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Bokeh

Klasifikasi Jenis Buah Anggur (Merah, Thompson, Concord)

MobileNet

```
import os
import numpy as np
import tensorflow as tf
from tensorflow.keras import layers
from tensorflow.keras.models import Sequential, load_model
from tensorflow.keras.layers import Conv2D, MaxPooling2D, Dense,
Dropout, Flatten

count = 0
dirs = os.listdir(r'C:\Users\lenovo\OneDrive\Documents\TubesPMDPM\
train_data')
for dir in dirs:
    files = list(os.listdir(r'C:\Users\lenovo\OneDrive\Documents\
TubesPMDPM\train_data/'+dir))
    print(dir + ' Folder has ' + str(len(files)) + ' Images')
    count = count + len(files)
print('Images Folder has ' + str(count) + ' Images')
```

```
Concord Folder has 100 Images
Merah Folder has 110 Images
Thompson Folder has 100 Images
Images Folder has 310 Images
```

```
base_dir = r'C:\Users\lenovo\OneDrive\Documents\TubesPMDPM\train_data'
img_size = 180
batch = 16
validation_split = 0.1

num_classes = 3

dataset = tf.keras.utils.image_dataset_from_directory(
    base_dir,
    seed=123,
    image_size=(img_size, img_size),
    batch_size=batch,
    class_names=['Merah', 'Thompson', 'Concord']
)
```

```
Found 310 files belonging to 3 classes.
```

```
class_names = dataset.class_names
print("Class Names:", class_names)

expected_classes = ['Merah', 'Thompson', 'Concord']
if set(class_names) != set(expected_classes):
    print("Warning: Kelas yang diambil tidak sesuai dengan yang
diharapkan!")
```

```
Class Names: ['Merah', 'Thompson', 'Concord']
```

Pembagian Dataset menjadi Train, Validation, dan Test dengan rasio 80:10:10

```
total_count = len(dataset)
train_count = int(total_count * 0.8)
val_count = int(total_count * 0.1)
test_count = total_count - train_count - val_count

if train_count < 0 or val_count < 0 or test_count < 0:
    raise ValueError("Jumlah gambar untuk pelatihan, validasi, atau
pengujian tidak valid!")

print("Total Images:", total_count)
print("Train Images:", train_count)
print("Validation Images:", val_count)
print("Test Images:", test_count)
```

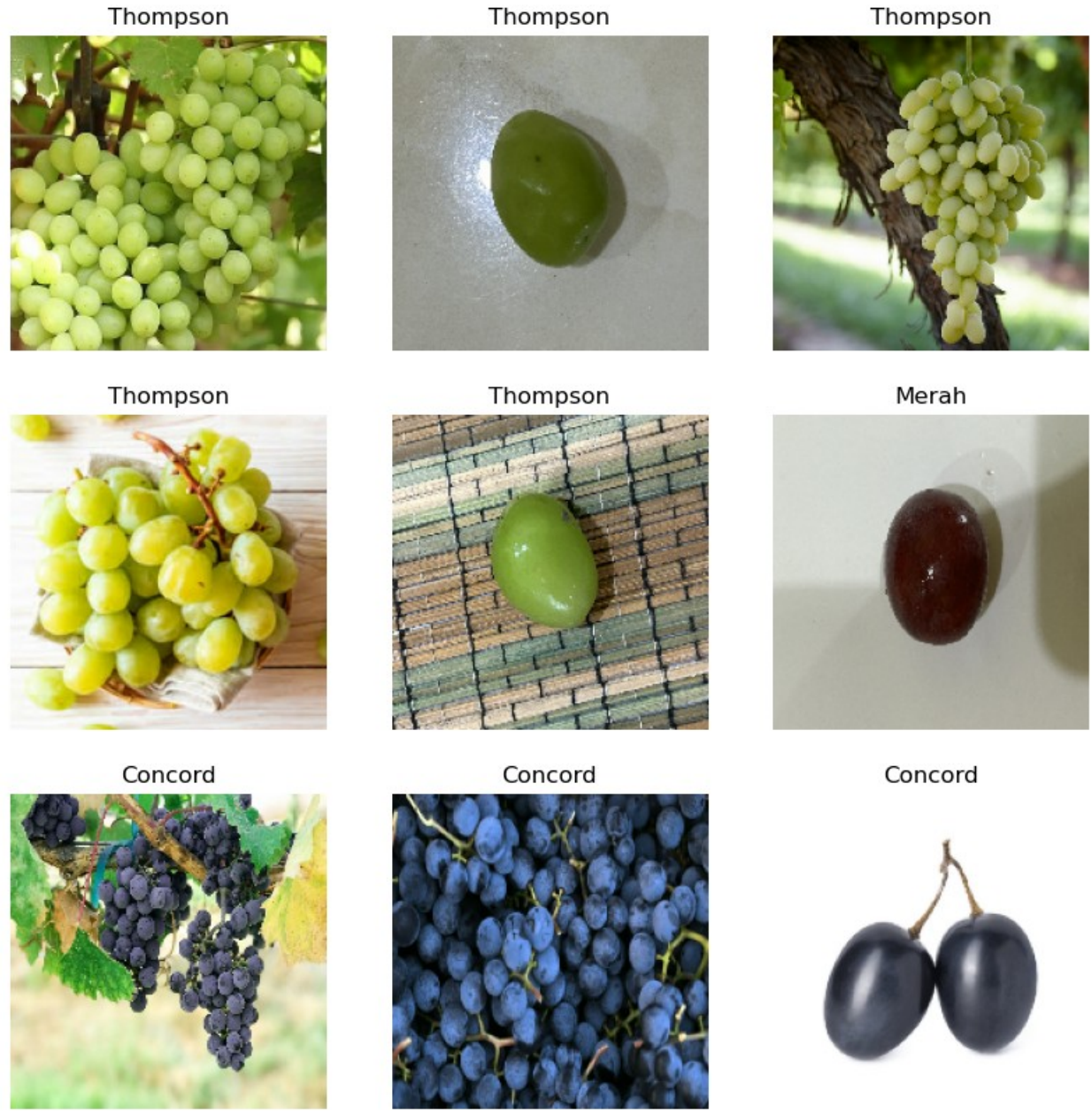
```
Total Images: 20
Train Images: 16
Validation Images: 2
Test Images: 2
```

```
train_ds = dataset.take(train_count)
val_ds = dataset.skip(train_count)

print(f"Dataset telah dibagi menjadi {train_count} gambar untuk
pelatihan dan {val_count} gambar untuk validasi.")
```

```
Dataset telah dibagi menjadi 16 gambar untuk pelatihan dan 2 gambar
untuk validasi.
```

```
import matplotlib.pyplot as plt

plt.figure(figsize=(10,10))

for images, labels in train_ds.take(1):
    num_images_to_display = min(9, len(images))
    for i in range(num_images_to_display):
        plt.subplot(3, 3, i + 1)
        plt.imshow(images[i].numpy().astype('uint8'))
        plt.title(class_names[labels[i]])
```

```
        plt.axis('off')

plt.show()
```




```
import numpy as np

for images, labels in train_ds.take(1):
    images_array = np.array(images)
    print(images_array.shape)
```

```
(16, 180, 180, 3)
```

```
AUTOTUNE = tf.data.AUTOTUNE

train_ds = train_ds.cache().shuffle(1000).prefetch(buffer_size =
AUTOTUNE)
val_ds = val_ds.cache().shuffle(1000).prefetch(buffer_size = AUTOTUNE)

data_augmentation = Sequential([
    layers.RandomFlip("horizontal", input_shape=(img_size, img_size,
3)),
    layers.RandomRotation(0.1),
    layers.RandomZoom(0.1),
    layers.RandomBrightness(0.1)
])

plt.figure(figsize=(10, 10))

for images, labels in train_ds.take(1):
    num_images_to_display = min(9, len(images))
    for i in range(num_images_to_display):
        augmented_image = data_augmentation(images[i:i+1])
        plt.subplot(3, 3, i + 1)
        plt.imshow(augmented_image[0].numpy().astype('uint8'))
        plt.axis('off')

plt.show()
```

```
c:\Users\lenovo\anaconda3\Lib\site-packages\keras\src\layers\
preprocessing\tf_data_layer.py:19: UserWarning: Do not pass an
`input_shape`/`input_dim` argument to a layer. When using Sequential
models, prefer using an `Input(shape)` object as the first layer in
the model instead.
  super().__init__(**kwargs)
```









```
import tensorflow as tf
from tensorflow.keras import layers
from tensorflow.keras.models import Sequential

# Membuat model dari awal
model = Sequential([
    layers.Rescaling(1./255, input_shape=(img_size, img_size, 3)),
    layers.Conv2D(32, (3, 3), activation='relu'),
    layers.BatchNormalization(),
    layers.MaxPooling2D(pool_size=(2, 2)),

    layers.Conv2D(64, (3, 3), activation='relu'),
```

```
    layers.BatchNormalization(),
    layers.MaxPooling2D(pool_size=(2, 2)),

    layers.Conv2D(128, (3, 3), activation='relu'),
    layers.BatchNormalization(),
    layers.MaxPooling2D(pool_size=(2, 2)),

    layers.Conv2D(256, (3, 3), activation='relu'),
    layers.BatchNormalization(),
    layers.MaxPooling2D(pool_size=(2, 2)),

    layers.GlobalAveragePooling2D(),
    layers.Dense(128, activation='relu'),
    layers.Dropout(0.3),
    layers.Dense(len(class_names), activation='softmax')
])

from tensorflow.keras.optimizers import Adam

model.compile(
    optimizer=Adam(learning_rate=1e-4),
    loss='sparse_categorical_crossentropy',
    metrics=['accuracy']
)

model.summary()
```

Model: "sequential_3"

```
┏━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━┳━━━━━━━━━━━━━━━━━━━━━━━━━━━━━┳━━━━━━━━━━━━━━━━━┓
┃ Layer (type)                         ┃ Output Shape                ┃
Param # ┃
┡━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━╇━━━━━━━━━━━━━━━━━━━━━━━━━━━━━╇━━━━━━━━━━━━━━━━━┩
│ rescaling_1 (Rescaling)              │ (None, 180, 180, 3)         │
0 │
├──────────────────────────────────────┼─────────────────────────────┼─────────────────┤
│ conv2d_4 (Conv2D)                    │ (None, 178, 178, 32)        │
896 │
├──────────────────────────────────────┼─────────────────────────────┼─────────────────┤
│ batch_normalization_4                │ (None, 178, 178, 32)        │
128 │
│ (BatchNormalization)                 │                             │
│
├──────────────────────────────────────┼─────────────────────────────┼─────────────────┤
│ max_pooling2d_4 (MaxPooling2D)       │ (None, 89, 89, 32)          │
```

```
0 |
├──────────────────────────────────────┼─────────────────────────────┼──────────
──────┤
| conv2d_5 (Conv2D)                    | (None, 87, 87, 64)          |
18,496 |
├──────────────────────────────────────┼─────────────────────────────┼──────────
──────┤
| batch_normalization_5                | (None, 87, 87, 64)          |
256 |
| (BatchNormalization)                 |                             |
|
├──────────────────────────────────────┼─────────────────────────────┼──────────
──────┤
| max_pooling2d_5 (MaxPooling2D)       | (None, 43, 43, 64)          |
0 |
├──────────────────────────────────────┼─────────────────────────────┼──────────
──────┤
| conv2d_6 (Conv2D)                    | (None, 41, 41, 128)         |
73,856 |
├──────────────────────────────────────┼─────────────────────────────┼──────────
──────┤
| batch_normalization_6                | (None, 41, 41, 128)         |
512 |
| (BatchNormalization)                 |                             |
|
├──────────────────────────────────────┼─────────────────────────────┼──────────
──────┤
| max_pooling2d_6 (MaxPooling2D)       | (None, 20, 20, 128)         |
0 |
├──────────────────────────────────────┼─────────────────────────────┼──────────
──────┤
| conv2d_7 (Conv2D)                    | (None, 18, 18, 256)         |
295,168 |
├──────────────────────────────────────┼─────────────────────────────┼──────────
──────┤
| batch_normalization_7                | (None, 18, 18, 256)         |
1,024 |
| (BatchNormalization)                 |                             |
|
├──────────────────────────────────────┼─────────────────────────────┼──────────
──────┤
| max_pooling2d_7 (MaxPooling2D)       | (None, 9, 9, 256)           |
0 |
├──────────────────────────────────────┼─────────────────────────────┼──────────
──────┤
| global_average_pooling2d_1           | (None, 256)                 |
0 |
| (GlobalAveragePooling2D)             |                             |
|
```

```
├─────────────────────────────────┼────────────────────────┼───────
─────┤
│ dense_2 (Dense)                 │ (None, 128)            │
32,896 │
├─────────────────────────────────┼────────────────────────┼───────
─────┤
│ dropout_1 (Dropout)             │ (None, 128)            │
0 │
├─────────────────────────────────┼────────────────────────┼───────
─────┤
│ dense_3 (Dense)                 │ (None, 3)              │
387 │
└─────────────────────────────────┴────────────────────────┴───────
─────┘
```

```
 Total params: 423,619 (1.62 MB)

 Trainable params: 422,659 (1.61 MB)

 Non-trainable params: 960 (3.75 KB)
```

