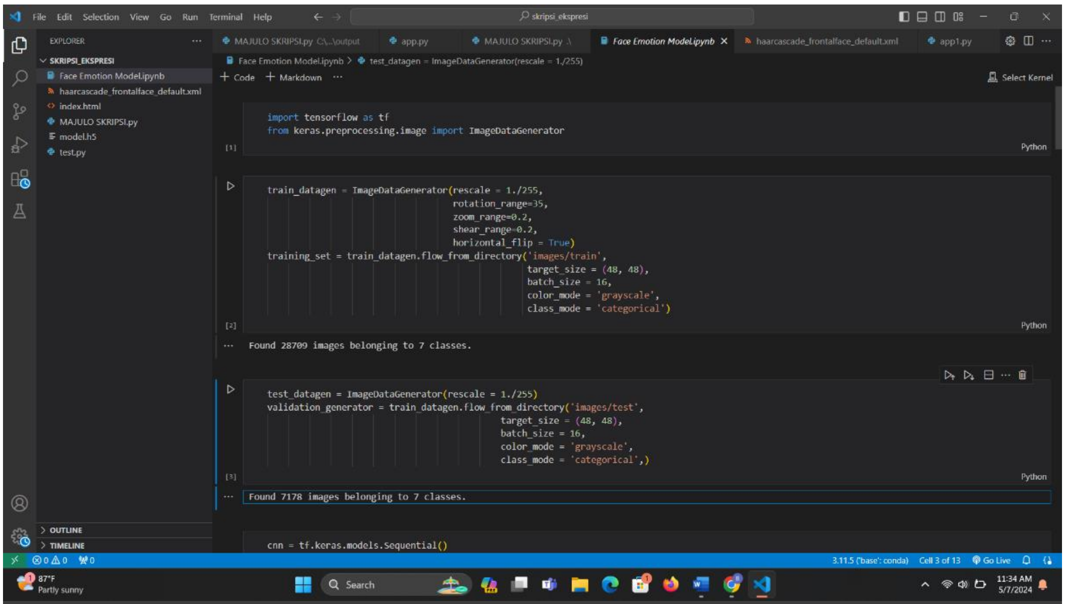
LAMPIRAN

1. Code program



```
import tensorflow as tf
from keras.preprocessing.image import ImageDataGenerator
```

[1]

```
train_datagen = ImageDataGenerator(rescale = 1./255,
                                   rotation_range=35,
                                   zoom_range=0.2,
                                   shear_range=0.2,
                                   horizontal_flip = True)
training_set = train_datagen.flow_from_directory('images/train',
                                                 target_size = (48, 48),
                                                 batch_size = 16,
                                                 color_mode = 'grayscale',
                                                 class_mode = 'categorical')
```

[2]

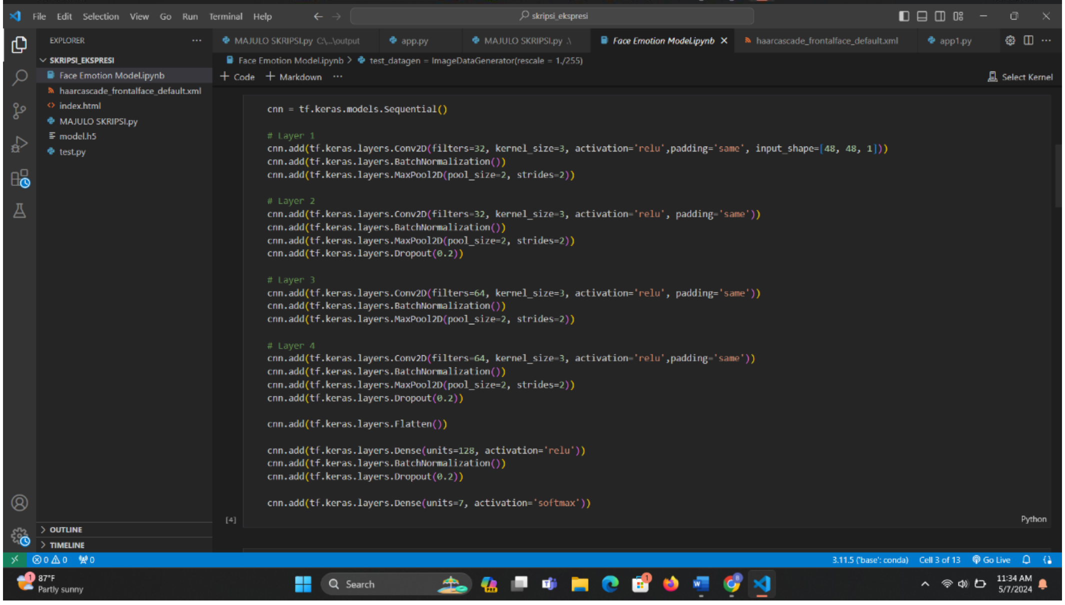
```
Found 28709 images belonging to 7 classes.
```

```
test_datagen = ImageDataGenerator(rescale = 1./255)
validation_generator = train_datagen.flow_from_directory('images/test',
                                                 target_size = (48, 48),
                                                 batch_size = 16,
                                                 color_mode = 'grayscale',
                                                 class_mode = 'categorical',)
```

