loss: 0.0127 - val\_model\_acc: 0.8439  
Epoch 15/40  
2987/2987 [=====] - 204s 68ms/step - loss: 0.0024 - model\_acc: 0.9671 - val\_loss: 0.0123 - val\_model\_acc: 0.8473  
Epoch 16/40  
2987/2987 [=====] - 203s 68ms/step - loss: 0.0022 - model\_acc: 0.9705 - val\_loss: 0.0122 - val\_model\_acc: 0.8469  
Epoch 17/40  
2987/2987 [=====] - 203s 68ms/step - loss: 0.0018 - model\_acc: 0.9751 - val\_loss: 0.0122 - val\_model\_acc: 0.8441  
Epoch 18/40  
2987/2987 [=====] - 204s 68ms/step - loss: 0.0019 - model\_acc: 0.9730 - val\_loss: 0.0122 - val\_model\_acc: 0.8506  
Epoch 19/40  
2987/2987 [=====] - 205s 69ms/step - loss: 0.0016 - model\_acc: 0.9779 - val\_loss: 0.0123 - val\_model\_acc: 0.8413  
Epoch 20/40  
2987/2987 [=====] - 205s 69ms/step - loss: 0.0016 - model\_acc: 0.9773 - val\_loss: 0.0122 - val\_model\_acc: 0.8444  
Epoch 21/40  
2987/2987 [=====] - 207s 69ms/step - loss: 0.0016 - model\_acc: 0.9763 - val\_loss: 0.0123 - val\_model\_acc: 0.8498  
Epoch 22/40  
2987/2987 [=====] - 205s 69ms/step - loss: 0.0014 - model\_acc: 0.9803 - val\_loss: 0.0124 - val\_model\_acc: 0.8447  
Epoch 23/40

```
2987/2987 [=====] - 279s 93ms/step - loss: 0.0014 - model_acc: 0.9812 - val_loss: 0.0123 -  
val_model_acc: 0.8433  
Epoch 24/40  
2987/2987 [=====] - 201s 67ms/step - loss: 0.0013 - model_acc: 0.9820 - val_loss: 0.0123 -  
val_model_acc: 0.8498  
Epoch 25/40  
2987/2987 [=====] - 203s 68ms/step - loss: 0.0012 - model_acc: 0.9842 - val_loss: 0.0126 -  
val_model_acc: 0.8430  
Epoch 26/40  
2987/2987 [=====] - 200s 67ms/step - loss: 0.0010 - model_acc: 0.9863 - val_loss: 0.0122 -  
val_model_acc: 0.8444  
Epoch 27/40  
2987/2987 [=====] - 208s 70ms/step - loss: 9.9918e-04 - model_acc: 0.9861 - val_loss: 0.012  
5 - val_model_acc: 0.8450  
Epoch 28/40  
2987/2987 [=====] - 207s 69ms/step - loss: 0.0014 - model_acc: 0.9791 - val_loss: 0.0127 -  
val_model_acc: 0.8436  
Epoch 29/40  
2987/2987 [=====] - 196s 66ms/step - loss: 8.7693e-04 - model_acc: 0.9885 - val_loss: 0.013  
8 - val_model_acc: 0.8323  
Epoch 30/40  
2987/2987 [=====] - 207s 69ms/step - loss: 8.9548e-04 - model_acc: 0.9878 - val_loss: 0.012  
8 - val_model_acc: 0.8470  
Epoch 31/40  
2987/2987 [=====] - 207s 69ms/step - loss: 7.7606e-04 - model_acc: 0.9896 - val_loss: 0.012  
4 - val_model_acc: 0.8445  
Epoch 32/40  
2987/2987 [=====] - 209s 70ms/step - loss: 0.0012 - model_acc: 0.9811 - val_loss: 0.0131 -  
val_model_acc: 0.8441  
Epoch 33/40  
2987/2987 [=====] - 202s 68ms/step - loss: 8.1612e-04 - model_acc: 0.9890 - val_loss: 0.012  
5 - val_model_acc: 0.8489  
Epoch 34/40  
2987/2987 [=====] - 196s 66ms/step - loss: 6.4489e-04 - model_acc: 0.9922 - val_loss: 0.012  
8 - val_model_acc: 0.8439  
Epoch 35/40  
2987/2987 [=====] - 195s 65ms/step - loss: 0.0011 - model_acc: 0.9841 - val_loss: 0.0128 -  
val_model_acc: 0.8442  
Epoch 36/40  
2987/2987 [=====] - 307s 103ms/step - loss: 6.4368e-04 - model_acc: 0.9919 - val_loss: 0.01  
28 - val_model_acc: 0.8430  
Epoch 37/40  
2987/2987 [=====] - 210s 70ms/step - loss: 6.1601e-04 - model_acc: 0.9922 - val_loss: 0.012  
8 - val_model_acc: 0.8433  
Epoch 38/40  
2987/2987 [=====] - 202s 68ms/step - loss: 6.8696e-04 - model_acc: 0.9897 - val_loss: 0.012
```

9 - val\_model\_acc: 0.8447

Epoch 39/40

2987/2987 [=====] - 209s 70ms/step - loss: 8.8572e-04 - model\_acc: 0.9867 - val\_loss: 0.013

9 - val\_model\_acc: 0.8346

Epoch 40/40

2987/2987 [=====] - 195s 65ms/step - loss: 5.4640e-04 - model\_acc: 0.9924 - val\_loss: 0.012

7 - val\_model\_acc: 0.8430

Out[5]: <tensorflow.python.keras.callbacks.History at 0x26380944d00>