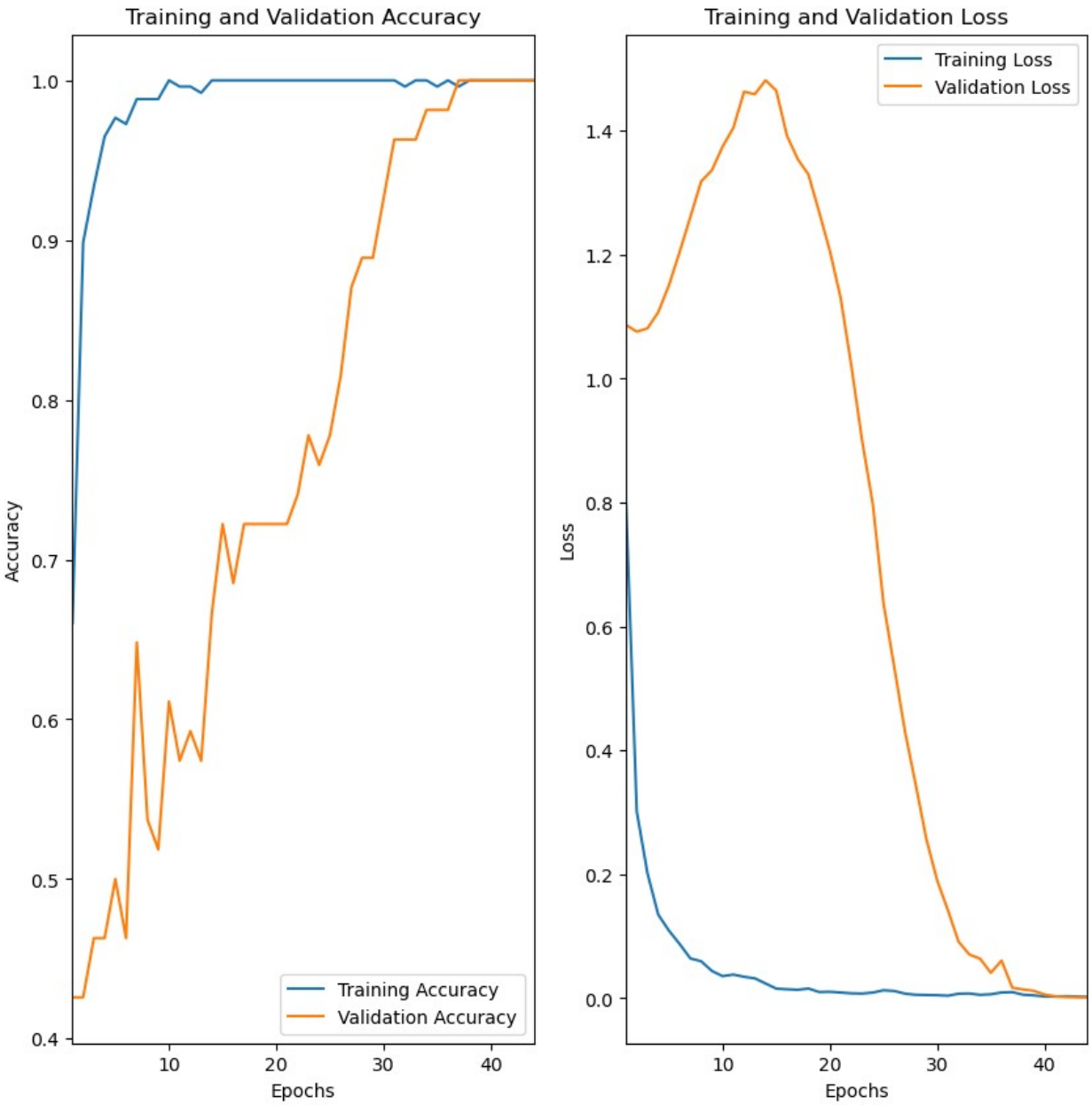
```
from tensorflow.keras.callbacks import EarlyStopping

early_stopping = EarlyStopping(monitor='val_accuracy',
                               patience=7,
                               mode='max')

history = model.fit(train_ds,
                    epochs=50,
                    validation_data=val_ds,
                    callbacks=[early_stopping])
```

```
Epoch 1/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 13s 555ms/step - accuracy: 0.5065 - loss:
1.1305 - val_accuracy: 0.4259 - val_loss: 1.0868
Epoch 2/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 443ms/step - accuracy: 0.8666 - loss:
0.3589 - val_accuracy: 0.4259 - val_loss: 1.0759
Epoch 3/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 443ms/step - accuracy: 0.9323 - loss:
0.1850 - val_accuracy: 0.4630 - val_loss: 1.0813
Epoch 4/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 447ms/step - accuracy: 0.9626 - loss:
0.1353 - val_accuracy: 0.4630 - val_loss: 1.1073
Epoch 5/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 443ms/step - accuracy: 0.9665 - loss:
0.1258 - val_accuracy: 0.5000 - val_loss: 1.1509
Epoch 6/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 442ms/step - accuracy: 0.9786 - loss:
0.0842 - val_accuracy: 0.4630 - val_loss: 1.2048
Epoch 7/50
```

```
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 445ms/step - accuracy: 0.9957 - loss:
0.0533 - val_accuracy: 0.6481 - val_loss: 1.2614
Epoch 8/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 449ms/step - accuracy: 0.9832 - loss:
0.0667 - val_accuracy: 0.5370 - val_loss: 1.3185
Epoch 9/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 448ms/step - accuracy: 0.9854 - loss:
0.0419 - val_accuracy: 0.5185 - val_loss: 1.3365
Epoch 10/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 449ms/step - accuracy: 1.0000 - loss:
0.0371 - val_accuracy: 0.6111 - val_loss: 1.3747
Epoch 11/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 445ms/step - accuracy: 0.9973 - loss:
0.0311 - val_accuracy: 0.5741 - val_loss: 1.4049
Epoch 12/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 444ms/step - accuracy: 0.9941 - loss:
0.0399 - val_accuracy: 0.5926 - val_loss: 1.4633
Epoch 13/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 445ms/step - accuracy: 0.9918 - loss:
0.0379 - val_accuracy: 0.5741 - val_loss: 1.4593
Epoch 14/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 443ms/step - accuracy: 1.0000 - loss:
0.0221 - val_accuracy: 0.6667 - val_loss: 1.4816
Epoch 15/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 444ms/step - accuracy: 1.0000 - loss:
0.0161 - val_accuracy: 0.7222 - val_loss: 1.4652
Epoch 16/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 442ms/step - accuracy: 1.0000 - loss:
0.0146 - val_accuracy: 0.6852 - val_loss: 1.3921
Epoch 17/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 441ms/step - accuracy: 1.0000 - loss:
0.0135 - val_accuracy: 0.7222 - val_loss: 1.3546
Epoch 18/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 442ms/step - accuracy: 1.0000 - loss:
0.0134 - val_accuracy: 0.7222 - val_loss: 1.3295
Epoch 19/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 444ms/step - accuracy: 1.0000 - loss:
0.0092 - val_accuracy: 0.7222 - val_loss: 1.2690
Epoch 20/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 445ms/step - accuracy: 1.0000 - loss:
0.0096 - val_accuracy: 0.7222 - val_loss: 1.2061
Epoch 21/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 450ms/step - accuracy: 1.0000 - loss:
0.0095 - val_accuracy: 0.7222 - val_loss: 1.1308
Epoch 22/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 446ms/step - accuracy: 1.0000 - loss:
0.0082 - val_accuracy: 0.7407 - val_loss: 1.0207
Epoch 23/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 440ms/step - accuracy: 1.0000 - loss:
```

```
0.0087 - val_accuracy: 0.7778 - val_loss: 0.9006
Epoch 24/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 443ms/step - accuracy: 1.0000 - loss:
0.0079 - val_accuracy: 0.7593 - val_loss: 0.7974
Epoch 25/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 448ms/step - accuracy: 1.0000 - loss:
0.0112 - val_accuracy: 0.7778 - val_loss: 0.6371
Epoch 26/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 447ms/step - accuracy: 1.0000 - loss:
0.0108 - val_accuracy: 0.8148 - val_loss: 0.5343
Epoch 27/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 440ms/step - accuracy: 1.0000 - loss:
0.0080 - val_accuracy: 0.8704 - val_loss: 0.4304
Epoch 28/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 446ms/step - accuracy: 1.0000 - loss:
0.0056 - val_accuracy: 0.8889 - val_loss: 0.3447
Epoch 29/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 440ms/step - accuracy: 1.0000 - loss:
0.0062 - val_accuracy: 0.8889 - val_loss: 0.2561
Epoch 30/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 443ms/step - accuracy: 1.0000 - loss:
0.0051 - val_accuracy: 0.9259 - val_loss: 0.1902
Epoch 31/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 8s 474ms/step - accuracy: 1.0000 - loss:
0.0038 - val_accuracy: 0.9630 - val_loss: 0.1421
Epoch 32/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 8s 479ms/step - accuracy: 0.9984 - loss:
0.0053 - val_accuracy: 0.9630 - val_loss: 0.0910
Epoch 33/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 466ms/step - accuracy: 1.0000 - loss:
0.0083 - val_accuracy: 0.9630 - val_loss: 0.0706
Epoch 34/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 452ms/step - accuracy: 1.0000 - loss:
0.0066 - val_accuracy: 0.9815 - val_loss: 0.0638
Epoch 35/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 437ms/step - accuracy: 0.9973 - loss:
0.0056 - val_accuracy: 0.9815 - val_loss: 0.0410
Epoch 36/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 435ms/step - accuracy: 1.0000 - loss:
0.0105 - val_accuracy: 0.9815 - val_loss: 0.0609
Epoch 37/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 450ms/step - accuracy: 0.9929 - loss:
0.0143 - val_accuracy: 1.0000 - val_loss: 0.0170
Epoch 38/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 445ms/step - accuracy: 1.0000 - loss:
0.0070 - val_accuracy: 1.0000 - val_loss: 0.0141
Epoch 39/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 443ms/step - accuracy: 1.0000 - loss:
0.0065 - val_accuracy: 1.0000 - val_loss: 0.0119
```

```
Epoch 40/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 447ms/step - accuracy: 1.0000 - loss:
0.0023 - val_accuracy: 1.0000 - val_loss: 0.0061
Epoch 41/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 438ms/step - accuracy: 1.0000 - loss:
0.0025 - val_accuracy: 1.0000 - val_loss: 0.0031
Epoch 42/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 437ms/step - accuracy: 1.0000 - loss:
0.0035 - val_accuracy: 1.0000 - val_loss: 0.0019
Epoch 43/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 440ms/step - accuracy: 1.0000 - loss:
0.0023 - val_accuracy: 1.0000 - val_loss: 0.0016
Epoch 44/50
16/16 ━━━━━━━━━━━━━━━━━━━━ 7s 437ms/step - accuracy: 1.0000 - loss:
0.0017 - val_accuracy: 1.0000 - val_loss: 0.0015

epochs_range = range(1, len(history.history['loss']) + 1)

plt.figure(figsize=(10, 10))

plt.subplot(1, 2, 1)
plt.plot(epochs_range, history.history['accuracy'], label='Training
Accuracy')
plt.plot(epochs_range, history.history['val_accuracy'],
label='Validation Accuracy')
plt.legend(loc='lower right')
plt.xlim(1, len(epochs_range))
plt.xlabel('Epochs')
plt.ylabel('Accuracy')
plt.title('Training and Validation Accuracy')

plt.subplot(1, 2, 2)
plt.plot(epochs_range, history.history['loss'], label='Training Loss')
plt.plot(epochs_range, history.history['val_loss'], label='Validation
Loss')
plt.legend(loc='upper right')
plt.xlim(1, len(epochs_range))
plt.xlabel('Epochs')
plt.ylabel('Loss')
plt.title('Training and Validation Loss')
plt.show()
```




```
model.save('MobileNet_Bokeh.h5')
```

```
WARNING:absl:You are saving your model as an HDF5 file via
`model.save()` or `keras.saving.save_model(model)`. This file format
is considered legacy. We recommend using instead the native Keras
format, e.g. `model.save('my_model.keras')` or
`keras.saving.save_model(model, 'my_model.keras')`.
```

```
import tensorflow as tf
import numpy as np
import matplotlib.pyplot as plt
from tensorflow.keras.models import load_model
```

```
from PIL import Image

model = load_model(r'C:\Users\lenovo\OneDrive\Documents\TubesPMDPM\
MobileNet_Bokeh.h5')
class_names = ['Merah', 'Thompson', 'Concord']

def classify_images(image_path, save_path='predicted_image.jpg'):
    try:
        input_image = tf.keras.utils.load_img(image_path,
target_size=(180, 180))
        input_image_array = tf.keras.utils.img_to_array(input_image)
        input_image_exp_dim = tf.expand_dims(input_image_array, 0)

        predictions = model.predict(input_image_exp_dim)
        result = tf.nn.softmax(predictions[0])
        class_idx = np.argmax(result)
        confidence = np.max(result) * 100

        print(f"Prediksi: {class_names[class_idx]}")
        print(f"Confidence: {confidence:.2f}%")

        input_image = Image.open(image_path)
        input_image.save(save_path)

        return f"Prediksi: {class_names[class_idx]} dengan confidence
{confidence:.2f}%. Gambar asli disimpan di {save_path}."
    except Exception as e:
        return f"Terjadi kesalahan: {e}"

result = classify_images(r'C:\Users\lenovo\OneDrive\Documents\
TubesPMDPM\test_data\Concord\Concord_Grape_Original_Data010.jpg',
save_path='predicted_image.jpg')
print(result)
```

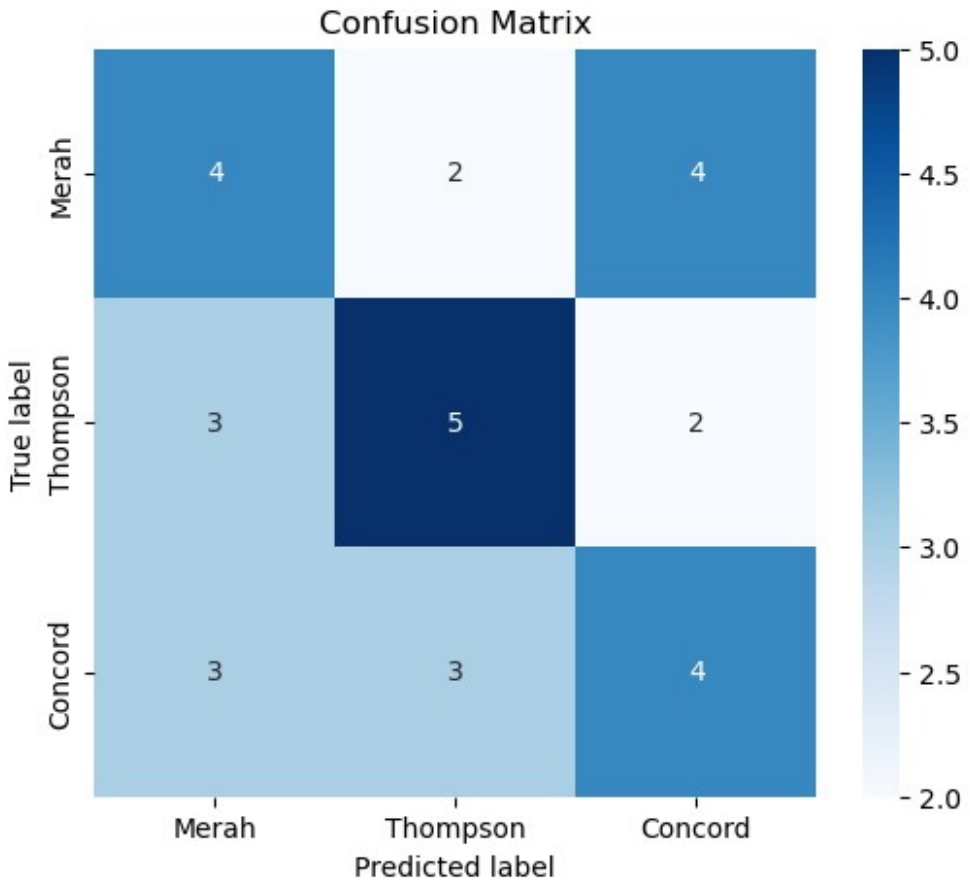
```
WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 162ms/step
Prediksi: Concord
Confidence: 57.43%
Prediksi: Concord dengan confidence 57.43%. Gambar asli disimpan di
predicted_image.jpg.
```

```
import tensorflow as tf
from tensorflow.keras.models import load_model
import seaborn as sns
import matplotlib.pyplot as plt

model = load_model(r'C:\Users\lenovo\OneDrive\Documents\TubesPMDPM\
MobileNet_Bokeh.h5')
```

```
test_data = tf.keras.preprocessing.image_dataset_from_directory(
    r'test_data',
    labels='inferred',
    label_mode='categorical',
    batch_size=32,
    image_size=(180, 180)
)

y_pred = model.predict(test_data)
y_pred_class = tf.argmax(y_pred, axis=1)

true_labels = []
for _, labels in test_data:
    true_labels.extend(tf.argmax(labels, axis=1).numpy())
true_labels = tf.convert_to_tensor(true_labels)

conf_mat = tf.math.confusion_matrix(true_labels, y_pred_class)

accuracy = tf.reduce_sum(tf.linalg.diag_part(conf_mat)) /
tf.reduce_sum(conf_mat)

precision = tf.linalg.diag_part(conf_mat) / tf.reduce_sum(conf_mat,
axis=0)
recall = tf.linalg.diag_part(conf_mat) / tf.reduce_sum(conf_mat,
axis=1)

f1_score = 2 * (precision * recall) / (precision + recall)

plt.figure(figsize=(6, 5))
sns.heatmap(conf_mat.numpy(), annot=True, fmt='d', cmap='Blues',
            xticklabels=["Merah", "Thompson", "Concord"],
yticklabels=["Merah", "Thompson", "Concord"])
plt.title('Confusion Matrix')
plt.xlabel('Predicted label')
plt.ylabel('True label')
plt.show()

print("Confusion Matrix:\n", conf_mat.numpy())
print("Akurasi:", accuracy.numpy())
print("Presisi:", precision.numpy())
print("Recall:", recall.numpy())
print("F1 Score:", f1_score.numpy())
```

```
WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.
```

```
Found 30 files belonging to 3 classes.
1/1 ━━━━━━━━━━━━━━━━━━━━ 1s 676ms/step
```




```
Confusion Matrix:
 [[4 2 4]
 [3 5 2]
 [3 3 4]]
Akurasi: 0.43333333333333335
Presisi: [0.4 0.5 0.4]
Recall: [0.4 0.5 0.4]
F1 Score: [0.4 0.5 0.4]
```