[3]

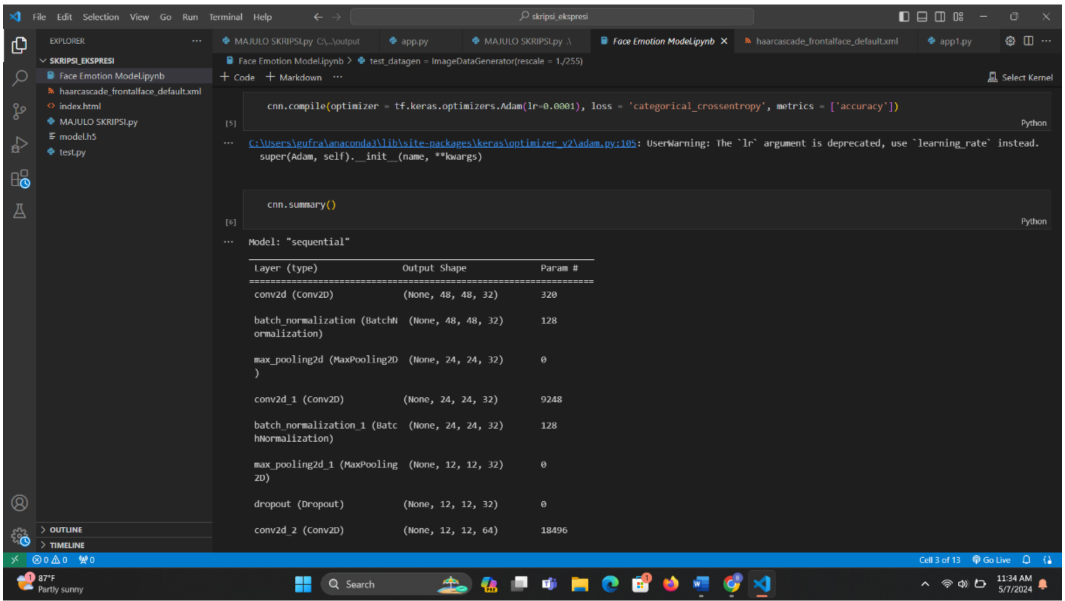
```
Found 7178 images belonging to 7 classes.
```

```
cnn = tf.keras.models.Sequential()
```



```
cnn = tf.keras.models.Sequential()

# Layer 1
cnn.add(tf.keras.layers.Conv2D(filters=32, kernel_size=3, activation='relu',padding='same', input_shape=[48, 48, 1]))
cnn.add(tf.keras.layers.BatchNormalization())
cnn.add(tf.keras.layers.MaxPool2D(pool_size=2, strides=2))

# Layer 2
cnn.add(tf.keras.layers.Conv2D(filters=32, kernel_size=3, activation='relu', padding='same'))
cnn.add(tf.keras.layers.BatchNormalization())
cnn.add(tf.keras.layers.MaxPool2D(pool_size=2, strides=2))
cnn.add(tf.keras.layers.Dropout(0.2))

# Layer 3
cnn.add(tf.keras.layers.Conv2D(filters=64, kernel_size=3, activation='relu', padding='same'))
cnn.add(tf.keras.layers.BatchNormalization())
cnn.add(tf.keras.layers.MaxPool2D(pool_size=2, strides=2))

# Layer 4
cnn.add(tf.keras.layers.Conv2D(filters=64, kernel_size=3, activation='relu',padding='same'))
cnn.add(tf.keras.layers.BatchNormalization())
cnn.add(tf.keras.layers.MaxPool2D(pool_size=2, strides=2))
cnn.add(tf.keras.layers.Dropout(0.2))

cnn.add(tf.keras.layers.Flatten())

cnn.add(tf.keras.layers.Dense(units=128, activation='relu'))
cnn.add(tf.keras.layers.BatchNormalization())
cnn.add(tf.keras.layers.Dropout(0.2))

cnn.add(tf.keras.layers.Dense(units=7, activation='softmax'))
```

[4]

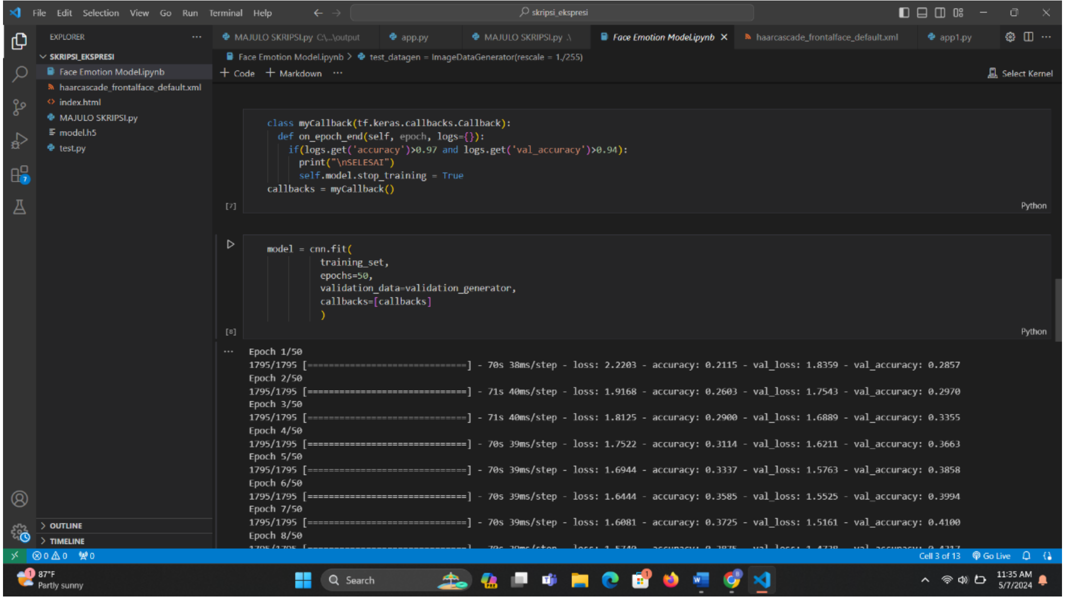


```
[5]
cnn.compile(optimizer = tf.keras.optimizers.Adam(lr=0.0001), loss = 'categorical_crossentropy', metrics = ['accuracy'])
```

```
C:\Users\gufra\anaconda3\lib\site-packages\keras\optimizer_v2\adam.py:105: UserWarning: The `lr` argument is deprecated, use `learning_rate` instead.
  super(Adam, self).__init__(name, **kwargs)
```

```
[6]
cnn.summary()
```

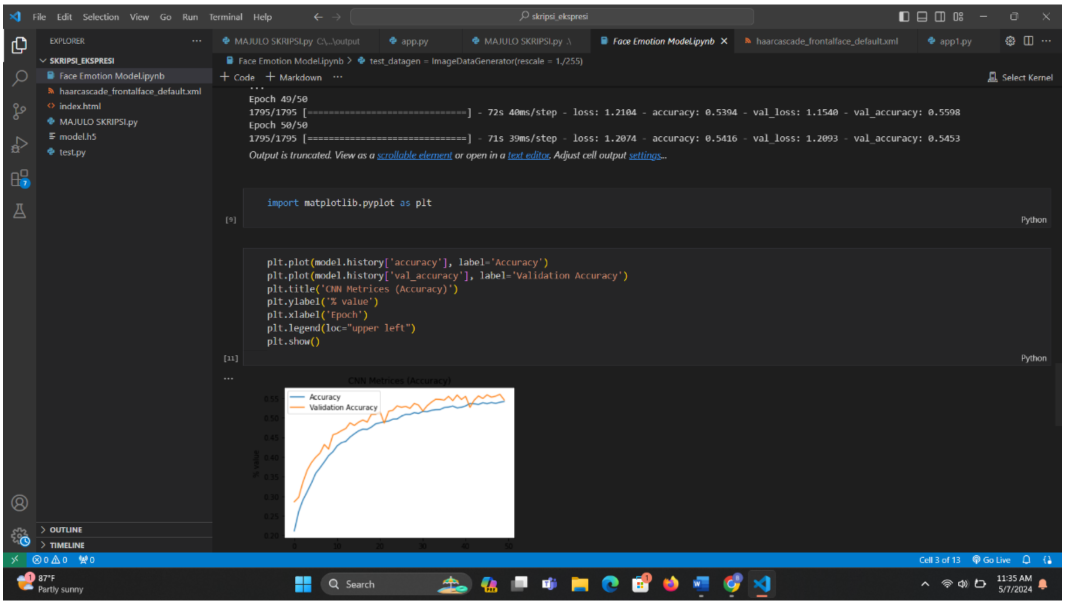
```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d (Conv2D)             (None, 48, 48, 32)        320

 batch_normalization (BatchN  (None, 48, 48, 32)       128
 ormalization)

 max_pooling2d (MaxPooling2D  (None, 24, 24, 32)       0
 )

 conv2d_1 (Conv2D)           (None, 24, 24, 32)        9248

 batch_normalization_1 (Batc  (None, 24, 24, 32)       128
 hNormalization)

 max_pooling2d_1 (MaxPooling  (None, 12, 12, 32)       0
 2D)

 dropout (Dropout)           (None, 12, 12, 32)        0

 conv2d_2 (Conv2D)           (None, 12, 12, 64)        18496
```



```
[7]
class myCallback(tf.keras.callbacks.Callback):
  def on_epoch_end(self, epoch, logs={}):
    if(logs.get('accuracy')>0.97 and logs.get('val_accuracy')>0.94):
      print("\nSELESAI")
      self.model.stop_training = True
callbacks = myCallback()
```

```
[8]
model = cnn.fit(
          training_set,
          epochs=50,
          validation_data=validation_generator,
          callbacks=[callbacks]
          )
```

```
Epoch 1/50
1795/1795 [==============================] - 70s 38ms/step - loss: 2.2203 - accuracy: 0.2115 - val_loss: 1.8359 - val_accuracy: 0.2857
Epoch 2/50
1795/1795 [==============================] - 71s 40ms/step - loss: 1.9168 - accuracy: 0.2603 - val_loss: 1.7543 - val_accuracy: 0.2970
Epoch 3/50
1795/1795 [==============================] - 71s 40ms/step - loss: 1.8125 - accuracy: 0.2900 - val_loss: 1.6889 - val_accuracy: 0.3355
Epoch 4/50
1795/1795 [==============================] - 70s 39ms/step - loss: 1.7522 - accuracy: 0.3114 - val_loss: 1.6211 - val_accuracy: 0.3663
Epoch 5/50
1795/1795 [==============================] - 70s 39ms/step - loss: 1.6944 - accuracy: 0.3337 - val_loss: 1.5763 - val_accuracy: 0.3858
Epoch 6/50
1795/1795 [==============================] - 70s 39ms/step - loss: 1.6444 - accuracy: 0.3585 - val_loss: 1.5525 - val_accuracy: 0.3994
Epoch 7/50
1795/1795 [==============================] - 70s 39ms/step - loss: 1.6081 - accuracy: 0.3725 - val_loss: 1.5161 - val_accuracy: 0.4100
Epoch 8/50
```



```
...
Epoch 49/50
1795/1795 [==============================] - 72s 40ms/step - loss: 1.2104 - accuracy: 0.5394 - val_loss: 1.1540 - val_accuracy: 0.5598
Epoch 50/50
1795/1795 [==============================] - 71s 39ms/step - loss: 1.2074 - accuracy: 0.5416 - val_loss: 1.2093 - val_accuracy: 0.5453
```

