In [1]:
```
# data augmentation: mirror (use read_dataset2, dataset2)
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']

samples = 67251 # 2~67252
training_samples = 28317*2  # 2~56635 (Training)
validation_samples = 3541*2 # 56636~63717 (PublicTest)
test_samples = 3535         # 63718~67252 (PrivateTest)

image_path = "./dataset2/images.npy"
emotion_multi_path = "./dataset2/emotions_multi.npy"
emotion_single_path = "./dataset2/emotions_single.npy"
```

In [2]:
```
images = np.load(image_path)
emotions_multi = np.load(emotion_multi_path)
emotions_single = np.load(emotion_single_path)

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

```
(67251, 48, 48, 1)
(67251, 8)
(67251, 8)
```

In [3]:
```
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 [4]:

```
emotions = emotions_single
#emotions = emotions_multi

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

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: (63716, 48, 48, 1)
training_emotions shape: (63716, 8)
test_images shape: (3535, 48, 48, 1)
test_emotions shape: (3535, 8)
```

In [5]:

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

In [6]:

```
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=losses.CategoricalCrossentropy(),
              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\Darkl\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. T
o force eager execution of tf.data functions, please use `tf.data.experimental.enable.debug_mode()`.
  warnings.warn(
Epoch 1/40
1992/1992 [==============================] - 134s 66ms/step - loss: 0.8649 - model_acc: 0.7185 - val_loss: 0.7005 -
val_model_acc: 0.7675
Epoch 2/40
1992/1992 [==============================] - 130s 65ms/step - loss: 0.5777 - model_acc: 0.8177 - val_loss: 0.6141 -
val_model_acc: 0.7985
Epoch 3/40
1992/1992 [==============================] - 128s 64ms/step - loss: 0.4486 - model_acc: 0.8625 - val_loss: 0.5900 -
val_model_acc: 0.8169
Epoch 4/40
1992/1992 [==============================] - 132s 66ms/step - loss: 0.3523 - model_acc: 0.8964 - val_loss: 0.6380 -
val_model_acc: 0.8247
Epoch 5/40
1992/1992 [==============================] - 131s 66ms/step - loss: 0.2690 - model_acc: 0.9290 - val_loss: 0.6297 -
val_model_acc: 0.8278
Epoch 6/40
1992/1992 [==============================] - 133s 67ms/step - loss: 0.2132 - model_acc: 0.9493 - val_loss: 0.6599 -
val_model_acc: 0.8171
Epoch 7/40
1992/1992 [==============================] - 132s 66ms/step - loss: 0.1751 - model_acc: 0.9629 - val_loss: 0.7474 -
val_model_acc: 0.8146
Epoch 8/40
```

```
1992/1992 [==============================] - 129s 65ms/step - loss: 0.1529 - model_acc: 0.9706 - val_loss: 0.8276 -
val_model_acc: 0.7980
Epoch 9/40
1992/1992 [==============================] - 131s 66ms/step - loss: 0.1364 - model_acc: 0.9755 - val_loss: 0.7102 -
val_model_acc: 0.8239
Epoch 10/40
1992/1992 [==============================] - 131s 66ms/step - loss: 0.1243 - model_acc: 0.9796 - val_loss: 0.7975 -
val_model_acc: 0.8334
Epoch 11/40
1992/1992 [==============================] - 131s 66ms/step - loss: 0.1172 - model_acc: 0.9819 - val_loss: 0.8123 -
val_model_acc: 0.8315
Epoch 12/40
1992/1992 [==============================] - 130s 65ms/step - loss: 0.1103 - model_acc: 0.9839 - val_loss: 0.8830 -
val_model_acc: 0.8284
Epoch 13/40
1992/1992 [==============================] - 135s 68ms/step - loss: 0.1046 - model_acc: 0.9849 - val_loss: 0.7742 -
val_model_acc: 0.8282
Epoch 14/40
1992/1992 [==============================] - 135s 68ms/step - loss: 0.0999 - model_acc: 0.9864 - val_loss: 0.8764 -
val_model_acc: 0.8295
Epoch 15/40
1992/1992 [==============================] - 132s 66ms/step - loss: 0.0943 - model_acc: 0.9872 - val_loss: 0.9007 -
val_model_acc: 0.8246
Epoch 16/40