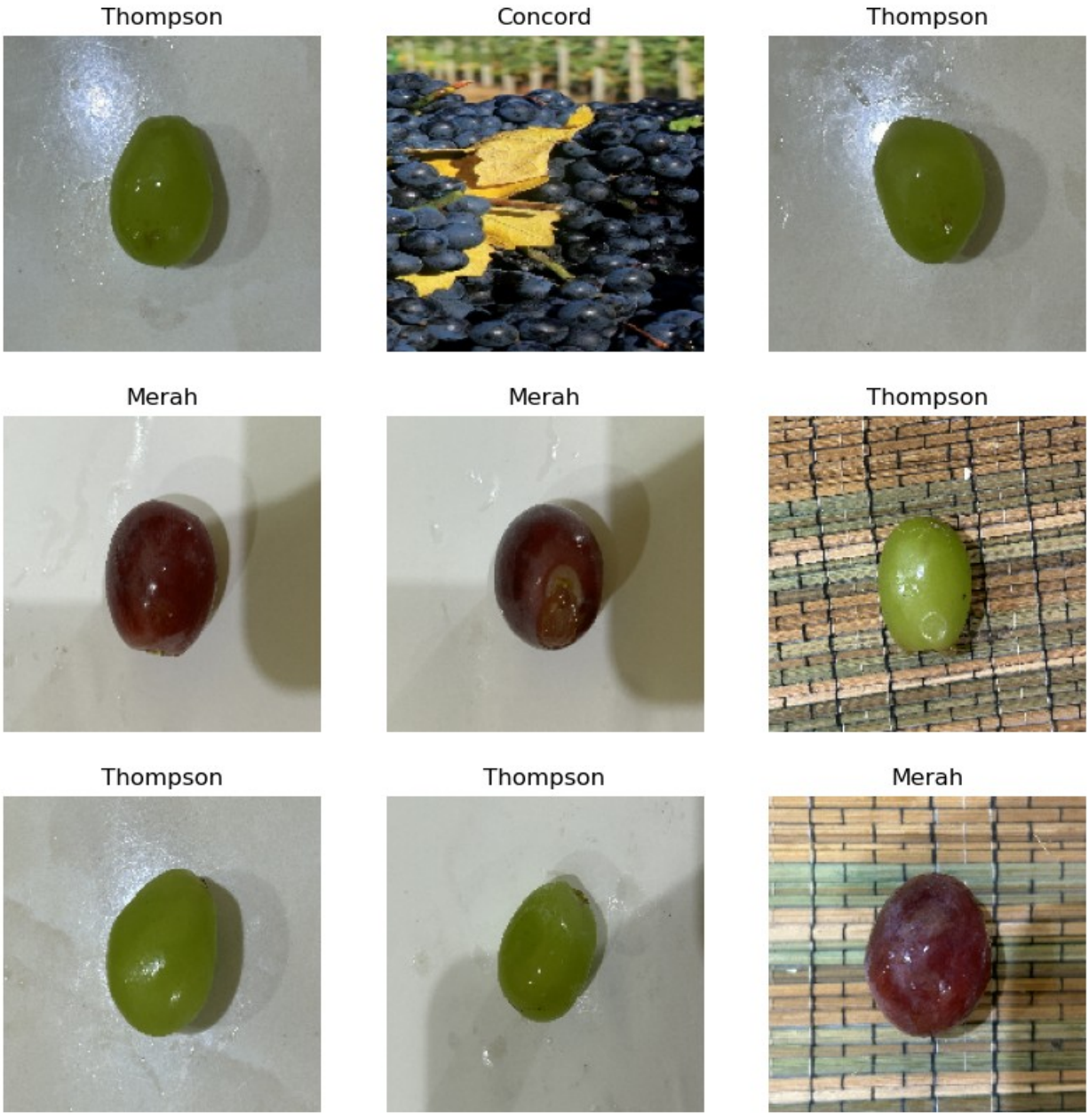
Julius Aditya 220711892 Bokeh Mengklsifikasi Anggur Merah, Concord, dan Thompson

```
import tensorflow as tf
import cv2
import numpy as np
from matplotlib import pyplot as plt
#load data
data_dir = r"C:\Users\LENOVO LEGION\Videos\TUBESMLUAS\train_data"
#Randomize data yang telah di load sekaligus resize menjadi 180 x 180
data = tf.keras.utils.image_dataset_from_directory(data_dir,seed =
123, image_size=(180,180), batch_size=16)
###Terdapat code yang hilang disini! lihat modul untuk menemukanya

print(data.class_names)

class_names = data.class_names

img_size = 180
batch = 32
validation_split = 0.1
dataset = tf.keras.utils. image_dataset_from_directory(
    data_dir,
    seed=123,
    image_size=(img_size, img_size),
    batch_size=batch,
)
total_count = len(dataset)
val_count = int(total_count * validation_split)
train_count = total_count - val_count

print("Total Images:", total_count)
print("Train Images:", train_count)
print("Validation Images:", val_count)

train_ds = dataset.take(train_count)
val_ds = dataset.skip(train_count)
```

```
Found 300 files belonging to 3 classes.
['Concord', 'Merah', 'Thompson']
Found 300 files belonging to 3 classes.
Total Images: 10
Train Images: 9
Validation Images: 1
```

```
import matplotlib.pyplot as plt

i = 0
plt.figure(figsize=(10,10))

for images, labels in train_ds.take(1):
```

```
    for i in range(9):
        plt.subplot(3,3, i+1)
        plt.imshow(images[i].numpy().astype('uint8'))
        plt.title(class_names[labels[i]])
        plt.axis('off')
```

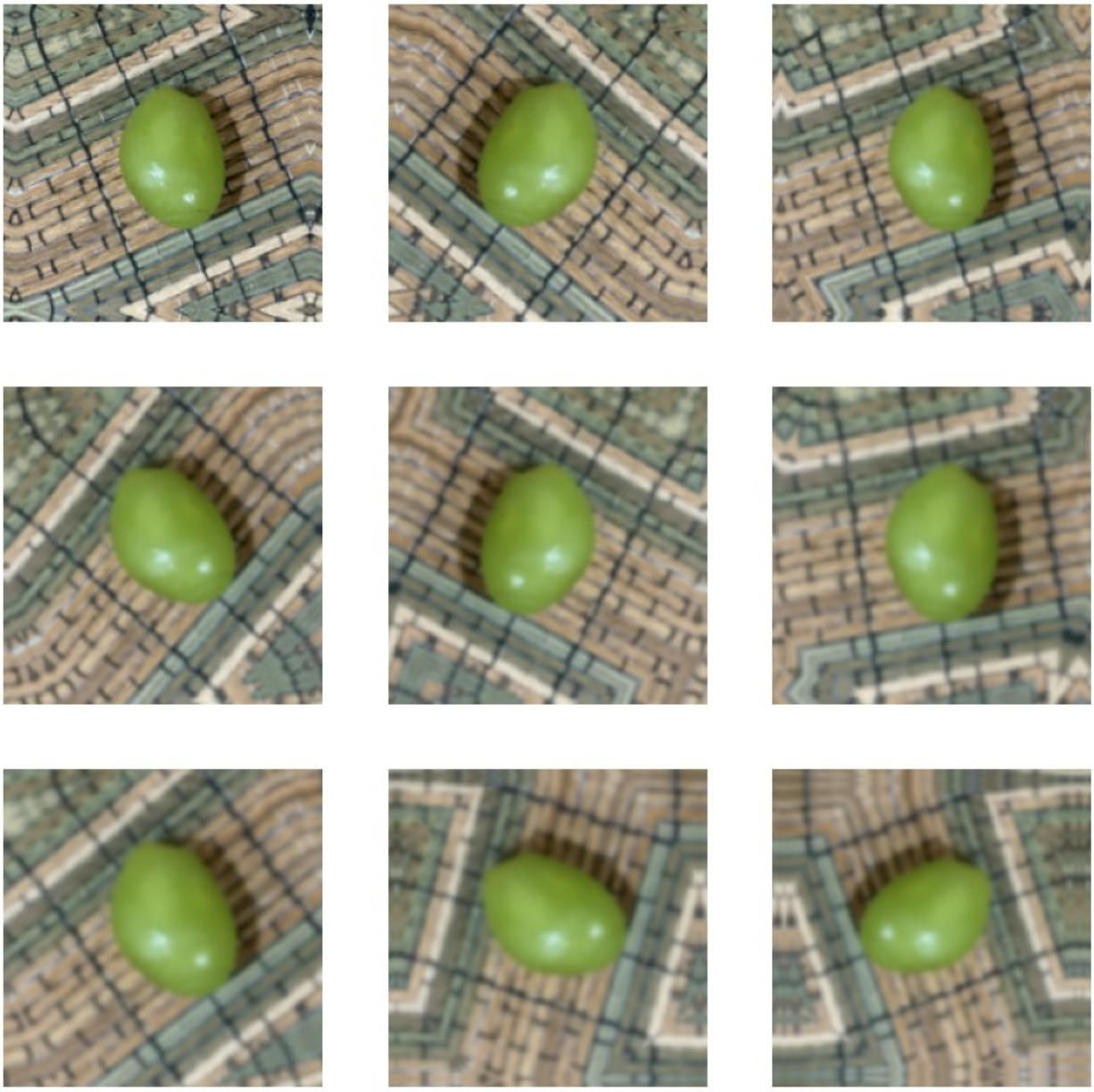



```
for images, labels in train_ds.take(1):
    images_array = np.array(images)
    print(images_array.shape)
```

```
(32, 180, 180, 3)
```

```
from tensorflow.keras import layers
from tensorflow.keras.models import Sequential, load_model

Tuner = tf.data.AUTOTUNE
train_ds = train_ds.cache().shuffle(1000).prefetch(buffer_size =
Tuner)
val_ds = val_ds.cache().shuffle(1000).prefetch(buffer_size = Tuner)

#Augmentasi data dengan menggunakan Sequential
###Terdapat code yang hilang disini! lihat modul untuk menemukanya
data_augmentation = Sequential([
    layers.RandomFlip("horizontal", input_shape=
(img_size,img_size,3)),
    layers.RandomRotation(0.1),
    layers.RandomZoom(0.1)
])

i = 0
plt.figure(figsize=(10,10))
#Lihat data setelah di augmentasi
for images, labels in train_ds.take(69):
    for i in range(9):
        images = data_augmentation(images)
        plt.subplot(3,3, i+1)
        plt.imshow(images[0].numpy().astype('uint8'))
        plt.axis('off')
```

```
c:\Users\LENOVO LEGION\anaconda3\Lib\site-packages\keras\src\layers\
preprocessing\tf_data_layer.py:19: UserWarning: Do not pass an
`input_shape`/`input_dim` argument to a layer. When using Sequential
models, prefer using an `Input(shape)` object as the first layer in
the model instead.
  super().__init__(**kwargs)
```



```
import tensorflow as tf
from keras.models import Model
from keras.layers import Input, Conv2D, MaxPool2D, Flatten, Dense,
Dropout
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.callbacks import EarlyStopping
from tensorflow.keras.preprocessing.image import ImageDataGenerator

# Fungsi model AlexNet
def alexnet(input_shape, n_classes):
    input = Input(input_shape)
```

```
    # Layer 1
    x = Conv2D(96, (11, 11), strides=4, activation='relu',
padding='valid')(input)
    x = MaxPool2D((3, 3), strides=2)(x)

    # Layer 2
    x = Conv2D(256, (5, 5), activation='relu', padding='same')(x)
    x = MaxPool2D((3, 3), strides=2)(x)

    # Layer 3
    x = Conv2D(384, (3, 3), activation='relu', padding='same')(x)

    # Layer 4
    x = Conv2D(384, (3, 3), activation='relu', padding='same')(x)

    # Layer 5
    x = Conv2D(256, (3, 3), activation='relu', padding='same')(x)
    x = MaxPool2D((3, 3), strides=2)(x)

    # Flatten
    x = Flatten()(x)

    # Fully connected layers
    x = Dense(4096, activation='relu')(x)
    x = Dropout(0.5)(x)
    x = Dense(4096, activation='relu')(x)
    x = Dropout(0.5)(x)
    x = Dense(1000, activation='relu')(x)

    # Output layer
    output = Dense(n_classes, activation='softmax')(x)

    # Model
    model = Model(input, output)
    return model

# Definisikan input shape dan jumlah kelas
input_shape = (227, 227, 3)  # AlexNet menggunakan gambar 227x227
n_classes = 3  # Ubah sesuai dengan dataset Anda (jumlah kelas)

# Buat model AlexNet
model = alexnet(input_shape, n_classes)
model.summary()

# Compile model
model.compile(
    optimizer=Adam(),
    loss='sparse_categorical_crossentropy',
    metrics=['accuracy']
)
```

```python
# Data preprocessing
datagen = ImageDataGenerator(rescale=1./255)  # Normalisasi data
val_datagen = ImageDataGenerator(rescale=1./255)

# Load dataset
train_ds = datagen.flow_from_directory(
    r'C:\Users\LENOVO LEGION\Videos\TUBESMLUAS\train_data',  # Ganti
dengan path dataset pelatihan Anda
    target_size=(227, 227),  # Ukuran gambar sesuai AlexNet
    batch_size=32,
    class_mode='sparse'  # Gunakan sparse untuk label integer
)

val_ds = val_datagen.flow_from_directory(
    r'C:\Users\LENOVO LEGION\Videos\TUBESMLUAS\test_data',  # Ganti
dengan path dataset validasi Anda
    target_size=(227, 227),  # Ukuran gambar sesuai AlexNet
    batch_size=32,
    class_mode='sparse'
)

# Callback Early Stopping
early_stopping = EarlyStopping(
    monitor='val_accuracy',
    patience=5,
    mode='max'
)

# Fit model menggunakan dataset dengan validasi
history = model.fit(
    train_ds,  # Data pelatihan
    epochs=30,  # Maksimum epoch
    validation_data=val_ds,  # Data validasi
    callbacks=[early_stopping],  # Callback early stopping
    verbose=1  # Tampilkan log pelatihan
)
```

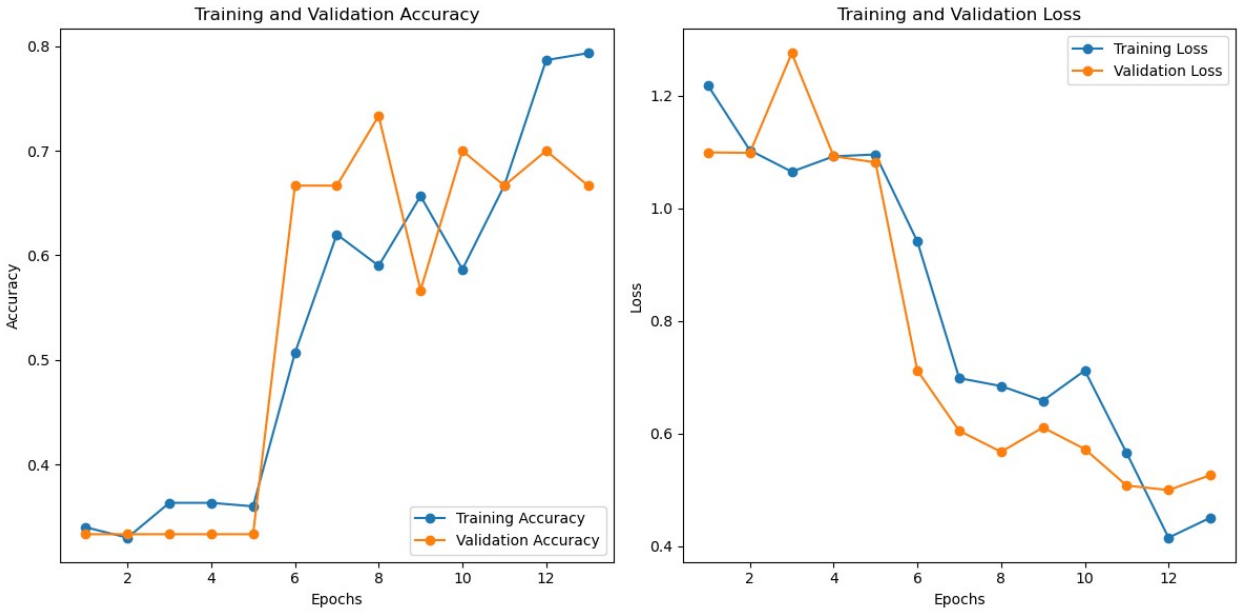
```
Model: "functional_5"

┏━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━┳━━━━━━━━━━━━━━━━━━━━━━━━━━━━┳━━━━━━━
━━━━━┓
┃ Layer (type)                     ┃ Output Shape               ┃
Param # ┃
┡━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━╇━━━━━━━━━━━━━━━━━━━━━━━━━━━━╇━━━━━━━
━━━━━┩
│ input_layer_2 (InputLayer)       │ (None, 227, 227, 3)        │
0 │
├──────────────────────────────────┼────────────────────────────┼───────
─────┤
```

```
| conv2d_62 (Conv2D)                | (None, 55, 55, 96)        |
34,944 |
├──────────────────────────────────┼──────────────────────────┼──────
──────┤
| max_pooling2d_16 (MaxPooling2D) | (None, 27, 27, 96)        |
0 |
├──────────────────────────────────┼──────────────────────────┼──────
──────┤
| conv2d_63 (Conv2D)                | (None, 27, 27, 256)       |
614,656 |
├──────────────────────────────────┼──────────────────────────┼──────
──────┤
| max_pooling2d_17 (MaxPooling2D) | (None, 13, 13, 256)       |
0 |
├──────────────────────────────────┼──────────────────────────┼──────
──────┤
| conv2d_64 (Conv2D)                | (None, 13, 13, 384)       |
885,120 |
├──────────────────────────────────┼──────────────────────────┼──────
──────┤
| conv2d_65 (Conv2D)                | (None, 13, 13, 384)       |
1,327,488 |
├──────────────────────────────────┼──────────────────────────┼──────
──────┤
| conv2d_66 (Conv2D)                | (None, 13, 13, 256)       |
884,992 |
├──────────────────────────────────┼──────────────────────────┼──────
──────┤
| max_pooling2d_18 (MaxPooling2D) | (None, 6, 6, 256)         |
0 |
├──────────────────────────────────┼──────────────────────────┼──────
──────┤
| flatten_2 (Flatten)               | (None, 9216)              |
0 |
├──────────────────────────────────┼──────────────────────────┼──────
──────┤
| dense_5 (Dense)                   | (None, 4096)              |
37,752,832 |
├──────────────────────────────────┼──────────────────────────┼──────
──────┤
| dropout_3 (Dropout)               | (None, 4096)              |
0 |
├──────────────────────────────────┼──────────────────────────┼──────
──────┤
| dense_6 (Dense)                   | (None, 4096)              |
16,781,312 |
├──────────────────────────────────┼──────────────────────────┼──────
──────┤
| dropout_4 (Dropout)               | (None, 4096)              |
```

```
0 │
├─────────────────────────────────────┼─────────────────────────────────────┼──────
──────┤
│ dense_7 (Dense)                     │ (None, 1000)                        │
4,097,000 │
├─────────────────────────────────────┼─────────────────────────────────────┼──────
──────┤
│ dense_8 (Dense)                     │ (None, 3)                           │
3,003 │
└─────────────────────────────────────┴─────────────────────────────────────┴──────
──────┘

 Total params: 62,381,347 (237.97 MB)

 Trainable params: 62,381,347 (237.97 MB)

 Non-trainable params: 0 (0.00 B)

Found 300 images belonging to 3 classes.
Found 30 images belonging to 3 classes.
Epoch 1/30
10/10 ━━━━━━━━━━━━━━━━━━━━ 52s 3s/step - accuracy: 0.3564 - loss:
1.2833 - val_accuracy: 0.3333 - val_loss: 1.0993
Epoch 2/30
10/10 ━━━━━━━━━━━━━━━━━━━━ 46s 2s/step - accuracy: 0.3342 - loss:
1.1019 - val_accuracy: 0.3333 - val_loss: 1.0985
Epoch 3/30
10/10 ━━━━━━━━━━━━━━━━━━━━ 46s 2s/step - accuracy: 0.3462 - loss:
1.0918 - val_accuracy: 0.3333 - val_loss: 1.2755
Epoch 4/30
10/10 ━━━━━━━━━━━━━━━━━━━━ 45s 2s/step - accuracy: 0.4247 - loss:
1.0748 - val_accuracy: 0.3333 - val_loss: 1.0925
Epoch 5/30
10/10 ━━━━━━━━━━━━━━━━━━━━ 44s 2s/step - accuracy: 0.3857 - loss:
1.0897 - val_accuracy: 0.3333 - val_loss: 1.0817
Epoch 6/30
10/10 ━━━━━━━━━━━━━━━━━━━━ 45s 2s/step - accuracy: 0.4407 - loss:
1.0092 - val_accuracy: 0.6667 - val_loss: 0.7122
Epoch 7/30
10/10 ━━━━━━━━━━━━━━━━━━━━ 45s 2s/step - accuracy: 0.5615 - loss:
0.7364 - val_accuracy: 0.6667 - val_loss: 0.6051
Epoch 8/30
10/10 ━━━━━━━━━━━━━━━━━━━━ 45s 2s/step - accuracy: 0.6344 - loss:
0.6450 - val_accuracy: 0.7333 - val_loss: 0.5678
Epoch 9/30
10/10 ━━━━━━━━━━━━━━━━━━━━ 44s 2s/step - accuracy: 0.6718 - loss:
0.6451 - val_accuracy: 0.5667 - val_loss: 0.6109
Epoch 10/30
10/10 ━━━━━━━━━━━━━━━━━━━━ 45s 2s/step - accuracy: 0.5678 - loss:
0.7227 - val_accuracy: 0.7000 - val_loss: 0.5727
```

```
Epoch 11/30
10/10 ━━━━━━━━━━━━━━━━━━━━ 45s 2s/step - accuracy: 0.6532 - loss:
0.6000 - val_accuracy: 0.6667 - val_loss: 0.5079
Epoch 12/30
10/10 ━━━━━━━━━━━━━━━━━━━━ 51s 3s/step - accuracy: 0.7645 - loss:
0.4547 - val_accuracy: 0.7000 - val_loss: 0.4999
Epoch 13/30
10/10 ━━━━━━━━━━━━━━━━━━━━ 46s 2s/step - accuracy: 0.8111 - loss:
0.4152 - val_accuracy: 0.6667 - val_loss: 0.5264
```

```python
import matplotlib.pyplot as plt

# Pastikan history telah dihasilkan dari pelatihan model
epochs_range = range(1, len(history.history['loss']) + 1)

# Plot Training and Validation Accuracy and Loss
plt.figure(figsize=(12, 6))

# Plot Accuracy
plt.subplot(1, 2, 1)
plt.plot(epochs_range, history.history['accuracy'], label='Training
Accuracy', marker='o')
plt.plot(epochs_range, history.history['val_accuracy'],
label='Validation Accuracy', marker='o')
plt.legend(loc='lower right')
plt.title('Training and Validation Accuracy')
plt.xlabel('Epochs')
plt.ylabel('Accuracy')

# Plot Loss
plt.subplot(1, 2, 2)
plt.plot(epochs_range, history.history['loss'], label='Training Loss',
marker='o')
plt.plot(epochs_range, history.history['val_loss'], label='Validation
Loss', marker='o')
plt.legend(loc='upper right')
plt.title('Training and Validation Loss')
plt.xlabel('Epochs')
plt.ylabel('Loss')

# Display the plots
plt.tight_layout()
plt.show()
```




```
model.save('alexnet.h5')
```

```
c:\Users\LENOVO LEGION\anaconda3\Lib\site-packages\keras\src\models\
model.py:342: UserWarning: You are saving your model as an HDF5 file
via `model.save()`. This file format is considered legacy. We
recommend using instead the native Keras format, e.g.
`model.save('my_model.keras')`.
  warnings.warn(
```

```
import tensorflow as tf
import numpy as np
import matplotlib.pyplot as plt
from tensorflow.keras.models import load_model
from PIL import Image

# Load the trained model
model = load_model(r'C:\Users\LENOVO LEGION\Videos\TUBESMLUAS\
alexnet.h5')  # Ganti dengan path model Anda
class_names = ['Concord', 'Merah', 'Thompson']

# Function to classify images and save the original image
def classify_images(image_path, save_path='predicted_image.jpg'):
    try:
        # Load and preprocess the image
        input_image = tf.keras.utils.load_img(image_path,
target_size=(180, 180))
        input_image_array = tf.keras.utils.img_to_array(input_image)
        input_image_exp_dim = tf.expand_dims(input_image_array, 0)  #
Add batch dimension

        # Predict
```

```
        predictions = model.predict(input_image_exp_dim)
        result = tf.nn.softmax(predictions[0])
        class_idx = np.argmax(result)
        confidence = np.max(result) * 100

        # Display prediction and confidence in notebook
        print(f"Prediksi: {class_names[class_idx]}")
        print(f"Confidence: {confidence:.2f}%")

        # Save the original image (without text)
        input_image = Image.open(image_path)
        input_image.save(save_path)

        return f"Prediksi: {class_names[class_idx]} dengan confidence
{confidence:.2f}%. Gambar asli disimpan di {save_path}."
    except Exception as e:
        return f"Terjadi kesalahan: {e}"

result = classify_images(r'test_data\Merah\
Merah_Grape_Original_Data03.JPG', save_path='merah2.jpg')
print(result)
```

```
WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.
```

```
Terjadi kesalahan: Input 0 of layer "functional_5" is incompatible
with the layer: expected shape=(None, 227, 227, 3), found shape=(1,
180, 180, 3)
```

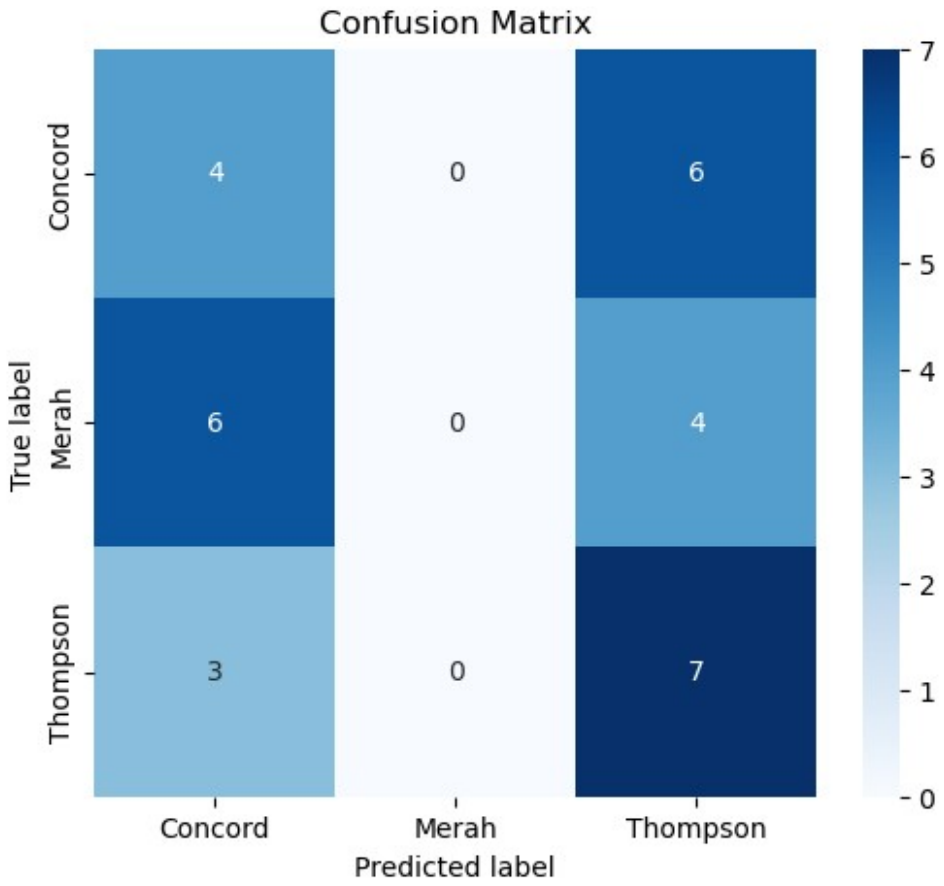
```
import tensorflow as tf
from tensorflow.keras.models import load_model
import seaborn as sns
import matplotlib.pyplot as plt

# Muat data test yang sebenarnya
test_data = tf.keras.preprocessing.image_dataset_from_directory(
    r'test_data',  # Ganti dengan path ke folder data uji Anda
    labels='inferred',
    label_mode='categorical',  # Menghasilkan label dalam bentuk one-
hot encoding
    batch_size=32,
    image_size=(227, 227)  # Sesuaikan dengan input ukuran AlexNet
)

# Muat model AlexNet
model = load_model(r'C:\Users\LENOVO LEGION\Videos\TUBESMLUAS\
alexnet.h5')  # Ganti dengan path model Anda

# Prediksi model
y_pred = model.predict(test_data)
```

```
y_pred_class = tf.argmax(y_pred, axis=1)  # Konversi ke kelas prediksi

# Ekstrak label sebenarnya dari test_data dan konversi ke bentuk
indeks kelas
true_labels = []
for _, labels in test_data:
    true_labels.extend(tf.argmax(labels, axis=1).numpy())  # Konversi
one-hot ke indeks kelas
true_labels = tf.convert_to_tensor(true_labels)

# Membuat matriks kebingungan
conf_mat = tf.math.confusion_matrix(true_labels, y_pred_class)

# Menghitung akurasi
accuracy = tf.reduce_sum(tf.linalg.diag_part(conf_mat)) /
tf.reduce_sum(conf_mat)

# Menghitung presisi dan recall
precision = tf.linalg.diag_part(conf_mat) / tf.reduce_sum(conf_mat,
axis=0)
recall = tf.linalg.diag_part(conf_mat) / tf.reduce_sum(conf_mat,
axis=1)

# Menghitung F1 Score
f1_score = 2 * (precision * recall) / (precision + recall)

# Visualisasi Confusion Matrix
plt.figure(figsize=(6, 5))
sns.heatmap(conf_mat.numpy(), annot=True, fmt='d', cmap='Blues',
            xticklabels=["Concord", "Merah", "Thompson"],
yticklabels=["Concord", "Merah", "Thompson"])
plt.title('Confusion Matrix')
plt.xlabel('Predicted label')
plt.ylabel('True label')
plt.show()

print("Confusion Matrix:\n", conf_mat.numpy())
print("Akurasi: ", accuracy.numpy())
print("Presisi: ", precision.numpy())
print("Recall:", recall.numpy())
print("F1 Score: ", f1_score.numpy())
```

```
Found 30 files belonging to 3 classes.
```

```
WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.
```

```
1/1 ━━━━━━━━━━━━━━━━━━━━ 1s 803ms/step
```




```
Confusion Matrix:
 [[4 0 6]
 [6 0 4]
 [3 0 7]]
Akurasi:  0.36666666666666664
Presisi:  [0.30769231        nan 0.41176471]
Recall: [0.4 0.  0.7]
F1 Score:  [0.34782609        nan 0.51851852]
```

Alouisius Gonzaga Duan Allegra / 220711881 / Bokeh / Mengklasifikasikan Anggur (Merah, Thompson, Concord) / Arsitektur VGG-16

```
import tensorflow as tf
import numpy as np
from matplotlib import pyplot as plt

data_dir = r"C:\Users\smerf\Downloads\Tugas6_B_11881\train_data"

data = tf.keras.utils.image_dataset_from_directory(data_dir,seed =
123, image_size=(180, 180), batch_size=16)
print(data.class_names)

class_names = data.class_names

img_size = 180
batch = 32
validation_split = 0.1
dataset = tf.keras.utils.image_dataset_from_directory(
    data_dir,
    seed=123,
    image_size=(img_size, img_size),
    batch_size=batch,
)
total_count = len(dataset)
val_count = int(total_count * validation_split)
train_count = total_count - val_count

print("Total Images:", total_count)
print("Train Images:",train_count)
print("Validation Images:", val_count)

train_ds = dataset.take(train_count)
val_ds = dataset.skip(train_count)
```

```
Found 300 files belonging to 3 classes.
['Concord', 'Merah', 'Thompson']
Found 300 files belonging to 3 classes.
Total Images: 10
Train Images: 9
Validation Images: 1
```

```
import matplotlib.pyplot as plt

i = 0
plt.figure(figsize=(10,10))

for images, labels in train_ds.take(1):
    for i in range(9):
        plt.subplot(3,3, i+1)
```

```
        plt.imshow(images[i].numpy().astype('uint8'))
        plt.axis('off')
```

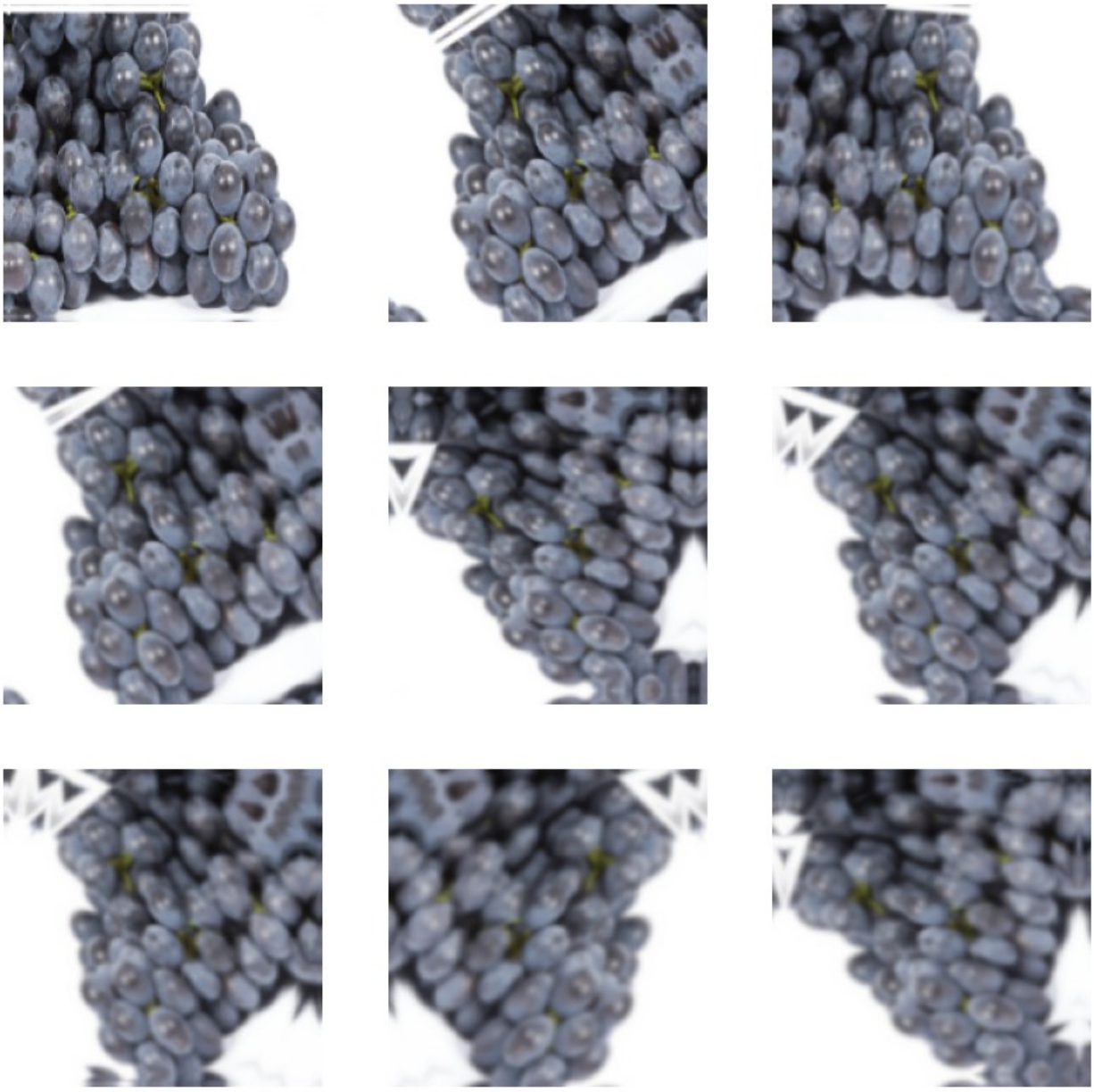
```
for images, labels in train_ds.take(1):
    images_array = np.array(images)
    print(images_array.shape)
```

```
(32, 180, 180, 3)
```

```
from tensorflow.keras import layers
from tensorflow.keras.models import Sequential, load_model
```

```
Tuner = tf.data.AUTOTUNE
train_ds = train_ds.cache().shuffle(1000).prefetch(buffer_size =
Tuner)
val_ds = val_ds.cache().shuffle(1000).prefetch(buffer_size = Tuner)

data_augmentation = Sequential([
    layers.RandomFlip('horizontal', input_shape =
(img_size,img_size,3)),
    layers.RandomRotation(0.1),
    layers.RandomZoom(0.1)
])

i = 0
plt.figure(figsize=(10,10))
#Lihat data setelah di augmentasi
for images, labels in train_ds.take(69):
    for i in range(9):
        images = data_augmentation(images)
        plt.subplot(3,3, i+1)
        plt.imshow(images[0].numpy().astype('uint8'))
        plt.axis('off')
```

```
C:\Users\smerf\AppData\Local\Packages\
PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-
packages\Python311\site-packages\keras\src\layers\preprocessing\
tf_data_layer.py:19: UserWarning: Do not pass an
`input_shape`/`input_dim` argument to a layer. When using Sequential
models, prefer using an `Input(shape)` object as the first layer in
the model instead.
  super().__init__(**kwargs)
```



```
import tensorflow as tf
from tensorflow.keras import layers, models
import keras._tf_keras.keras.backend as K

def vgg16(input_shape, n_classes):
    model = models.Sequential()

    model.add(layers.Conv2D(64, (3, 3), activation='relu',
padding='same', input_shape=input_shape))
    model.add(layers.Conv2D(64, (3, 3), activation='relu',
padding='same'))
    model.add(layers.MaxPooling2D((2, 2), strides=(2, 2)))
```

```
    model.add(layers.Conv2D(128, (3, 3), activation='relu',
padding='same'))
    model.add(layers.Conv2D(128, (3, 3), activation='relu',
padding='same'))
    model.add(layers.MaxPooling2D((2, 2), strides=(2, 2)))

    model.add(layers.Conv2D(256, (3, 3), activation='relu',
padding='same'))
    model.add(layers.Conv2D(256, (3, 3), activation='relu',
padding='same'))
    model.add(layers.Conv2D(256, (3, 3), activation='relu',
padding='same'))
    model.add(layers.MaxPooling2D((2, 2), strides=(2, 2)))

    model.add(layers.Conv2D(512, (3, 3), activation='relu',
padding='same'))
    model.add(layers.Conv2D(512, (3, 3), activation='relu',
padding='same'))
    model.add(layers.Conv2D(512, (3, 3), activation='relu',
padding='same'))
    model.add(layers.MaxPooling2D((2, 2), strides=(2, 2)))

    model.add(layers.Conv2D(512, (3, 3), activation='relu',
padding='same'))
    model.add(layers.Conv2D(512, (3, 3), activation='relu',
padding='same'))
    model.add(layers.Conv2D(512, (3, 3), activation='relu',
padding='same'))
    model.add(layers.MaxPooling2D((2, 2), strides=(2, 2)))

    model.add(layers.Flatten())
    model.add(layers.Dense(4096, activation='relu'))
    model.add(layers.Dropout(0.5))
    model.add(layers.Dense(4096, activation='relu'))
    model.add(layers.Dropout(0.5))
    model.add(layers.Dense(n_classes, activation='softmax'))

    return model

input_shape = (180, 180, 3)
n_classes = 2

K.clear_session()

model = vgg16(input_shape, n_classes)
model.summary()
```

```
WARNING:tensorflow:From C:\Users\smerf\AppData\Local\Packages\
PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-
```

```
packages\Python311\site-packages\keras\src\backend\common\
global_state.py:82: The name tf.reset_default_graph is deprecated.
Please use tf.compat.v1.reset_default_graph instead.


C:\Users\smerf\AppData\Local\Packages\
PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-
packages\Python311\site-packages\keras\src\layers\convolutional\
base_conv.py:107: UserWarning: Do not pass an
`input_shape`/`input_dim` argument to a layer. When using Sequential
models, prefer using an `Input(shape)` object as the first layer in
the model instead.
  super().__init__(activity_regularizer=activity_regularizer,
**kwargs)

Model: "sequential"

┏━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━┳━━━━━━━━━━━━━━━━━━━━━━━━━━━━━┳━━━━━━━━━━━━━━━━━
┓
┃ Layer (type)                         ┃ Output Shape                ┃
Param # ┃
┡━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━╇━━━━━━━━━━━━━━━━━━━━━━━━━━━━━╇━━━━━━━━━━━━━━━━━
┩
│ conv2d (Conv2D)                      │ (None, 180, 180, 64)        │
1,792 │
├──────────────────────────────────────┼─────────────────────────────┼─────────────────
┤
│ conv2d_1 (Conv2D)                    │ (None, 180, 180, 64)        │
36,928 │
├──────────────────────────────────────┼─────────────────────────────┼─────────────────
┤
│ max_pooling2d (MaxPooling2D)         │ (None, 90, 90, 64)          │
0 │
├──────────────────────────────────────┼─────────────────────────────┼─────────────────
┤
│ conv2d_2 (Conv2D)                    │ (None, 90, 90, 128)         │
73,856 │
├──────────────────────────────────────┼─────────────────────────────┼─────────────────
┤
│ conv2d_3 (Conv2D)                    │ (None, 90, 90, 128)         │
147,584 │
├──────────────────────────────────────┼─────────────────────────────┼─────────────────
┤
│ max_pooling2d_1 (MaxPooling2D)       │ (None, 45, 45, 128)         │
0 │
├──────────────────────────────────────┼─────────────────────────────┼─────────────────
┤
│ conv2d_4 (Conv2D)                    │ (None, 45, 45, 256)         │
295,168 │
├──────────────────────────────────────┼─────────────────────────────┼─────────────────
```

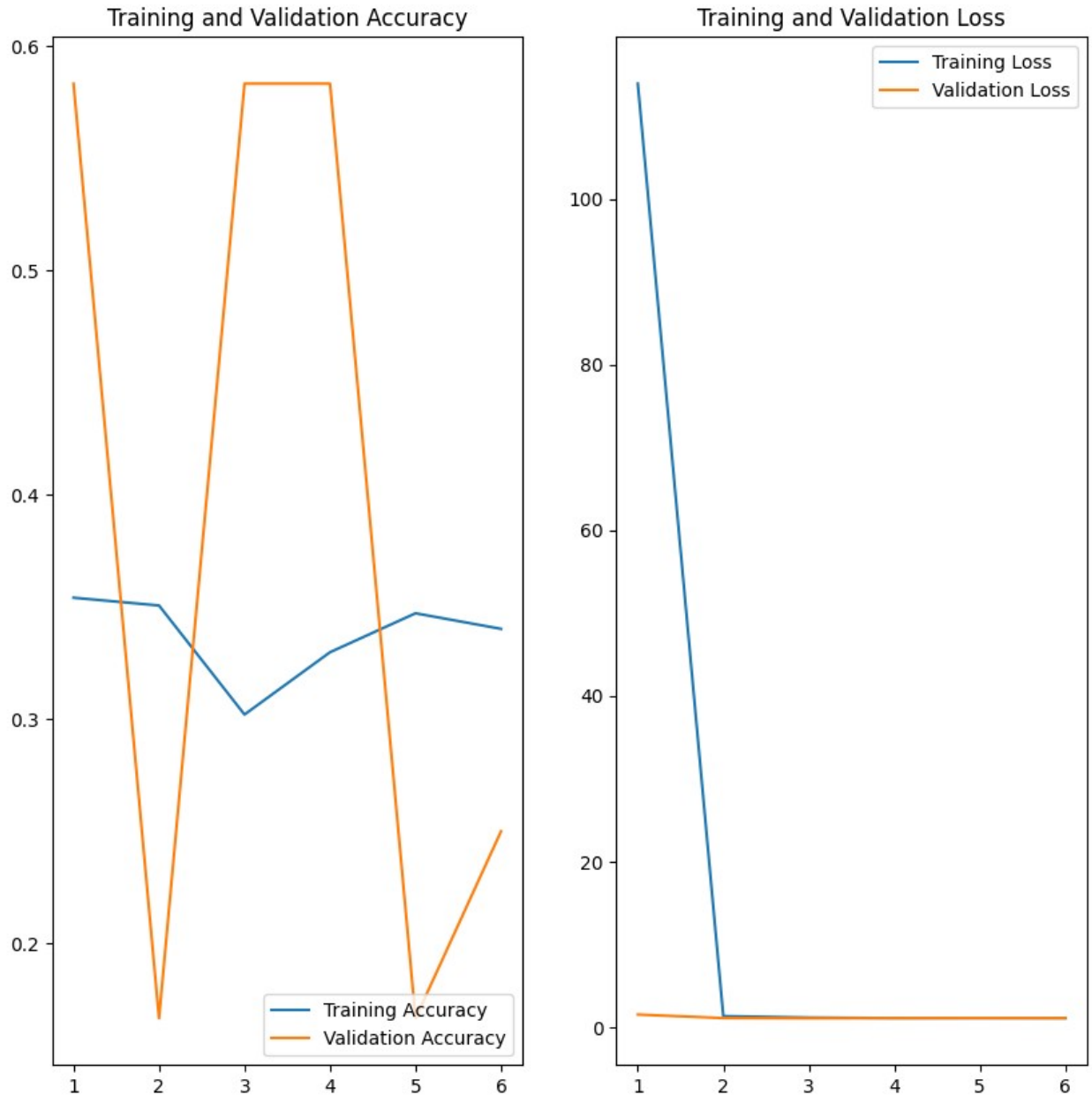
```
──────┤
| conv2d_5 (Conv2D)                | (None, 45, 45, 256)    |
590,080 |
├──────────────────────────────────┼─────────────────────────┼──────────
──────┤
| conv2d_6 (Conv2D)                | (None, 45, 45, 256)    |
590,080 |
├──────────────────────────────────┼─────────────────────────┼──────────
──────┤
| max_pooling2d_2 (MaxPooling2D)   | (None, 22, 22, 256)    |
0 |
├──────────────────────────────────┼─────────────────────────┼──────────
──────┤
| conv2d_7 (Conv2D)                | (None, 22, 22, 512)    |
1,180,160 |
├──────────────────────────────────┼─────────────────────────┼──────────
──────┤
| conv2d_8 (Conv2D)                | (None, 22, 22, 512)    |
2,359,808 |
├──────────────────────────────────┼─────────────────────────┼──────────
──────┤
| conv2d_9 (Conv2D)                | (None, 22, 22, 512)    |
2,359,808 |
├──────────────────────────────────┼─────────────────────────┼──────────
──────┤
| max_pooling2d_3 (MaxPooling2D)   | (None, 11, 11, 512)    |
0 |
├──────────────────────────────────┼─────────────────────────┼──────────
──────┤
| conv2d_10 (Conv2D)               | (None, 11, 11, 512)    |
2,359,808 |
├──────────────────────────────────┼─────────────────────────┼──────────
──────┤
| conv2d_11 (Conv2D)               | (None, 11, 11, 512)    |
2,359,808 |
├──────────────────────────────────┼─────────────────────────┼──────────
──────┤
| conv2d_12 (Conv2D)               | (None, 11, 11, 512)    |
2,359,808 |
├──────────────────────────────────┼─────────────────────────┼──────────
──────┤
| max_pooling2d_4 (MaxPooling2D)   | (None, 5, 5, 512)      |
0 |
├──────────────────────────────────┼─────────────────────────┼──────────
──────┤
| flatten (Flatten)                | (None, 12800)          |
0 |
├──────────────────────────────────┼─────────────────────────┼──────────
──────┤
```

```
| dense (Dense)                       | (None, 4096)              |
52,432,896 |
├─────────────────────────────────────┼───────────────────────────┼──────────
──────┤
| dropout (Dropout)                   | (None, 4096)              |
0 |
├─────────────────────────────────────┼───────────────────────────┼──────────
──────┤
| dense_1 (Dense)                     | (None, 4096)              |
16,781,312 |
├─────────────────────────────────────┼───────────────────────────┼──────────
──────┤
| dropout_1 (Dropout)                 | (None, 4096)              |
0 |
├─────────────────────────────────────┼───────────────────────────┼──────────
──────┤
| dense_2 (Dense)                     | (None, 2)                 |
8,194 |
└─────────────────────────────────────┴───────────────────────────┴──────────
──────┘

 Total params: 83,937,090 (320.19 MB)

 Trainable params: 83,937,090 (320.19 MB)

 Non-trainable params: 0 (0.00 B)
```

```python
from tensorflow.keras.callbacks import EarlyStopping
from tensorflow.keras.optimizers import Adam

n_classes = 3

model = vgg16(input_shape, n_classes)

model.compile(
    optimizer=Adam(),
    loss='sparse_categorical_crossentropy',
)

early_stopping = EarlyStopping(monitor='val_accuracy',
                               patience=5,
                               mode='max')

history = model.fit(train_ds,
                    epochs=30,
                    validation_data=val_ds,
                    callbacks=[early_stopping])
```

```
Epoch 1/30
9/9 ━━━━━━━━━━━━━━━━━━━━ 115s 12s/step - accuracy: 0.3861 - loss:
197.9797 - val_accuracy: 0.5833 - val_loss: 1.5339
```

```
Epoch 2/30
9/9 ━━━━━━━━━━━━━━━━━━━━ 105s 12s/step - accuracy: 0.3919 - loss:
1.3644 - val_accuracy: 0.1667 - val_loss: 1.1038
Epoch 3/30
9/9 ━━━━━━━━━━━━━━━━━━━━ 109s 12s/step - accuracy: 0.2777 - loss:
1.1617 - val_accuracy: 0.5833 - val_loss: 1.0776
Epoch 4/30
9/9 ━━━━━━━━━━━━━━━━━━━━ 106s 12s/step - accuracy: 0.3198 - loss:
1.1015 - val_accuracy: 0.5833 - val_loss: 1.0951
Epoch 5/30
9/9 ━━━━━━━━━━━━━━━━━━━━ 100s 11s/step - accuracy: 0.3596 - loss:
1.0998 - val_accuracy: 0.1667 - val_loss: 1.1126
Epoch 6/30
9/9 ━━━━━━━━━━━━━━━━━━━━ 107s 12s/step - accuracy: 0.3625 - loss:
1.0999 - val_accuracy: 0.2500 - val_loss: 1.0935

ephocs_range = range(1, len(history.history['loss']) + 1)
plt.figure(figsize=(10, 10))
plt.subplot(1, 2, 1)
plt.plot(ephocs_range, history.history['accuracy'], label='Training
Accuracy')
plt.plot(ephocs_range, history.history['val_accuracy'],
label='Validation Accuracy')
plt.legend(loc='lower right')
plt.title('Training and Validation Accuracy')

plt.subplot(1, 2, 2)
plt.plot(ephocs_range, history.history['loss'], label='Training Loss')
plt.plot(ephocs_range, history.history['val_loss'], label='Validation
Loss')
plt.legend(loc='upper right')
plt.title('Training and Validation Loss')
plt.show()
```




```
model.save('vgg-16.h5')
```

```
WARNING:absl:You are saving your model as an HDF5 file via
`model.save()` or `keras.saving.save_model(model)`. This file format
is considered legacy. We recommend using instead the native Keras
format, e.g. `model.save('my_model.keras')` or
`keras.saving.save_model(model, 'my_model.keras')`.
```

```
import tensorflow as tf
import numpy as np
import matplotlib.pyplot as plt
from tensorflow.keras.models import load_model
```

```
from PIL import Image

model = load_model(r'C:\Users\smerf\Downloads\Tugas6_B_11881\vgg-
16.h5')
class_names = ['Merah', 'Thompson', 'Concord']

def classify_images(image_path, save_path='predicted_image.jpg'):
    try:
        input_image = tf.keras.utils.load_img(image_path,
target_size=(180, 180))
        input_image_array = tf.keras.utils.img_to_array(input_image)
        input_image_exp_dim = tf.expand_dims(input_image_array, 0)

        predictions = model.predict(input_image_exp_dim)
        result = tf.nn.softmax(predictions[0])
        class_idx = np.argmax(result)
        confidence = np.max(result) * 100

        print(f"Prediksi: {class_names[class_idx]}")
        print(f"Confidence: {confidence:.2f}%")

        input_image = Image.open(image_path)
        input_image.save(save_path)

        return f"Prediksi: {class_names[class_idx]} dengan confidence
{confidence:.2f}%. Gambar asli disimpan di {save_path}."
    except Exception as e:
        return f"Terjadi kesalahan: {e}"

result = classify_images(r'C:\Users\smerf\Downloads\Tugas6_B_11881\
train_data\Concord\Concord_Grape_Original_Data009.jpg',
save_path='concord9.jpg')
print(result)
```

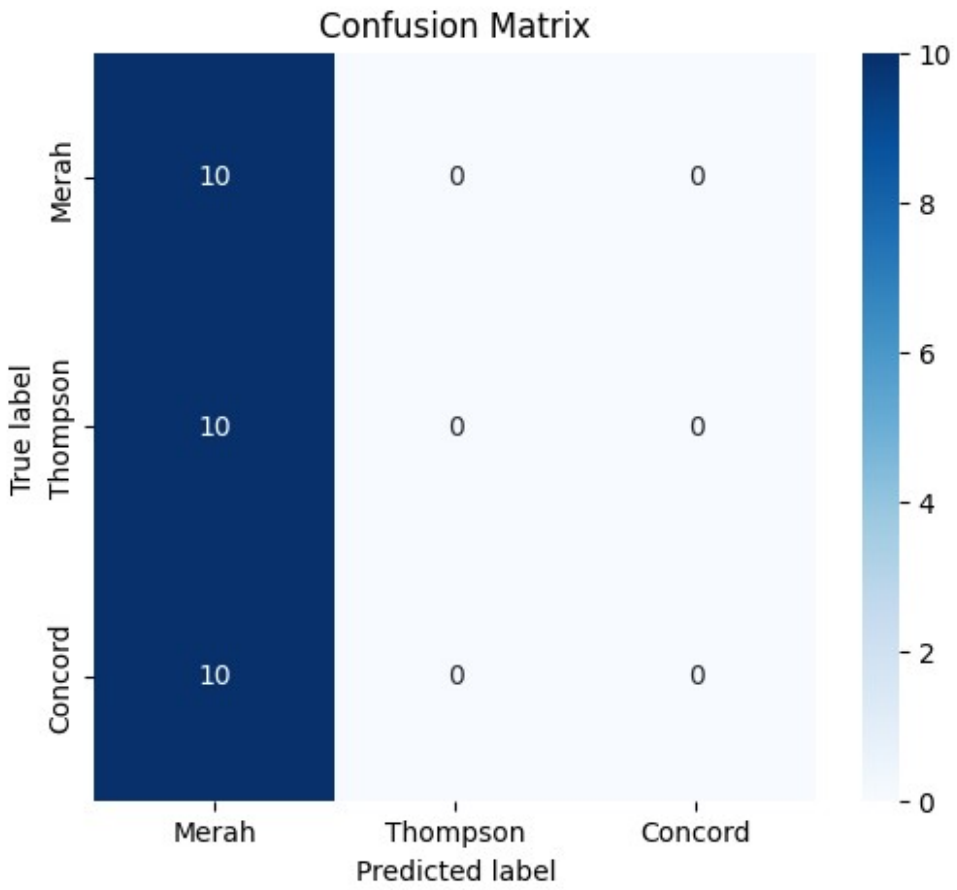
```
WARNING:absl:Compiled the loaded model, but the compiled metrics have
yet to be built. `model.compile_metrics` will be empty until you train
or evaluate the model.

1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 406ms/step
Prediksi: Merah
Confidence: 33.49%
Prediksi: Merah dengan confidence 33.49%. Gambar asli disimpan di
concord9.jpg.
```

```
import tensorflow as tf
from tensorflow.keras.models import load_model
import seaborn as sns
import matplotlib.pyplot as plt

test_data = tf.keras.preprocessing.image_dataset_from_directory(
    r'test_data',
```

```
    labels='inferred',
    label_mode='categorical',
    batch_size=32,
    image_size=(180, 180)
)

y_pred = model.predict(test_data)
y_pred_class = tf.argmax(y_pred, axis=1)

true_labels = []
for _, labels in test_data:
    true_labels.extend(tf.argmax(labels, axis=1).numpy())
true_labels = tf.convert_to_tensor(true_labels)

conf_mat = tf.math.confusion_matrix(true_labels, y_pred_class)
accuracy = tf.reduce_sum(tf.linalg.diag_part(conf_mat)) /
tf.reduce_sum(conf_mat)

precision = tf.linalg.diag_part(conf_mat) / tf.reduce_sum(conf_mat,
axis=0)
recall = tf.linalg.diag_part(conf_mat) / tf.reduce_sum(conf_mat,
axis=1)

f1_score = 2 * (precision * recall) / (precision + recall)

plt.figure(figsize=(6, 5))
sns.heatmap(conf_mat.numpy(), annot=True, fmt='d', cmap='Blues',
            xticklabels=["Merah", "Thompson", "Concord"],
            yticklabels=["Merah", "Thompson", "Concord"])
plt.title('Confusion Matrix')
plt.xlabel('Predicted label')
plt.ylabel('True label')
plt.show()

print("Confusion Matrix:\n", conf_mat.numpy())
print("Akurasi:", accuracy.numpy())
print("Presisi:", precision.numpy())
print("Recall:", recall.numpy())
print("F1 Score:",f1_score.numpy())
```

```
Found 30 files belonging to 3 classes.
```

```
1/1 ━━━━━━━━━━━━━━━━━━━━ 4s 4s/step
```




```
Confusion Matrix:
 [[10  0  0]
 [10  0  0]
 [10  0  0]]
Akurasi: 0.3333333333333333
Presisi: [0.33333333        nan        nan]
Recall: [1. 0. 0.]
F1 Score: [0.5 nan nan]
```

Panji Anugrah Agung 220711843 Bokeh Mengklasifikasi Anggur merah, anggur concord, dan anggur Thompson GoogleNet

```
import tensorflow as tf
import cv2
import numpy as np
from matplotlib import pyplot as plt
#load data
data_dir = r"C:\Users\bravo\Downloads\Documents\pembelajaranMesin\
train_data"
#Randomize data yang telah di load sekaligus resize menjadi 180 x 180
data = tf.keras.utils.image_dataset_from_directory(data_dir, seed=
123, image_size=(180,180), batch_size=16)
print(data.class_names)

class_names = data.class_names

img_size = 180
batch = 10
validation_split = 0.1
dataset = tf.keras.utils.image_dataset_from_directory(
    data_dir,
    seed=123,
    image_size=(img_size, img_size),
    batch_size=batch,
)

total_count = len(dataset)
val_count = int(total_count * validation_split)
train_count = total_count - val_count

print("Total Images:", total_count)
print("Train Images:", train_count)
print("Validation Images:", val_count)

train_ds = dataset.take(train_count)
val_ds = dataset.skip(train_count)
```

```
Found 322 files belonging to 3 classes.
['Concord', 'Merah', 'Thompson']
Found 322 files belonging to 3 classes.
Total Images: 33
Train Images: 30
Validation Images: 3
```

```
import matplotlib.pyplot as plt

i = 0
plt.figure(figsize=(10,10))
```

```
#tampilkan untuk memastikan data sudah di Load
for images, labels in train_ds.take(1):
    for i in range(9):
        plt.subplot(3,3, i+1)
        plt.imshow(images[i].numpy().astype('uint8'))
        plt.title(class_names[labels[i]])
        plt.axis('off')
```


```
for images, labels in train_ds.take(1):
    images_array = np.array(images)
    print(images_array.shape)
```

```
(10, 180, 180, 3)
```

```
import matplotlib.pyplot as plt

i = 0
plt.figure(figsize=(10,10))

#tampilkan untuk memastikan data sudah di load
for images, labels in train_ds.take(1):
    for i in range(9):
        plt.subplot(3,3, i+1)
        plt.imshow(images[i].numpy().astype('uint8'))
        plt.axis('off')
```

```
for images, labels in train_ds.take(1):
    images_array = np.array(images)
    print(images_array.shape)

#loop untuk mengecek atribut gambar(jumlah, tinggi, lebar, dan
channel(RGB))
```

```
(10, 180, 180, 3)
```

```
from tensorflow.keras import layers
from tensorflow.keras.models import Sequential, load_model

Tuner = tf.data.AUTOTUNE
```

```
train_ds = train_ds.cache().shuffle(1000).prefetch(buffer_size =
Tuner)
val_ds = val_ds.cache().shuffle(1000).prefetch(buffer_size = Tuner)


#Augmentasi data dengan menggunakan Sequential
data_augmentation = Sequential([
    layers.RandomFlip("horizontal", input_shape =
(img_size,img_size,3)),
    layers.RandomRotation(0.1),
    layers.RandomZoom(0.1),
    layers.RandomBrightness(0.1)
])


i = 0
plt.figure(figsize=(10,10))
#Lihat data setelah di augmentasi
for images, labels in train_ds.take(69):
    for i in range(9):
        images = data_augmentation(images)
        plt.subplot(3,3, i+1)
        plt.imshow(images[0].numpy().astype('uint8'))
        plt.axis('off')
```

```
C:\Users\bravo\AppData\Roaming\Python\Python312\site-packages\keras\
src\layers\preprocessing\tf_data_layer.py:19: UserWarning: Do not pass
an `input_shape`/`input_dim` argument to a layer. When using
Sequential models, prefer using an `Input(shape)` object as the first
layer in the model instead.
  super().__init__(**kwargs)
```

```
import tensorflow as tf
import keras

import keras._tf_keras.keras.backend as K
from keras._tf_keras.keras.models import Model
from keras._tf_keras.keras.layers import Input, Dense, Conv2D
from keras._tf_keras.keras.layers import Flatten, MaxPool2D, AvgPool2D
from keras._tf_keras.keras.layers import Concatenate, Dropout

from keras._tf_keras.keras.models import load_model

#membuat model from scratch
```

```
def googlenet(input_shape, n_classes):

    def inception_block(x, f):
        t1 = Conv2D(f[0], 1, activation='relu')(x)

        t2 = Conv2D(f[1], 1, activation='relu')(x)
        t2 = Conv2D(f[2], 3, padding='same', activation='relu')(t2)

        t3 = Conv2D(f[3], 1, activation='relu')(x)
        t3 = Conv2D(f[4], 5, padding='same', activation='relu')(t3)

        t4 = MaxPool2D(3, 1, padding='same')(x)
        t4 = Conv2D(f[5], 1, activation='relu')(t4)

        output = Concatenate()([t1, t2, t3, t4])
        return output


    input = Input(input_shape)

    x = Conv2D(64, 7, strides=2, padding='same', activation='relu')
(input)
    x = MaxPool2D(3, strides=2, padding='same')(x)

    x = Conv2D(64, 1, activation='relu')(x)
    x = Conv2D(192, 3, padding='same', activation='relu')(x)
    x = MaxPool2D(3, strides=2)(x)

    x = inception_block(x, [64, 96, 128, 16, 32, 32])
    x = inception_block(x, [128, 128, 192, 32, 96, 64])
    x = MaxPool2D(3, strides=2, padding='same')(x)

    x = inception_block(x, [192, 96, 208, 16, 48, 64])
    x = inception_block(x, [160, 112, 224, 24, 64, 64])
    x = inception_block(x, [128, 128, 256, 24, 64, 64])
    x = inception_block(x, [112, 144, 288, 32, 64, 64])
    x = inception_block(x, [256, 160, 320, 32, 128, 128])
    x = MaxPool2D(3, strides=2, padding='same')(x)

    x = inception_block(x, [256, 160, 320, 32, 128, 128])
    x = inception_block(x, [384, 192, 384, 48, 128, 128])

    x = AvgPool2D(3, strides=1)(x)
    x = Dropout(0.4)(x)

    x = Flatten()(x)
    output = Dense(n_classes, activation='softmax')(x)

    model = Model(input, output)
    return model
```

```
#Pastikan input shae dan jumlah kelas sesuai
input_shape = 180, 180, 3
n_classes = 3

#Clear Cache Keras menggunakan clear session
K.clear_session()
#buat model dengan
model = googlenet(input_shape, n_classes)
model.summary()
###Terdapat code yang hilang disini! lihat modul untuk menemukanya
```

```
Model: "functional"
```

```
┏━━━━━━━━━━━━━━━━━━━━━━━┳━━━━━━━━━━━━━━━━━━━━━━━┳━━━━━━━━━━━━━━━┳━━━━━━━━━━━━━━━━━━━━━━━┓
┃ Layer (type)          ┃ Output Shape          ┃       Param # ┃ Connected to          ┃
┡━━━━━━━━━━━━━━━━━━━━━━━╇━━━━━━━━━━━━━━━━━━━━━━━╇━━━━━━━━━━━━━━━╇━━━━━━━━━━━━━━━━━━━━━━━┩
│ input_layer           │ (None, 180, 180,      │             0 │ -                     │
│ (InputLayer)          │ 3)                    │               │                       │
├───────────────────────┼───────────────────────┼───────────────┼───────────────────────┤
│ conv2d (Conv2D)       │ (None, 90, 90,        │         9,472 │ input_layer[0][0]     │
│                       │ 64)                   │               │                       │
├───────────────────────┼───────────────────────┼───────────────┼───────────────────────┤
│ max_pooling2d         │ (None, 45, 45,        │             0 │ conv2d[0][0]          │
│ (MaxPooling2D)        │ 64)                   │               │                       │
├───────────────────────┼───────────────────────┼───────────────┼───────────────────────┤
│ conv2d_1 (Conv2D)     │ (None, 45, 45,        │         4,160 │ max_pooling2d[0][0]…  │
│                       │ 64)                   │               │                       │
├───────────────────────┼───────────────────────┼───────────────┼───────────────────────┤
│ conv2d_2 (Conv2D)     │ (None, 45, 45,        │       110,784 │ conv2d_1[0][0]        │
│                       │ 192)                  │               │                       │
├───────────────────────┼───────────────────────┼───────────────┼───────────────────────┤
│ max_pooling2d_1       │ (None, 22, 22,        │             0 │ conv2d_2[0]           │
```

```
[0]    │
│ (MaxPooling2D)      │ 192)               │             │
│
├─────────────────────┼────────────────────┼─────────────┼──────────────────
──────┤
│ conv2d_4 (Conv2D)   │ (None, 22, 22,     │     18,528 │
max_pooling2d_1[… │
│                     │ 96)                │             │
│
├─────────────────────┼────────────────────┼─────────────┼──────────────────
──────┤
│ conv2d_6 (Conv2D)   │ (None, 22, 22,     │      3,088 │
max_pooling2d_1[… │
│                     │ 16)                │             │
│
├─────────────────────┼────────────────────┼─────────────┼──────────────────
──────┤
│ max_pooling2d_2     │ (None, 22, 22,     │           0 │
max_pooling2d_1[… │
│ (MaxPooling2D)      │ 192)               │             │
│
├─────────────────────┼────────────────────┼─────────────┼──────────────────
──────┤
│ conv2d_3 (Conv2D)   │ (None, 22, 22,     │     12,352 │
max_pooling2d_1[… │
│                     │ 64)                │             │
│
├─────────────────────┼────────────────────┼─────────────┼──────────────────
──────┤
│ conv2d_5 (Conv2D)   │ (None, 22, 22,     │    110,720 │ conv2d_4[0]
[0]    │
│                     │ 128)               │             │
│
├─────────────────────┼────────────────────┼─────────────┼──────────────────
──────┤
│ conv2d_7 (Conv2D)   │ (None, 22, 22,     │     12,832 │ conv2d_6[0]
[0]    │
│                     │ 32)                │             │
│
├─────────────────────┼────────────────────┼─────────────┼──────────────────
──────┤
│ conv2d_8 (Conv2D)   │ (None, 22, 22,     │      6,176 │
max_pooling2d_2[… │
│                     │ 32)                │             │
│
├─────────────────────┼────────────────────┼─────────────┼──────────────────
──────┤
│ concatenate         │ (None, 22, 22,     │           0 │ conv2d_3[0]
[0],   │
```

```
| (Concatenate)       | 256)               |            | conv2d_5[0]
[0],   |
|                     |                    |            | conv2d_7[0]
[0],   |
|                     |                    |            | conv2d_8[0]
[0]    |
├─────────────────────┼────────────────────┼────────────┼──────────────
──────┤
| conv2d_10 (Conv2D)  | (None, 22, 22,     |     32,896 |
concatenate[0][0] |
|                     | 128)               |            |
|
├─────────────────────┼────────────────────┼────────────┼──────────────
──────┤
| conv2d_12 (Conv2D)  | (None, 22, 22,     |      8,224 |
concatenate[0][0] |
|                     | 32)                |            |
|
├─────────────────────┼────────────────────┼────────────┼──────────────
──────┤
| max_pooling2d_3     | (None, 22, 22,     |          0 |
concatenate[0][0] |
| (MaxPooling2D)      | 256)               |            |
|
├─────────────────────┼────────────────────┼────────────┼──────────────
──────┤
| conv2d_9 (Conv2D)   | (None, 22, 22,     |     32,896 |
concatenate[0][0] |
|                     | 128)               |            |
|
├─────────────────────┼────────────────────┼────────────┼──────────────
──────┤
| conv2d_11 (Conv2D)  | (None, 22, 22,     |    221,376 | conv2d_10[0]
[0]   |
|                     | 192)               |            |
|
├─────────────────────┼────────────────────┼────────────┼──────────────
──────┤
| conv2d_13 (Conv2D)  | (None, 22, 22,     |     76,896 | conv2d_12[0]
[0]   |
|                     | 96)                |            |
|
├─────────────────────┼────────────────────┼────────────┼──────────────
──────┤
| conv2d_14 (Conv2D)  | (None, 22, 22,     |     16,448 |
max_pooling2d_3[… |
|                     | 64)                |            |
|
├─────────────────────┼────────────────────┼────────────┼──────────────
```

```
──────┤
| concatenate_1       | (None, 22, 22,    |          0 | conv2d_9[0]
[0],   |
| (Concatenate)       | 480)              |            | conv2d_11[0]
[0],  |
|                     |                   |            | conv2d_13[0]
[0],  |
|                     |                   |            | conv2d_14[0]
[0]   |
├─────────────────────┼───────────────────┼────────────┼──────────────
──────┤
| max_pooling2d_4     | (None, 11, 11,    |          0 |
concatenate_1[0]… |
| (MaxPooling2D)      | 480)              |            |
|
├─────────────────────┼───────────────────┼────────────┼──────────────
──────┤
| conv2d_16 (Conv2D)  | (None, 11, 11,    |     46,176 |
max_pooling2d_4[… |
|                     | 96)               |            |
|
├─────────────────────┼───────────────────┼────────────┼──────────────
──────┤
| conv2d_18 (Conv2D)  | (None, 11, 11,    |      7,696 |
max_pooling2d_4[… |
|                     | 16)               |            |
|
├─────────────────────┼───────────────────┼────────────┼──────────────
──────┤
| max_pooling2d_5     | (None, 11, 11,    |          0 |
max_pooling2d_4[… |
| (MaxPooling2D)      | 480)              |            |
|
├─────────────────────┼───────────────────┼────────────┼──────────────
──────┤
| conv2d_15 (Conv2D)  | (None, 11, 11,    |     92,352 |
max_pooling2d_4[… |
|                     | 192)              |            |
|
├─────────────────────┼───────────────────┼────────────┼──────────────
──────┤
| conv2d_17 (Conv2D)  | (None, 11, 11,    |    179,920 | conv2d_16[0]
[0]   |
|                     | 208)              |            |
|
├─────────────────────┼───────────────────┼────────────┼──────────────
──────┤
| conv2d_19 (Conv2D)  | (None, 11, 11,    |     19,248 | conv2d_18[0]
[0]   |
```

```
|                       | 48)                |             |
|
├──────────────────────┼────────────────────┼─────────────┼──────────────
──────┤
| conv2d_20 (Conv2D)   | (None, 11, 11,     |      30,784 |
max_pooling2d_5[… |
|                       | 64)                |             |
|
├──────────────────────┼────────────────────┼─────────────┼──────────────
──────┤
| concatenate_2        | (None, 11, 11,     |           0 | conv2d_15[0]
[0],  |
| (Concatenate)        | 512)               |             | conv2d_17[0]
[0],  |
|                       |                    |             | conv2d_19[0]
[0],  |
|                       |                    |             | conv2d_20[0]
[0]   |
├──────────────────────┼────────────────────┼─────────────┼──────────────
──────┤
| conv2d_22 (Conv2D)   | (None, 11, 11,     |      57,456 |
concatenate_2[0][… |
|                       | 112)               |             |
|
├──────────────────────┼────────────────────┼─────────────┼──────────────
──────┤
| conv2d_24 (Conv2D)   | (None, 11, 11,     |      12,312 |
concatenate_2[0][… |
|                       | 24)                |             |
|
├──────────────────────┼────────────────────┼─────────────┼──────────────
──────┤
| max_pooling2d_6      | (None, 11, 11,     |           0 |
concatenate_2[0][… |
| (MaxPooling2D)       | 512)               |             |
|
├──────────────────────┼────────────────────┼─────────────┼──────────────
──────┤
| conv2d_21 (Conv2D)   | (None, 11, 11,     |      82,080 |
concatenate_2[0][… |
|                       | 160)               |             |
|
├──────────────────────┼────────────────────┼─────────────┼──────────────
──────┤
| conv2d_23 (Conv2D)   | (None, 11, 11,     |     226,016 | conv2d_22[0]
[0]   |
|                       | 224)               |             |
|
├──────────────────────┼────────────────────┼─────────────┼──────────────
```

```
──────┤
| conv2d_25 (Conv2D)  | (None, 11, 11,    |     38,464 | conv2d_24[0]
[0]   |
|                     | 64)               |            |
|
├─────────────────────┼───────────────────┼────────────┼──────────────────
──────┤
| conv2d_26 (Conv2D)  | (None, 11, 11,    |     32,832 |
max_pooling2d_6[… |
|                     | 64)               |            |
|
├─────────────────────┼───────────────────┼────────────┼──────────────────
──────┤
| concatenate_3       | (None, 11, 11,    |          0 | conv2d_21[0]
[0],  |
| (Concatenate)       | 512)              |            | conv2d_23[0]
[0],  |
|                     |                   |            | conv2d_25[0]
[0],  |
|                     |                   |            | conv2d_26[0]
[0]   |
├─────────────────────┼───────────────────┼────────────┼──────────────────
──────┤
| conv2d_28 (Conv2D)  | (None, 11, 11,    |     65,664 |
concatenate_3[0]… |
|                     | 128)              |            |
|
├─────────────────────┼───────────────────┼────────────┼──────────────────
──────┤
| conv2d_30 (Conv2D)  | (None, 11, 11,    |     12,312 |
concatenate_3[0]… |
|                     | 24)               |            |
|
├─────────────────────┼───────────────────┼────────────┼──────────────────
──────┤
| max_pooling2d_7     | (None, 11, 11,    |          0 |
concatenate_3[0]… |
| (MaxPooling2D)      | 512)              |            |
|
├─────────────────────┼───────────────────┼────────────┼──────────────────
──────┤
| conv2d_27 (Conv2D)  | (None, 11, 11,    |     65,664 |
concatenate_3[0]… |
|                     | 128)              |            |
|
├─────────────────────┼───────────────────┼────────────┼──────────────────
──────┤
| conv2d_29 (Conv2D)  | (None, 11, 11,    |    295,168 | conv2d_28[0]
[0]   |
```

```
|                       | 256)                |             |
|
├──────────────────────┼─────────────────────┼─────────────┼──────────────
──────┤
| conv2d_31 (Conv2D)   | (None, 11, 11,      |     38,464 | conv2d_30[0]
[0]   |
|                       | 64)                 |             |
|
├──────────────────────┼─────────────────────┼─────────────┼──────────────
──────┤
| conv2d_32 (Conv2D)   | (None, 11, 11,      |     32,832 |
max_pooling2d_7[… |
|                       | 64)                 |             |
|
├──────────────────────┼─────────────────────┼─────────────┼──────────────
──────┤
| concatenate_4        | (None, 11, 11,      |          0 | conv2d_27[0]
[0],  |
| (Concatenate)        | 512)                |            | conv2d_29[0]
[0],  |
|                       |                     |            | conv2d_31[0]
[0],  |
|                       |                     |            | conv2d_32[0]
[0]   |
├──────────────────────┼─────────────────────┼─────────────┼──────────────
──────┤
| conv2d_34 (Conv2D)   | (None, 11, 11,      |     73,872 |
concatenate_4[0]… |
|                       | 144)                |             |
|
├──────────────────────┼─────────────────────┼─────────────┼──────────────
──────┤
| conv2d_36 (Conv2D)   | (None, 11, 11,      |     16,416 |
concatenate_4[0]… |
|                       | 32)                 |             |
|
├──────────────────────┼─────────────────────┼─────────────┼──────────────
──────┤
| max_pooling2d_8      | (None, 11, 11,      |          0 |
concatenate_4[0]… |
| (MaxPooling2D)       | 512)                |             |
|
├──────────────────────┼─────────────────────┼─────────────┼──────────────
──────┤
| conv2d_33 (Conv2D)   | (None, 11, 11,      |     57,456 |
concatenate_4[0]… |
|                       | 112)                |             |
|
├──────────────────────┼─────────────────────┼─────────────┼──────────────
```

```
──────┤
| conv2d_35 (Conv2D)  | (None, 11, 11,    |    373,536 | conv2d_34[0]
[0]   |
|                     | 288)              |            |
|
├─────────────────────┼───────────────────┼────────────┼──────────────
──────┤
| conv2d_37 (Conv2D)  | (None, 11, 11,    |     51,264 | conv2d_36[0]
[0]   |
|                     | 64)               |            |
|
├─────────────────────┼───────────────────┼────────────┼──────────────
──────┤
| conv2d_38 (Conv2D)  | (None, 11, 11,    |     32,832 |
max_pooling2d_8[… |
|                     | 64)               |            |
|
├─────────────────────┼───────────────────┼────────────┼──────────────
──────┤
| concatenate_5       | (None, 11, 11,    |          0 | conv2d_33[0]
[0],  |
| (Concatenate)       | 528)              |            | conv2d_35[0]
[0],  |
|                     |                   |            | conv2d_37[0]
[0],  |
|                     |                   |            | conv2d_38[0]
[0]   |
├─────────────────────┼───────────────────┼────────────┼──────────────
──────┤
| conv2d_40 (Conv2D)  | (None, 11, 11,    |     84,640 |
concatenate_5[0]… |
|                     | 160)              |            |
|
├─────────────────────┼───────────────────┼────────────┼──────────────
──────┤
| conv2d_42 (Conv2D)  | (None, 11, 11,    |     16,928 |
concatenate_5[0]… |
|                     | 32)               |            |
|
├─────────────────────┼───────────────────┼────────────┼──────────────
──────┤
| max_pooling2d_9     | (None, 11, 11,    |          0 |
concatenate_5[0]… |
| (MaxPooling2D)      | 528)              |            |
|
├─────────────────────┼───────────────────┼────────────┼──────────────
──────┤
| conv2d_39 (Conv2D)  | (None, 11, 11,    |    135,424 |
concatenate_5[0]… |
```

```
|                       | 256)                |             |
|
|-----------------------|---------------------|-------------|-----------------
------|
| conv2d_41 (Conv2D)    | (None, 11, 11,      |    461,120 | conv2d_40[0]
[0]   |
|                       | 320)                |             |
|
|-----------------------|---------------------|-------------|-----------------
------|
| conv2d_43 (Conv2D)    | (None, 11, 11,      |    102,528 | conv2d_42[0]
[0]   |
|                       | 128)                |             |
|
|-----------------------|---------------------|-------------|-----------------
------|
| conv2d_44 (Conv2D)    | (None, 11, 11,      |     67,712 |
max_pooling2d_9[… |
|                       | 128)                |             |
|
|-----------------------|---------------------|-------------|-----------------
------|
| concatenate_6         | (None, 11, 11,      |          0 | conv2d_39[0]
[0],  |
| (Concatenate)         | 832)                |            | conv2d_41[0]
[0],  |
|                       |                     |            | conv2d_43[0]
[0],  |
|                       |                     |            | conv2d_44[0]
[0]   |
|-----------------------|---------------------|-------------|-----------------
------|
| max_pooling2d_10      | (None, 6, 6, 832)   |          0 |
concatenate_6[0]… |
| (MaxPooling2D)        |                     |            |
|
|-----------------------|---------------------|-------------|-----------------
------|
| conv2d_46 (Conv2D)    | (None, 6, 6, 160)   |    133,280 |
max_pooling2d_10… |
|-----------------------|---------------------|-------------|-----------------
------|
| conv2d_48 (Conv2D)    | (None, 6, 6, 32)    |     26,656 |
max_pooling2d_10… |
|-----------------------|---------------------|-------------|-----------------
------|
| max_pooling2d_11      | (None, 6, 6, 832)   |          0 |
max_pooling2d_10… |
| (MaxPooling2D)        |                     |            |
```

```
│
├──────────────────────┼──────────────────────┼─────────────┼──────────────────
──────┤
│ conv2d_45 (Conv2D)   │ (None, 6, 6, 256) │    213,248 │
max_pooling2d_10… │
├──────────────────────┼──────────────────────┼─────────────┼──────────────────
──────┤
│ conv2d_47 (Conv2D)   │ (None, 6, 6, 320) │    461,120 │ conv2d_46[0]
[0]   │
├──────────────────────┼──────────────────────┼─────────────┼──────────────────
──────┤
│ conv2d_49 (Conv2D)   │ (None, 6, 6, 128) │    102,528 │ conv2d_48[0]
[0]   │
├──────────────────────┼──────────────────────┼─────────────┼──────────────────
──────┤
│ conv2d_50 (Conv2D)   │ (None, 6, 6, 128) │    106,624 │
max_pooling2d_11… │
├──────────────────────┼──────────────────────┼─────────────┼──────────────────
──────┤
│ concatenate_7        │ (None, 6, 6, 832) │          0 │ conv2d_45[0]
[0],  │
│ (Concatenate)        │                      │            │ conv2d_47[0]
[0],  │
│                      │                      │            │ conv2d_49[0]
[0],  │
│                      │                      │            │ conv2d_50[0]
[0]   │
├──────────────────────┼──────────────────────┼─────────────┼──────────────────
──────┤
│ conv2d_52 (Conv2D)   │ (None, 6, 6, 192) │    159,936 │
concatenate_7[0]… │
├──────────────────────┼──────────────────────┼─────────────┼──────────────────
──────┤
│ conv2d_54 (Conv2D)   │ (None, 6, 6, 48)  │     39,984 │
concatenate_7[0]… │
├──────────────────────┼──────────────────────┼─────────────┼──────────────────
──────┤
│ max_pooling2d_12     │ (None, 6, 6, 832) │          0 │
concatenate_7[0]… │
│ (MaxPooling2D)       │                      │            │
│
├──────────────────────┼──────────────────────┼─────────────┼──────────────────
──────┤
│ conv2d_51 (Conv2D)   │ (None, 6, 6, 384) │    319,872 │
concatenate_7[0]… │
├──────────────────────┼──────────────────────┼─────────────┼──────────────────
──────┤
│ conv2d_53 (Conv2D)   │ (None, 6, 6, 384) │    663,936 │ conv2d_52[0]
[0]   │
```

```
├─────────────────────┼─────────────────────┼─────────────┼──────────────────
─────┤
│ conv2d_55 (Conv2D)  │ (None, 6, 6, 128) │    153,728 │ conv2d_54[0]
[0]   │
├─────────────────────┼─────────────────────┼─────────────┼──────────────────
─────┤
│ conv2d_56 (Conv2D)  │ (None, 6, 6, 128) │    106,624 │
max_pooling2d_12… │
├─────────────────────┼─────────────────────┼─────────────┼──────────────────
─────┤
│ concatenate_8       │ (None, 6, 6,      │          0 │ conv2d_51[0]
[0],  │
│ (Concatenate)       │ 1024)             │            │ conv2d_53[0]
[0],  │
│                     │                   │            │ conv2d_55[0]
[0],  │
│                     │                   │            │ conv2d_56[0]
[0]   │
├─────────────────────┼─────────────────────┼─────────────┼──────────────────
─────┤
│ average_pooling2d   │ (None, 4, 4,      │          0 │
concatenate_8[0]… │
│ (AveragePooling2D)  │ 1024)             │            │
│
├─────────────────────┼─────────────────────┼─────────────┼──────────────────
─────┤
│ dropout (Dropout)   │ (None, 4, 4,      │          0 │
average_pooling2… │
│                     │ 1024)             │            │
│
├─────────────────────┼─────────────────────┼─────────────┼──────────────────
─────┤
│ flatten (Flatten)   │ (None, 16384)     │          0 │ dropout[0][0]
│
├─────────────────────┼─────────────────────┼─────────────┼──────────────────
─────┤
│ dense (Dense)       │ (None, 3)         │     49,155 │ flatten[0][0]
│
└─────────────────────┴─────────────────────┴─────────────┴──────────────────
─────┘

 Total params: 6,022,707 (22.97 MB)

 Trainable params: 6,022,707 (22.97 MB)

 Non-trainable params: 0 (0.00 B)
```

