‣ Preprocessing

▾ model 1

model1

```
ebc1.fit(train_generator,
         epochs=epochz,
         steps_per_epoch=s_p_e,
         #validation_data=val_generator,
         callbacks=[batch_stats_callback],
         )
```

```
Epoch 1/3
265/265 [==============================] - 6921s 26s/step - loss: 0.4547 - acc: 0.8750
Epoch 2/3
265/265 [==============================] - 6931s 26s/step - loss: 0.2585 - acc: 0.8750
Epoch 3/3
265/265 [==============================] - 7135s 27s/step - loss: 0.2894 - acc: 0.9062
<keras.callbacks.History at 0x7fa5ddef4c50>
```

```
ebc1.fit(train_generator,
         epochs=epochz,
         steps_per_epoch=s_p_e,
         #validation_data=val_generator,
         callbacks=[batch_stats_callback],
         )
```

```
Epoch 1/3
265/265 [==============================] - 7915s 30s/step - loss: 0.1661 - acc: 0.9375
Epoch 2/3
265/265 [==============================] - 7450s 28s/step - loss: 0.2484 - acc: 0.9375
Epoch 3/3
265/265 [==============================] - 7092s 27s/step - loss: 0.1019 - acc: 0.9688
<keras.callbacks.History at 0x7fa5d5704f10>
```

```
ebc1.fit(train_generator,
         epochs=epochz,
         steps_per_epoch=s_p_e,
         #validation_data=val_generator,
         callbacks=[batch_stats_callback],
         )
```

```
Epoch 1/3
265/265 [==============================] - 7240s 27s/step - loss: 0.3580 - acc: 0.8696
Epoch 2/3
265/265 [==============================] - 7554s 29s/step - loss: 0.1655 - acc: 0.9062
Epoch 3/3
```

```
265/265 [==============================] - 7566s 29s/step - loss: 0.2184 - acc: 0.8750
<keras.callbacks.History at 0x7fa5d4adf850>
```

```
ebc1.fit(train_generator,
         epochs=epochz,
         steps_per_epoch=s_p_e,
         #validation_data=val_generator,
         callbacks=[batch_stats_callback],
         )
```

```
Epoch 1/3
265/265 [==============================] - 7114s 27s/step - loss: 0.3442 - acc: 0.8750
Epoch 2/3
265/265 [==============================] - 7013s 26s/step - loss: 0.2897 - acc: 0.8438
Epoch 3/3
265/265 [==============================] - 6962s 26s/step - loss: 0.2257 - acc: 0.8750
<keras.callbacks.History at 0x7f44693210d0>
```

```
ebc1.fit(train_generator,
         epochs=epochz,
         steps_per_epoch=s_p_e,
         #validation_data=val_generator,
         callbacks=[batch_stats_callback],
         )
```

```
Epoch 1/3
265/265 [==============================] - 7014s 26s/step - loss: 0.1598 - acc: 0.9688
Epoch 2/3
265/265 [==============================] - 7031s 27s/step - loss: 0.4163 - acc: 0.9062
Epoch 3/3
265/265 [==============================] - 7097s 27s/step - loss: 0.1041 - acc: 0.9688
<keras.callbacks.History at 0x7f4455916f10>
```

教師モデル学習

mark

```
#上位分類層を接合
ebc1=Sequential([feature_extractor_layer,
                 layers.Dense(train_generator.num_classes,activation='softmax')])

ebc1.summary()

ebc1.compile(optimizer=tf.keras.optimizers.Adam(),
             loss='categorical_crossentropy',
             metrics=['acc'])
```

```
Model: "sequential_3"
_____
 Layer (type)                Output Shape              Param #
=================================================================
 keras_layer (KerasLayer)    (None, 1280)              207615832

 dense_3 (Dense)             (None, 4)                 5124
```

```
================================================================
Total params: 207,620,956
Trainable params: 5,124
Non-trainable params: 207,615,832
_____
```

```
ebc1.fit(train_generator,
        epochs=epochz,
        steps_per_epoch=s_p_e,
        validation_data=val_generator,
        callbacks=[checkpoint1,batch_stats_callback],
        )
```

```
Epoch 1/3
265/265 [==============================] - ETA: 0s - loss: 0.2897 - acc: 0.8438
Epoch 1: saving model to /content/drive/MyDrive/result11/model01-01.h5
265/265 [==============================] - 10209s 39s/step - loss: 0.2897 - acc: 0.8438 - val_loss: 0.5249 - val_acc: 0.8094
Epoch 2/3
265/265 [==============================] - ETA: 0s - loss: 0.2380 - acc: 0.9375
Epoch 2: saving model to /content/drive/MyDrive/result11/model01-02.h5
265/265 [==============================] - 10196s 39s/step - loss: 0.2380 - acc: 0.9375 - val_loss: 0.5457 - val_acc: 0.7970
Epoch 3/3
265/265 [==============================] - ETA: 0s - loss: 0.1190 - acc: 1.0000
Epoch 3: saving model to /content/drive/MyDrive/result11/model01-03.h5
265/265 [==============================] - 10235s 39s/step - loss: 0.1190 - acc: 1.0000 - val_loss: 0.4672 - val_acc: 0.8256
<keras.callbacks.History at 0x7f444d0a2490>
```

```
ebc1.fit(train_generator,
        epochs=epochz,
        steps_per_epoch=s_p_e,
        validation_data=val_generator,
        callbacks=[checkpoint1,batch_stats_callback],
        )
```

```
Epoch 1/3
265/265 [==============================] - ETA: 0s - loss: 0.6026 - acc: 0.7500
Epoch 1: saving model to /content/drive/MyDrive/result11/model01-01.h5
265/265 [==============================] - 6639s 25s/step - loss: 0.6026 - acc: 0.7500 - val_loss: 0.5886 - val_acc: 0.7780
Epoch 2/3
265/265 [==============================] - ETA: 0s - loss: 0.5779 - acc: 0.8125
Epoch 2: saving model to /content/drive/MyDrive/result11/model01-02.h5
265/265 [==============================] - 6606s 25s/step - loss: 0.5779 - acc: 0.8125 - val_loss: 0.4927 - val_acc: 0.8198
Epoch 3/3
265/265 [==============================] - ETA: 0s - loss: 0.1671 - acc: 1.0000
Epoch 3: saving model to /content/drive/MyDrive/result11/model01-03.h5
265/265 [==============================] - 6664s 25s/step - loss: 0.1671 - acc: 1.0000 - val_loss: 0.4859 - val_acc: 0.8185
<keras.callbacks.History at 0x7fee82d5e490>
```

```
ebc1.fit(train_generator,
        epochs=epochz,
        steps_per_epoch=s_p_e,
        validation_data=val_generator,
        callbacks=[checkpoint1,batch_stats_callback],
        )
```

```
Epoch 1/3
265/265 [==============================] - ETA: 0s - loss: 0.0600 - acc: 1.0000
```

```
Epoch 1: saving model to /content/drive/MyDrive/result11/model01-01.h5
265/265 [==============================] - 6748s 25s/step - loss: 0.0600 - acc: 1.0000 - val_loss: 0.4724 - val_acc: 0.8256
Epoch 2/3
265/265 [==============================] - ETA: 0s - loss: 0.1740 - acc: 0.9062
Epoch 2: saving model to /content/drive/MyDrive/result11/model01-02.h5
265/265 [==============================] - 6826s 26s/step - loss: 0.1740 - acc: 0.9062 - val_loss: 0.4606 - val_acc: 0.8240
Epoch 3/3
265/265 [==============================] - ETA: 0s - loss: 0.1909 - acc: 0.9375
Epoch 3: saving model to /content/drive/MyDrive/result11/model01-03.h5
265/265 [==============================] - 6715s 25s/step - loss: 0.1909 - acc: 0.9375 - val_loss: 0.5256 - val_acc: 0.8080
<keras.callbacks.History at 0x7fedf0700710>
```

```
ebc1.fit(train_generator,
        epochs=epochz,
        steps_per_epoch=s_p_e,
        validation_data=val_generator,
        callbacks=[checkpoint1,batch_stats_callback],
        )
```

```
Epoch 1/3
265/265 [==============================] - ETA: 0s - loss: 0.4816 - acc: 0.7812
Epoch 1: saving model to /content/drive/MyDrive/result11/model01-01.h5
265/265 [==============================] - 10370s 39s/step - loss: 0.4816 - acc: 0.7812 - val_loss: 0.5300 - val_acc: 0.7981
Epoch 2/3
265/265 [==============================] - ETA: 0s - loss: 0.4023 - acc: 0.8750
Epoch 2: saving model to /content/drive/MyDrive/result11/model01-02.h5
265/265 [==============================] - 10455s 39s/step - loss: 0.4023 - acc: 0.8750 - val_loss: 0.5439 - val_acc: 0.7948
Epoch 3/3
265/265 [==============================] - ETA: 0s - loss: 0.2054 - acc: 0.9375
Epoch 3: saving model to /content/drive/MyDrive/result11/model01-03.h5
265/265 [==============================] - 10709s 40s/step - loss: 0.2054 - acc: 0.9375 - val_loss: 0.4732 - val_acc: 0.8215
<keras.callbacks.History at 0x7f57df077650>
```

```
ebc1.fit(train_generator,
        epochs=epochz,
        steps_per_epoch=s_p_e,
        validation_data=val_generator,
        callbacks=[checkpoint1,batch_stats_callback],
        )
```

```
Epoch 1/3
265/265 [==============================] - ETA: 0s - loss: 0.1071 - acc: 1.0000
Epoch 1: saving model to /content/drive/MyDrive/result11/model01-01.h5
265/265 [==============================] - 10552s 40s/step - loss: 0.1071 - acc: 1.0000 - val_loss: 0.4821 - val_acc: 0.8209
Epoch 2/3
265/265 [==============================] - ETA: 0s - loss: 0.2996 - acc: 0.9062
Epoch 2: saving model to /content/drive/MyDrive/result11/model01-02.h5
265/265 [==============================] - 10481s 40s/step - loss: 0.2996 - acc: 0.9062 - val_loss: 0.4500 - val_acc: 0.8306
Epoch 3/3
265/265 [==============================] - ETA: 0s - loss: 0.2123 - acc: 0.9688
Epoch 3: saving model to /content/drive/MyDrive/result11/model01-03.h5
265/265 [==============================] - 10611s 40s/step - loss: 0.2123 - acc: 0.9688 - val_loss: 0.4666 - val_acc: 0.8262
<keras.callbacks.History at 0x7f57d13aead0>
```

mark

```
#上位分類層を接合
```

```
ebc1=Sequential([feature_extractor_layer,
                    layers.Dense(train_generator.num_classes,activation='softmax')])

ebc1.summary()

ebc1.compile(optimizer=tf.keras.optimizers.Adam(),
              loss='categorical_crossentropy',
              metrics=['acc'])
```

```
Model: "sequential_4"

_____
 Layer (type)                Output Shape              Param #
=================================================================
 keras_layer (KerasLayer)    (None, 1280)              207615832

 dense_4 (Dense)             (None, 4)                 5124

=================================================================
Total params: 207,620,956
Trainable params: 5,124
Non-trainable params: 207,615,832
_____
```

```
#擬似ラベル作成
history=ebc1.fit(train_generator,
                  epochs=epochz,
                  steps_per_epoch=s_p_e,
                  validation_data=gizi_data,
                  callbacks=[checkpoint1,batch_stats_callback]
                  )
```

```
Epoch 1/3
265/265 [==============================] - ETA: 0s - loss: 0.5400 - acc: 0.7812
Epoch 1: saving model to /content/drive/MyDrive/result11/model01-01.h5
265/265 [==============================] - 13663s 52s/step - loss: 0.5400 - acc: 0.7812 - val_loss: 0.4218 - val_acc: 0.8470
Epoch 2/3
265/265 [==============================] - ETA: 0s - loss: 0.2713 - acc: 0.8750
Epoch 2: saving model to /content/drive/MyDrive/result11/model01-02.h5
265/265 [==============================] - 13793s 52s/step - loss: 0.2713 - acc: 0.8750 - val_loss: 0.3377 - val_acc: 0.8830
Epoch 3/3
265/265 [==============================] - ETA: 0s - loss: 0.2521 - acc: 0.9062
Epoch 3: saving model to /content/drive/MyDrive/result11/model01-03.h5
265/265 [==============================] - 13845s 52s/step - loss: 0.2521 - acc: 0.9062 - val_loss: 0.3220 - val_acc: 0.8870
```

```
history=ebc1.fit(train_generator,
                  epochs=epochz,
                  steps_per_epoch=s_p_e,
                  validation_data=gizi_data,
                  callbacks=[checkpoint1,batch_stats_callback]
                  )
```

```
Epoch 1/3
265/265 [==============================] - ETA: 0s - loss: 0.2781 - acc: 0.8750
Epoch 1: saving model to /content/drive/MyDrive/result11/model01-01.h5
265/265 [==============================] - 13670s 52s/step - loss: 0.2781 - acc: 0.8750 - val_loss: 0.2886 - val_acc: 0.8965
Epoch 2/3
```

```
265/265 [==============================] - ETA: 0s - loss: 0.0784 - acc: 0.9688
Epoch 2: saving model to /content/drive/MyDrive/result11/model01-02.h5
265/265 [==============================] - 14036s 53s/step - loss: 0.0784 - acc: 0.9688 - val_loss: 0.2820 - val_acc: 0.8998
Epoch 3/3
265/265 [==============================] - ETA: 0s - loss: 0.1907 - acc: 0.9375
Epoch 3: saving model to /content/drive/MyDrive/result11/model01-03.h5
265/265 [==============================] - 14110s 53s/step - loss: 0.1907 - acc: 0.9375 - val_loss: 0.2877 - val_acc: 0.8990
```

```
history=ebc1.fit(train_generator,
                 epochs=epochz,
                 steps_per_epoch=s_p_e,
                 validation_data=gizi_data,
                 callbacks=[checkpoint1,batch_stats_callback]
                 )
```

```
Epoch 1/3
265/265 [==============================] - ETA: 0s - loss: 0.4968 - acc: 0.8438
Epoch 1: saving model to /content/drive/MyDrive/result11/model01-01.h5
265/265 [==============================] - 17471s 66s/step - loss: 0.4968 - acc: 0.8438 - val_loss: 0.3886 - val_acc: 0.8619
Epoch 2/3
265/265 [==============================] - ETA: 0s - loss: 0.1510 - acc: 0.9375
Epoch 2: saving model to /content/drive/MyDrive/result11/model01-02.h5
265/265 [==============================] - 17397s 66s/step - loss: 0.1510 - acc: 0.9375 - val_loss: 0.3450 - val_acc: 0.8784
Epoch 3/3
265/265 [==============================] - ETA: 0s - loss: 0.3350 - acc: 0.8438
Epoch 3: saving model to /content/drive/MyDrive/result11/model01-03.h5
265/265 [==============================] - 17950s 68s/step - loss: 0.3350 - acc: 0.8438 - val_loss: 0.3149 - val_acc: 0.8881
```

```
history=ebc1.fit(train_generator,
                 epochs=epochz,
                 steps_per_epoch=s_p_e,
                 validation_data=gizi_data,
                 callbacks=[checkpoint1,batch_stats_callback]
                 )
```

```
Epoch 1/3
265/265 [==============================] - ETA: 0s - loss: 0.7040 - acc: 0.6562
Epoch 1: saving model to /content/drive/MyDrive/result11/model01-01.h5
265/265 [==============================] - 17895s 67s/step - loss: 0.7040 - acc: 0.6562 - val_loss: 0.4171 - val_acc: 0.8446
Epoch 2/3
265/265 [==============================] - ETA: 0s - loss: 0.5065 - acc: 0.8750
Epoch 2: saving model to /content/drive/MyDrive/result11/model01-02.h5
265/265 [==============================] - 17959s 68s/step - loss: 0.5065 - acc: 0.8750 - val_loss: 0.3282 - val_acc: 0.8817
Epoch 3/3
258/265 [===========================>.] - ETA: 3:14 - loss: 0.2771 - acc: 0.9062
```

```
history=ebc1.fit(train_generator,
                 epochs=epochz,
                 steps_per_epoch=s_p_e,
                 validation_data=gizi_data,
                 callbacks=[checkpoint1,batch_stats_callback]
                 )
```

```
Epoch 1/3
265/265 [==============================] - ETA: 0s - loss: 0.4689 - acc: 0.8125
Epoch 1: saving model to /content/drive/MyDrive/result11/model01-01.h5
265/265 [==============================] - 13634s 51s/step - loss: 0.4689 - acc: 0.8125 - val_loss: 0.3824 - val_acc: 0.8625
```

```
Epoch 2/3
265/265 [==============================] - ETA: 0s - loss: 0.2146 - acc: 0.9375
Epoch 2: saving model to /content/drive/MyDrive/result11/model01-02.h5
265/265 [==============================] - 14113s 53s/step - loss: 0.2146 - acc: 0.9375 - val_loss: 0.3238 - val_acc: 0.8869
Epoch 3/3
265/265 [==============================] - ETA: 0s - loss: 0.2532 - acc: 0.8750
```

```
#疑似ラベルの予測
gizi_label1=ebc1.predict(gizi_data)
```

```
379/379 [==============================] - 7531s 20s/step
```

mark

```
feature_extractor_layer.trainable=False
#入力画像ノイズ(rand augmentation)の設定
data_augmentation=Sequential([layers.RandomRotation(2.10)])
#モデルノイズ（stochastic depth）の設定
stochastic_Depth=Sequential([tfa.layers.StochasticDepth(0.35)])

#モデルにrand augmentationを適用
model1=Sequential([data_augmentation])
#モデルにstochastic depthを適用
model1=Sequential([stochastic_Depth])

#モデルノイズ（dropout）の設定と適用
model1=Sequential([feature_extractor_layer,
                    layers.Dense(train_generator.num_classes,activation='softmax'),
                    #layers.Dropout(0.2)

                ])
```

mark

```
#model1
model1.compile(optimizer=tf.keras.optimizers.Adam(),
            loss='categorical_crossentropy',
            metrics=['acc'])
model1.summary()
```

```
Model: "sequential_9"
_____
 Layer (type)                Output Shape              Param #
=================================================================
 keras_layer (KerasLayer)    (None, 1280)              207615832

 dense_5 (Dense)             (None, 4)                 5124

=================================================================
Total params: 207,620,956
Trainable params: 5,124
Non-trainable params: 207,615,832
_____
```

```
#model1
history=model1.fit(gizi_data,
                    epochs=epochz,
                    steps_per_epoch=np.ceil(gizi_data.samples/batch_size),
                    validation_data=val_generator,
                    callbacks=[checkpoint1,batch_stats_callback]
                    )
```

```
Epoch 1/3
379/379 [==============================] - ETA: 0s - loss: 0.2881 - acc: 0.9062
Epoch 1: saving model to /content/drive/MyDrive/result11/model01-01.h5
379/379 [==============================] - 8853s 23s/step - loss: 0.2881 - acc: 0.9062 - val_loss: 0.3884 - val_acc: 0.8656
Epoch 2/3
379/379 [==============================] - ETA: 0s - loss: 0.2952 - acc: 0.8750
Epoch 2: saving model to /content/drive/MyDrive/result11/model01-02.h5
379/379 [==============================] - 8914s 24s/step - loss: 0.2952 - acc: 0.8750 - val_loss: 0.3308 - val_acc: 0.8771
Epoch 3/3
379/379 [==============================] - ETA: 0s - loss: 0.3965 - acc: 0.8438
Epoch 3: saving model to /content/drive/MyDrive/result11/model01-03.h5
379/379 [==============================] - 9083s 24s/step - loss: 0.3965 - acc: 0.8438 - val_loss: 0.2959 - val_acc: 0.8909
```

```
history=model1.fit(gizi_data,
                    epochs=epochz,
                    steps_per_epoch=np.ceil(gizi_data.samples/batch_size),
                    validation_data=val_generator,
                    callbacks=[checkpoint1,batch_stats_callback]
                    )
```

```
Epoch 1/3
379/379 [==============================] - ETA: 0s - loss: 0.4209 - acc: 0.8438
Epoch 1: saving model to /content/drive/MyDrive/result11/model01-01.h5
379/379 [==============================] - 11872s 31s/step - loss: 0.4209 - acc: 0.8438 - val_loss: 0.4004 - val_acc: 0.8512
Epoch 2/3
379/379 [==============================] - ETA: 0s - loss: 0.2977 - acc: 0.9062
Epoch 2: saving model to /content/drive/MyDrive/result11/model01-02.h5
379/379 [==============================] - 11836s 31s/step - loss: 0.2977 - acc: 0.9062 - val_loss: 0.3136 - val_acc: 0.8840
Epoch 3/3
379/379 [==============================] - ETA: 0s - loss: 0.3518 - acc: 0.8438
Epoch 3: saving model to /content/drive/MyDrive/result11/model01-03.h5
379/379 [==============================] - 11985s 32s/step - loss: 0.3518 - acc: 0.8438 - val_loss: 0.2978 - val_acc: 0.8868
```

```
history=model1.fit(gizi_data,
                    epochs=epochz,
                    steps_per_epoch=np.ceil(gizi_data.samples/batch_size),
                    validation_data=val_generator,
                    callbacks=[checkpoint1,batch_stats_callback]
                    )
```

```
Epoch 1/3
379/379 [==============================] - ETA: 0s - loss: 0.2713 - acc: 0.9062
Epoch 1: saving model to /content/drive/MyDrive/result11/model01-01.h5
379/379 [==============================] - 13618s 36s/step - loss: 0.2713 - acc: 0.9062 - val_loss: 0.4174 - val_acc: 0.8526
Epoch 2/3
379/379 [==============================] - ETA: 0s - loss: 0.1294 - acc: 1.0000
Epoch 2: saving model to /content/drive/MyDrive/result11/model01-02.h5
379/379 [==============================] - 13586s 36s/step - loss: 0.1294 - acc: 1.0000 - val_loss: 0.3399 - val_acc: 0.8752
Epoch 3/3
```

```
379/379 [==============================] - ETA: 0s - loss: 0.2835 - acc: 0.9062
Epoch 3: saving model to /content/drive/MyDrive/result11/model01-03.h5
379/379 [==============================] - 13776s 36s/step - loss: 0.2835 - acc: 0.9062 - val_loss: 0.2847 - val_acc: 0.8967
```

```
history=model1.fit(gizi_data,
                   epochs=epochz,
                   steps_per_epoch=np.ceil(gizi_data.samples/batch_size),
                   validation_data=val_generator,
                   callbacks=[checkpoint1,batch_stats_callback]
                   )
```

```
Epoch 1/3
379/379 [==============================] - ETA: 0s - loss: 0.2840 - acc: 0.9062
Epoch 1: saving model to /content/drive/MyDrive/result11/model01-01.h5
379/379 [==============================] - 13107s 34s/step - loss: 0.2840 - acc: 0.9062 - val_loss: 0.3823 - val_acc: 0.8634
Epoch 2/3
379/379 [==============================] - ETA: 0s - loss: 0.1438 - acc: 0.9688
Epoch 2: saving model to /content/drive/MyDrive/result11/model01-02.h5
379/379 [==============================] - 13223s 35s/step - loss: 0.1438 - acc: 0.9688 - val_loss: 0.3278 - val_acc: 0.8785
Epoch 3/3
379/379 [==============================] - ETA: 0s - loss: 0.2193 - acc: 0.9375
Epoch 3: saving model to /content/drive/MyDrive/result11/model01-03.h5
379/379 [==============================] - 13253s 35s/step - loss: 0.2193 - acc: 0.9375 - val_loss: 0.3272 - val_acc: 0.8788
```

```
history=model1.fit(gizi_data,
                   epochs=epochz,
                   steps_per_epoch=np.ceil(gizi_data.samples/batch_size),
                   validation_data=val_generator,
                   callbacks=[checkpoint1,batch_stats_callback]
                   )
```

```
Epoch 1/3
379/379 [==============================] - ETA: 0s - loss: 0.3353 - acc: 0.8750
Epoch 1: saving model to /content/drive/MyDrive/result11/model01-01.h5
379/379 [==============================] - 11820s 31s/step - loss: 0.3353 - acc: 0.8750 - val_loss: 0.4554 - val_acc: 0.8204
Epoch 2/3
379/379 [==============================] - ETA: 0s - loss: 0.3131 - acc: 0.9375
Epoch 2: saving model to /content/drive/MyDrive/result11/model01-02.h5
379/379 [==============================] - 11922s 31s/step - loss: 0.3131 - acc: 0.9375 - val_loss: 0.3254 - val_acc: 0.8821
Epoch 3/3
379/379 [==============================] - ETA: 0s - loss: 0.4790 - acc: 0.9062
Epoch 3: saving model to /content/drive/MyDrive/result11/model01-03.h5
379/379 [==============================] - 11771s 31s/step - loss: 0.4790 - acc: 0.9062 - val_loss: 0.3037 - val_acc: 0.8895
```

1

```
history=model1.fit(train_generator,
                   epochs=epochz,
                   steps_per_epoch=s_p_e,
                   validation_data=val_generator,
                   callbacks=[checkpoint1,batch_stats_callback]
                   )
```

```
Epoch 1/3
265/265 [==============================] - ETA: 0s - loss: 0.3432 - acc: 0.8438
Epoch 1: saving model to /content/drive/MyDrive/result11/model01-01.h5
```

```
265/265 [==============================] - 10556s 40s/step - loss: 0.3432 - acc: 0.8438 - val_loss: 0.5175 - val_acc: 0.8069
Epoch 2/3
265/265 [==============================] - ETA: 0s - loss: 0.3482 - acc: 0.8125
Epoch 2: saving model to /content/drive/MyDrive/result11/model01-02.h5
265/265 [==============================] - 10392s 39s/step - loss: 0.3482 - acc: 0.8125 - val_loss: 0.5115 - val_acc: 0.8069
Epoch 3/3
265/265 [==============================] - ETA: 0s - loss: 0.2299 - acc: 0.9062
Epoch 3: saving model to /content/drive/MyDrive/result11/model01-03.h5
265/265 [==============================] - 10318s 39s/step - loss: 0.2299 - acc: 0.9062 - val_loss: 0.4722 - val_acc: 0.8187
```

```python
history=model1.fit(train_generator,
                   epochs=epochz,
                   steps_per_epoch=s_p_e,
                   validation_data=val_generator,
                   callbacks=[checkpoint1,batch_stats_callback]
                   )
```

```
Epoch 1/3
263/263 [==============================] - ETA: 0s - loss: 0.1829 - acc: 1.0000
Epoch 1: saving model to /content/drive/MyDrive/result11/model01-01.h5
263/263 [==============================] - 6747s 26s/step - loss: 0.1829 - acc: 1.0000 - val_loss: 0.5243 - val_acc: 0.8039
Epoch 2/3
263/263 [==============================] - ETA: 0s - loss: 0.4427 - acc: 0.9062
Epoch 2: saving model to /content/drive/MyDrive/result11/model01-02.h5
263/263 [==============================] - 6865s 26s/step - loss: 0.4427 - acc: 0.9062 - val_loss: 0.4706 - val_acc: 0.8256
Epoch 3/3
263/263 [==============================] - ETA: 0s - loss: 0.2462 - acc: 0.8750
Epoch 3: saving model to /content/drive/MyDrive/result11/model01-03.h5
263/263 [==============================] - 6985s 27s/step - loss: 0.2462 - acc: 0.8750 - val_loss: 0.4538 - val_acc: 0.8292
```

```python
history=model1.fit(train_generator,
                   epochs=epochz,
                   steps_per_epoch=s_p_e,
                   validation_data=val_generator,
                   callbacks=[checkpoint1,batch_stats_callback]
                   )
```

```
Epoch 1/3
263/263 [==============================] - ETA: 0s - loss: 0.6212 - acc: 0.7500
Epoch 1: saving model to /content/drive/MyDrive/result11/model01-01.h5
263/263 [==============================] - 9131s 35s/step - loss: 0.6212 - acc: 0.7500 - val_loss: 0.5230 - val_acc: 0.8067
Epoch 2/3
263/263 [==============================] - ETA: 0s - loss: 0.3511 - acc: 0.8125
Epoch 2: saving model to /content/drive/MyDrive/result11/model01-02.h5
263/263 [==============================] - 9154s 35s/step - loss: 0.3511 - acc: 0.8125 - val_loss: 0.5031 - val_acc: 0.8161