1992/1992 [==============================] - 129s 65ms/step - loss: 0.0926 - model_acc: 0.9873 - val_loss: 0.8827 -
val_model_acc: 0.8255
Epoch 17/40
1992/1992 [==============================] - 129s 65ms/step - loss: 0.0857 - model_acc: 0.9892 - val_loss: 1.0737 -
val_model_acc: 0.8290
Epoch 18/40
1992/1992 [==============================] - 132s 66ms/step - loss: 0.0883 - model_acc: 0.9881 - val_loss: 0.9646 -
val_model_acc: 0.8261
Epoch 19/40
1992/1992 [==============================] - 130s 65ms/step - loss: 0.0806 - model_acc: 0.9898 - val_loss: 1.0302 -
val_model_acc: 0.8287
Epoch 20/40
1992/1992 [==============================] - 134s 67ms/step - loss: 0.0816 - model_acc: 0.9896 - val_loss: 0.9912 -
val_model_acc: 0.8284
Epoch 21/40
1992/1992 [==============================] - 129s 65ms/step - loss: 0.0778 - model_acc: 0.9895 - val_loss: 1.0564 -
val_model_acc: 0.8267
Epoch 22/40
1992/1992 [==============================] - 130s 65ms/step - loss: 0.0802 - model_acc: 0.9893 - val_loss: 0.8188 -
val_model_acc: 0.8062
Epoch 23/40
1992/1992 [==============================] - 129s 65ms/step - loss: 0.0768 - model_acc: 0.9903 - val_loss: 1.0676 -
```

```
val_model_acc: 0.8343
Epoch 24/40
1992/1992 [==============================] - 129s 65ms/step - loss: 0.0749 - model_acc: 0.9904 - val_loss: 0.9872 -
val_model_acc: 0.8250
Epoch 25/40
1992/1992 [==============================] - 151s 76ms/step - loss: 0.0745 - model_acc: 0.9897 - val_loss: 1.1203 -
val_model_acc: 0.8284
Epoch 26/40
1992/1992 [==============================] - 131s 66ms/step - loss: 0.0765 - model_acc: 0.9903 - val_loss: 1.1576 -
val_model_acc: 0.8335
Epoch 27/40
1992/1992 [==============================] - 134s 67ms/step - loss: 0.0686 - model_acc: 0.9919 - val_loss: 1.1749 -
val_model_acc: 0.8312
Epoch 28/40
1992/1992 [==============================] - 132s 66ms/step - loss: 0.0666 - model_acc: 0.9922 - val_loss: 1.1521 -
val_model_acc: 0.8197
Epoch 29/40
1992/1992 [==============================] - 133s 67ms/step - loss: 0.0694 - model_acc: 0.9920 - val_loss: 1.1921 -
val_model_acc: 0.8329
Epoch 30/40
1992/1992 [==============================] - 130s 65ms/step - loss: 0.0737 - model_acc: 0.9905 - val_loss: 1.1782 -
val_model_acc: 0.8304
Epoch 31/40
1992/1992 [==============================] - 131s 66ms/step - loss: 0.0717 - model_acc: 0.9915 - val_loss: 1.1603 -
val_model_acc: 0.8346
Epoch 32/40
1992/1992 [==============================] - 130s 65ms/step - loss: 0.0716 - model_acc: 0.9910 - val_loss: 1.1356 -
val_model_acc: 0.8286
Epoch 33/40
1992/1992 [==============================] - 132s 66ms/step - loss: 0.0651 - model_acc: 0.9925 - val_loss: 1.0727 -
val_model_acc: 0.8309
Epoch 34/40
1992/1992 [==============================] - 134s 67ms/step - loss: 0.0678 - model_acc: 0.9918 - val_loss: 1.0219 -
val_model_acc: 0.8213
Epoch 35/40
1992/1992 [==============================] - 131s 66ms/step - loss: 0.0650 - model_acc: 0.9927 - val_loss: 1.0482 -
val_model_acc: 0.8334
Epoch 36/40
1992/1992 [==============================] - 160s 80ms/step - loss: 0.0627 - model_acc: 0.9929 - val_loss: 1.1830 -
val_model_acc: 0.8270
Epoch 37/40
1992/1992 [==============================] - 170s 85ms/step - loss: 0.0634 - model_acc: 0.9926 - val_loss: 1.0924 -
val_model_acc: 0.8278
Epoch 38/40
1992/1992 [==============================] - 141s 71ms/step - loss: 0.0629 - model_acc: 0.9928 - val_loss: 1.1469 -
val_model_acc: 0.8127
```

```
Epoch 39/40
1992/1992 [==============================] - 136s 68ms/step - loss: 0.0634 - model_acc: 0.9925 - val_loss: 1.1186 -
val_model_acc: 0.8326
Epoch 40/40
1992/1992 [==============================] - 134s 67ms/step - loss: 0.0732 - model_acc: 0.9894 - val_loss: 0.9347 -
val_model_acc: 0.8219
```

Out[6]: <tensorflow.python.keras.callbacks.History at 0x1baf1f932b0>

In [ ]: