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

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.MeanSquaredError(),
              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.c
onfig.experimental_run_functions_eagerly` option is set, this option does not apply to tf.data functions. To force eager exec
ution of tf.data functions, please use `tf.data.experimental.enable.debug_mode()`.
  warnings.warn(
Epoch 1/40
1992/1992 [==============================] - 134s 66ms/step - loss: 0.0528 - model_acc: 0.6965 - val_loss: 0.0448 - val_model
_acc: 0.7605
Epoch 2/40
1992/1992 [==============================] - 131s 66ms/step - loss: 0.0363 - model_acc: 0.8022 - val_loss: 0.0360 - val_model
_acc: 0.7965
Epoch 3/40
1992/1992 [==============================] - 130s 65ms/step - loss: 0.0293 - model_acc: 0.8466 - val_loss: 0.0364 - val_model
_acc: 0.8107
Epoch 4/40
1992/1992 [==============================] - 128s 64ms/step - loss: 0.0242 - model_acc: 0.8765 - val_loss: 0.0353 - val_model
_acc: 0.8171
Epoch 5/40
1992/1992 [==============================] - 131s 66ms/step - loss: 0.0202 - model_acc: 0.8996 - val_loss: 0.0338 - val_model
_acc: 0.8188
Epoch 6/40
1992/1992 [==============================] - 129s 65ms/step - loss: 0.0169 - model_acc: 0.9190 - val_loss: 0.0354 - val_model
_acc: 0.8188
Epoch 7/40
1992/1992 [==============================] - 132s 66ms/step - loss: 0.0145 - model_acc: 0.9335 - val_loss: 0.0355 - val_model
_acc: 0.8196
```

```
Epoch 8/40
1992/1992 [==============================] - 130s 65ms/step - loss: 0.0130 - model_acc: 0.9402 - val_loss: 0.0344 - val_model
_acc: 0.8230
Epoch 9/40
1992/1992 [==============================] - 128s 64ms/step - loss: 0.0116 - model_acc: 0.9477 - val_loss: 0.0355 - val_model
_acc: 0.8287
Epoch 10/40
1992/1992 [==============================] - 131s 66ms/step - loss: 0.0104 - model_acc: 0.9546 - val_loss: 0.0369 - val_model
_acc: 0.8248
Epoch 11/40
1992/1992 [==============================] - 130s 65ms/step - loss: 0.0094 - model_acc: 0.9592 - val_loss: 0.0349 - val_model
_acc: 0.8233
Epoch 12/40
1992/1992 [==============================] - 131s 66ms/step - loss: 0.0087 - model_acc: 0.9636 - val_loss: 0.0354 - val_model
_acc: 0.8303
Epoch 13/40
1992/1992 [==============================] - 132s 66ms/step - loss: 0.0080 - model_acc: 0.9668 - val_loss: 0.0358 - val_model
_acc: 0.8275
Epoch 14/40
1992/1992 [==============================] - 132s 66ms/step - loss: 0.0079 - model_acc: 0.9677 - val_loss: 0.0378 - val_model
_acc: 0.8169
Epoch 15/40
1992/1992 [==============================] - 132s 66ms/step - loss: 0.0069 - model_acc: 0.9724 - val_loss: 0.0375 - val_model
_acc: 0.8142
Epoch 16/40
1992/1992 [==============================] - 128s 64ms/step - loss: 0.0067 - model_acc: 0.9747 - val_loss: 0.0352 - val_model
_acc: 0.8267
Epoch 17/40
1992/1992 [==============================] - 128s 64ms/step - loss: 0.0064 - model_acc: 0.9749 - val_loss: 0.0363 - val_model
_acc: 0.8244
Epoch 18/40
1992/1992 [==============================] - 130s 65ms/step - loss: 0.0059 - model_acc: 0.9774 - val_loss: 0.0360 - val_model
_acc: 0.8276
Epoch 19/40
1992/1992 [==============================] - 130s 65ms/step - loss: 0.0056 - model_acc: 0.9793 - val_loss: 0.0371 - val_model
_acc: 0.8205
Epoch 20/40
1992/1992 [==============================] - 129s 65ms/step - loss: 0.0055 - model_acc: 0.9799 - val_loss: 0.0366 - val_model
_acc: 0.8261
Epoch 21/40
1992/1992 [==============================] - 130s 65ms/step - loss: 0.0052 - model_acc: 0.9809 - val_loss: 0.0381 - val_model
_acc: 0.8132
Epoch 22/40
1992/1992 [==============================] - 131s 66ms/step - loss: 0.0049 - model_acc: 0.9825 - val_loss: 0.0357 - val_model
```

```
_acc: 0.8252
Epoch 23/40
1992/1992 [==============================] - 129s 65ms/step - loss: 0.0048 - model_acc: 0.9825 - val_loss: 0.0345 - val_model
_acc: 0.8286
Epoch 24/40
1992/1992 [==============================] - 128s 64ms/step - loss: 0.0041 - model_acc: 0.9862 - val_loss: 0.0372 - val_model
_acc: 0.8196
Epoch 25/40
1992/1992 [==============================] - 130s 65ms/step - loss: 0.0045 - model_acc: 0.9835 - val_loss: 0.0372 - val_model
_acc: 0.8267
Epoch 26/40
1992/1992 [==============================] - 130s 65ms/step - loss: 0.0044 - model_acc: 0.9842 - val_loss: 0.0370 - val_model
_acc: 0.8289
Epoch 27/40
1992/1992 [==============================] - 128s 64ms/step - loss: 0.0043 - model_acc: 0.9845 - val_loss: 0.0378 - val_model
_acc: 0.8272
Epoch 28/40
1992/1992 [==============================] - 132s 66ms/step - loss: 0.0040 - model_acc: 0.9856 - val_loss: 0.0368 - val_model
_acc: 0.8276
Epoch 29/40
1992/1992 [==============================] - 131s 66ms/step - loss: 0.0039 - model_acc: 0.9861 - val_loss: 0.0365 - val_model
_acc: 0.8261
Epoch 30/40
1992/1992 [==============================] - 133s 67ms/step - loss: 0.0038 - model_acc: 0.9862 - val_loss: 0.0362 - val_model
_acc: 0.8281
Epoch 31/40
1992/1992 [==============================] - 128s 64ms/step - loss: 0.0041 - model_acc: 0.9853 - val_loss: 0.0371 - val_model
_acc: 0.8286
Epoch 32/40
1992/1992 [==============================] - 129s 65ms/step - loss: 0.0035 - model_acc: 0.9872 - val_loss: 0.0377 - val_model
_acc: 0.8303
Epoch 33/40
1992/1992 [==============================] - 128s 64ms/step - loss: 0.0038 - model_acc: 0.9861 - val_loss: 0.0372 - val_model
_acc: 0.8227
Epoch 34/40
1992/1992 [==============================] - 128s 64ms/step - loss: 0.0033 - model_acc: 0.9880 - val_loss: 0.0372 - val_model
_acc: 0.8267
Epoch 35/40
1992/1992 [==============================] - 129s 65ms/step - loss: 0.0037 - model_acc: 0.9866 - val_loss: 0.0357 - val_model
_acc: 0.8261
Epoch 36/40
1992/1992 [==============================] - 131s 66ms/step - loss: 0.0031 - model_acc: 0.9888 - val_loss: 0.0374 - val_model
_acc: 0.8309
Epoch 37/40
```

```
1992/1992 [==============================] - 131s 66ms/step - loss: 0.0032 - model_acc: 0.9889 - val_loss: 0.0373 - val_model
_acc: 0.8304
Epoch 38/40
1992/1992 [==============================] - 131s 66ms/step - loss: 0.0031 - model_acc: 0.9889 - val_loss: 0.0369 - val_model
_acc: 0.8300
Epoch 39/40
1992/1992 [==============================] - 131s 66ms/step - loss: 0.0031 - model_acc: 0.9886 - val_loss: 0.0382 - val_model
_acc: 0.8185
Epoch 40/40
1992/1992 [==============================] - 129s 65ms/step - loss: 0.0031 - model_acc: 0.9889 - val_loss: 0.0391 - val_model
_acc: 0.8221
```

Out[6]:
```
<tensorflow.python.keras.callbacks.History at 0x17c80782af0>
```

In [ ]:
```

```