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 [==============================] - 133s 66ms/step - loss: 0.0257 - model_acc: 0.7141 - val_loss: 0.0178 - val_model
_acc: 0.7835
Epoch 2/40
1992/1992 [==============================] - 134s 67ms/step - loss: 0.0153 - model_acc: 0.8126 - val_loss: 0.0157 - val_model
_acc: 0.8038
Epoch 3/40
1992/1992 [==============================] - 132s 66ms/step - loss: 0.0120 - model_acc: 0.8487 - val_loss: 0.0144 - val_model
_acc: 0.8184
Epoch 4/40
1992/1992 [==============================] - 132s 66ms/step - loss: 0.0098 - model_acc: 0.8738 - val_loss: 0.0143 - val_model
_acc: 0.8228
Epoch 5/40
1992/1992 [==============================] - 130s 65ms/step - loss: 0.0080 - model_acc: 0.8955 - val_loss: 0.0141 - val_model
_acc: 0.8219
Epoch 6/40
1992/1992 [==============================] - 131s 66ms/step - loss: 0.0067 - model_acc: 0.9115 - val_loss: 0.0129 - val_model
_acc: 0.8388
Epoch 7/40
1992/1992 [==============================] - 131s 66ms/step - loss: 0.0056 - model_acc: 0.9271 - val_loss: 0.0122 - val_model
_acc: 0.8493
```

```
Epoch 8/40
1992/1992 [==============================] - 131s 66ms/step - loss: 0.0048 - model_acc: 0.9363 - val_loss: 0.0126 - val_model
_acc: 0.8456
Epoch 9/40
1992/1992 [==============================] - 132s 66ms/step - loss: 0.0043 - model_acc: 0.9436 - val_loss: 0.0125 - val_model
_acc: 0.8436
Epoch 10/40
1992/1992 [==============================] - 131s 66ms/step - loss: 0.0037 - model_acc: 0.9484 - val_loss: 0.0128 - val_model
_acc: 0.8363
Epoch 11/40
1992/1992 [==============================] - 131s 66ms/step - loss: 0.0033 - model_acc: 0.9557 - val_loss: 0.0119 - val_model
_acc: 0.8462
Epoch 12/40
1992/1992 [==============================] - 129s 65ms/step - loss: 0.0030 - model_acc: 0.9594 - val_loss: 0.0120 - val_model
_acc: 0.8487
Epoch 13/40
1992/1992 [==============================] - 132s 66ms/step - loss: 0.0027 - model_acc: 0.9620 - val_loss: 0.0125 - val_model
_acc: 0.8431
Epoch 14/40
1992/1992 [==============================] - 131s 66ms/step - loss: 0.0026 - model_acc: 0.9646 - val_loss: 0.0123 - val_model
_acc: 0.8470
Epoch 15/40
1992/1992 [==============================] - 134s 67ms/step - loss: 0.0023 - model_acc: 0.9690 - val_loss: 0.0121 - val_model
_acc: 0.8538
Epoch 16/40
1992/1992 [==============================] - 132s 66ms/step - loss: 0.0022 - model_acc: 0.9700 - val_loss: 0.0117 - val_model
_acc: 0.8541
Epoch 17/40
1992/1992 [==============================] - 133s 67ms/step - loss: 0.0019 - model_acc: 0.9747 - val_loss: 0.0117 - val_model
_acc: 0.8510
Epoch 18/40
1992/1992 [==============================] - 133s 67ms/step - loss: 0.0018 - model_acc: 0.9750 - val_loss: 0.0120 - val_model
_acc: 0.8535
Epoch 19/40
1992/1992 [==============================] - 132s 66ms/step - loss: 0.0017 - model_acc: 0.9755 - val_loss: 0.0119 - val_model
_acc: 0.8473
Epoch 20/40
1992/1992 [==============================] - 133s 67ms/step - loss: 0.0016 - model_acc: 0.9774 - val_loss: 0.0118 - val_model
_acc: 0.8543
Epoch 21/40
1992/1992 [==============================] - 132s 66ms/step - loss: 0.0015 - model_acc: 0.9795 - val_loss: 0.0120 - val_model
_acc: 0.8510
Epoch 22/40
1992/1992 [==============================] - 132s 66ms/step - loss: 0.0014 - model_acc: 0.9790 - val_loss: 0.0118 - val_model
```

```
_acc: 0.8510
Epoch 23/40
1992/1992 [==============================] - 133s 67ms/step - loss: 0.0013 - model_acc: 0.9806 - val_loss: 0.0116 - val_model
_acc: 0.8552
Epoch 24/40
1992/1992 [==============================] - 133s 67ms/step - loss: 0.0011 - model_acc: 0.9853 - val_loss: 0.0118 - val_model
_acc: 0.8572
Epoch 25/40
1992/1992 [==============================] - 131s 66ms/step - loss: 0.0011 - model_acc: 0.9842 - val_loss: 0.0118 - val_model
_acc: 0.8518
Epoch 26/40
1992/1992 [==============================] - 134s 67ms/step - loss: 0.0013 - model_acc: 0.9808 - val_loss: 0.0121 - val_model
_acc: 0.8493
Epoch 27/40
1992/1992 [==============================] - 133s 67ms/step - loss: 9.3766e-04 - model_acc: 0.9867 - val_loss: 0.0118 - val_m
odel_acc: 0.8572
Epoch 28/40
1992/1992 [==============================] - 133s 67ms/step - loss: 8.1103e-04 - model_acc: 0.9891 - val_loss: 0.0119 - val_m
odel_acc: 0.8510
Epoch 29/40
1992/1992 [==============================] - 130s 65ms/step - loss: 0.0012 - model_acc: 0.9805 - val_loss: 0.0125 - val_model
_acc: 0.8502
Epoch 30/40
1992/1992 [==============================] - 130s 65ms/step - loss: 9.4021e-04 - model_acc: 0.9866 - val_loss: 0.0119 - val_m
odel_acc: 0.8552
Epoch 31/40
1992/1992 [==============================] - 130s 65ms/step - loss: 6.7762e-04 - model_acc: 0.9917 - val_loss: 0.0119 - val_m
odel_acc: 0.8555
Epoch 32/40
1992/1992 [==============================] - 128s 64ms/step - loss: 7.1511e-04 - model_acc: 0.9909 - val_loss: 0.0124 - val_m
odel_acc: 0.8515
Epoch 33/40
1992/1992 [==============================] - 129s 65ms/step - loss: 7.9148e-04 - model_acc: 0.9877 - val_loss: 0.0120 - val_m
odel_acc: 0.8541
Epoch 34/40
1992/1992 [==============================] - 129s 65ms/step - loss: 7.8365e-04 - model_acc: 0.9879 - val_loss: 0.0121 - val_m
odel_acc: 0.8515
Epoch 35/40
1992/1992 [==============================] - 129s 65ms/step - loss: 6.6734e-04 - model_acc: 0.9902 - val_loss: 0.0131 - val_m
odel_acc: 0.8422
Epoch 36/40
1992/1992 [==============================] - 130s 65ms/step - loss: 6.9820e-04 - model_acc: 0.9899 - val_loss: 0.0120 - val_m
odel_acc: 0.8532
Epoch 37/40
```

```
1992/1992 [==============================] - 130s 65ms/step - loss: 5.6135e-04 - model_acc: 0.9928 - val_loss: 0.0122 - val_m
odel_acc: 0.8546
Epoch 38/40
1992/1992 [==============================] - 129s 65ms/step - loss: 5.8217e-04 - model_acc: 0.9912 - val_loss: 0.0121 - val_m
odel_acc: 0.8552
Epoch 39/40
1992/1992 [==============================] - 127s 64ms/step - loss: 6.4245e-04 - model_acc: 0.9904 - val_loss: 0.0120 - val_m
odel_acc: 0.8538
Epoch 40/40
1992/1992 [==============================] - 129s 65ms/step - loss: 5.1479e-04 - model_acc: 0.9929 - val_loss: 0.0119 - val_m
odel_acc: 0.8557
```

Out[6]:
```
<tensorflow.python.keras.callbacks.History at 0x1e6008d4af0>
```

In [7]:
```
base_model = resnet_v2.ResNet50V2(include_top=False,
                        weights="imagenet",
                        input_shape=(48,48,3))
base_model.trainable=True
model = Sequential([
    base_model,
    layers.GlobalAveragePooling2D(),
    layers.Dense(2048, activation='relu'),
    layers.Dense(2048, 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=training_images,
          y=training_emotions,
          batch_size=32,
          epochs=40,
          validation_data=(test_images, test_emotions))
```

```
Epoch 1/40
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
~\AppData\Local\Temp/ipykernel_5260/3271828104.py in <module>
     15              metrics = [model_acc])
     16
---> 17 model.fit(x=training_images,
     18           y=training_emotions,
```