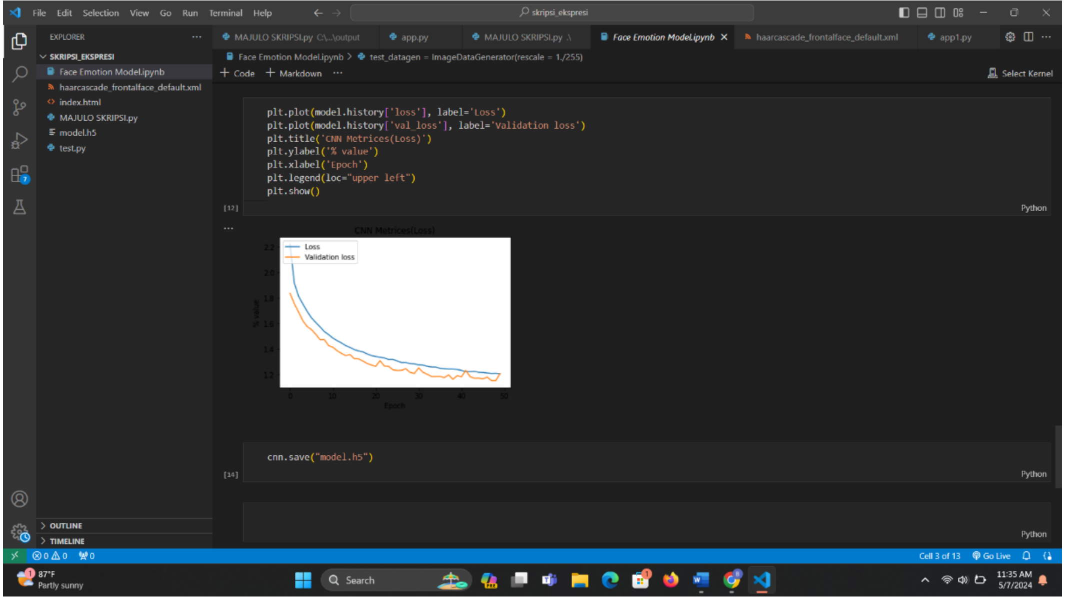
Output is truncated. View as a scrollable element or open in a text editor. Adjust cell output settings...

```python
import matplotlib.pyplot as plt
```

[9]

```python
plt.plot(model.history['accuracy'], label='Accuracy')
plt.plot(model.history['val_accuracy'], label='Validation Accuracy')
plt.title('CNN Metrices (Accuracy)')
plt.ylabel('% value')
plt.xlabel('Epoch')
plt.legend(loc="upper left")
plt.show()
```

[11]



```python
plt.plot(model.history['loss'], label='Loss')
plt.plot(model.history['val_loss'], label='Validation loss')
plt.title('CNN Metrices(Loss)')
plt.ylabel('% value')
plt.xlabel('Epoch')
plt.legend(loc="upper left")
plt.show()
```

[12]

```python
cnn.save("model.h5")
```

[14]