Epoch 3/3
263/263 [==============================] - ETA: 0s - loss: 0.2121 - acc: 0.9062
Epoch 3: saving model to /content/drive/MyDrive/result11/model01-03.h5
263/263 [==============================] - 9292s 35s/step - loss: 0.2121 - acc: 0.9062 - val_loss: 0.4716 - val_acc: 0.8197
```

```python
history=model1.fit(train_generator,
                   epochs=epochz,
                   steps_per_epoch=s_p_e,
                   validation_data=val_generator,
                   callbacks=[checkpoint1,batch_stats_callback]
                   )
```

```
Epoch 1/3
263/263 [==============================] - ETA: 0s - loss: 0.4961 - acc: 0.8125
Epoch 1: saving model to /content/drive/MyDrive/result11/model01-01.h5
263/263 [==============================] - 10169s 39s/step - loss: 0.4961 - acc: 0.8125 - val_loss: 0.5128 - val_acc: 0.8008
Epoch 2/3
263/263 [==============================] - ETA: 0s - loss: 0.1695 - acc: 0.9375
Epoch 2: saving model to /content/drive/MyDrive/result11/model01-02.h5
263/263 [==============================] - 10244s 39s/step - loss: 0.1695 - acc: 0.9375 - val_loss: 0.5022 - val_acc: 0.8144
Epoch 3/3
263/263 [==============================] - ETA: 0s - loss: 0.1772 - acc: 0.9688
Epoch 3: saving model to /content/drive/MyDrive/result11/model01-03.h5
263/263 [==============================] - 10246s 39s/step - loss: 0.1772 - acc: 0.9688 - val_loss: 0.4740 - val_acc: 0.8239
```

```python
history=model1.fit(train_generator,
                   epochs=epochz,
                   steps_per_epoch=s_p_e,
                   validation_data=val_generator,
                   callbacks=[checkpoint1,batch_stats_callback]
                   )
```

```
Epoch 1/3
263/263 [==============================] - ETA: 0s - loss: 0.3926 - acc: 0.7812
Epoch 1: saving model to /content/drive/MyDrive/result11/model01-01.h5
263/263 [==============================] - 10270s 39s/step - loss: 0.3926 - acc: 0.7812 - val_loss: 0.5872 - val_acc: 0.7833
Epoch 2/3
263/263 [==============================] - ETA: 0s - loss: 0.3009 - acc: 0.8750
Epoch 2: saving model to /content/drive/MyDrive/result11/model01-02.h5
263/263 [==============================] - 10242s 39s/step - loss: 0.3009 - acc: 0.8750 - val_loss: 0.4631 - val_acc: 0.8289
Epoch 3/3
263/263 [==============================] - ETA: 0s - loss: 0.3336 - acc: 0.8438
Epoch 3: saving model to /content/drive/MyDrive/result11/model01-03.h5
263/263 [==============================] - 10304s 39s/step - loss: 0.3336 - acc: 0.8438 - val_loss: 0.4634 - val_acc: 0.8264
```

```python
# HDF5フォーマットでモデルを保存するために必要
!pip install -q pyyaml h5py
```

```python
model1.save('/content/drive/MyDrive/result11/model1.h5/')
```

```
WARNING:absl:Found untraced functions such as restored_function_body, restored_function_body, restored_function_body, restored_function_body, restored_function_body while saving (
```

‣ model 2

[ ] ↳ *38 cells hidden*

‣ model 3

[ ] ↳ *38 cells hidden*

‣ VotingClassifier

[ ] ↳ 11 cells hidden

✓ 1m 12s completed at 11:19 PM