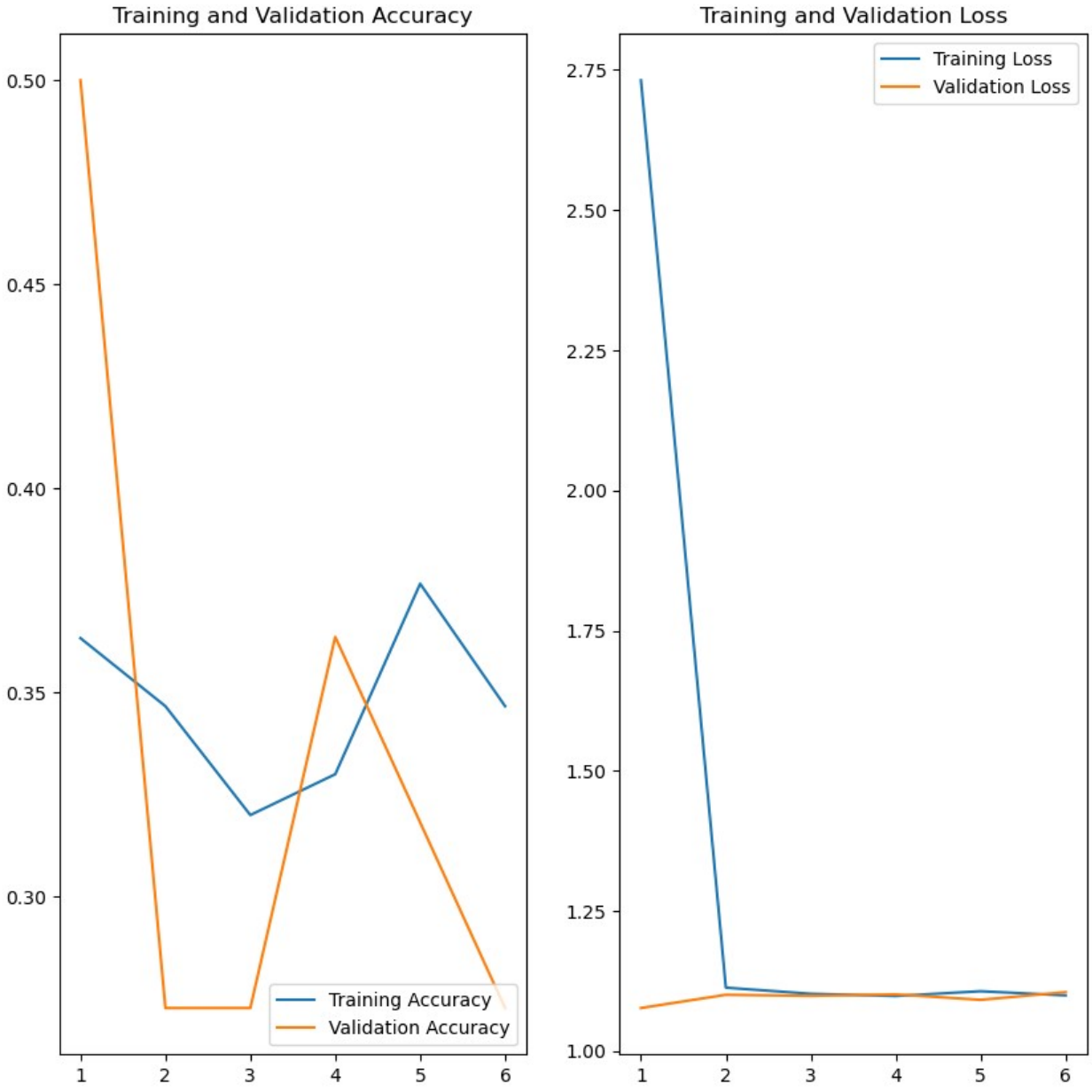
```python
from tensorflow.keras.callbacks import EarlyStopping
from tensorflow.keras.optimizers import Adam
#Coimpile dengan optimizer adam
```

```
###Terdapat code yang hilang disini! lihat modul untuk menemukanya
model.compile(
    optimizer=Adam(),
    loss='sparse_categorical_crossentropy',
    metrics=['accuracy']
)

#buat early stopping
early_stopping = EarlyStopping(monitor='val_accuracy',
                               patience=5,
                               mode='max')
#fit validation data ke dalam model
history= model.fit(train_ds,
                   epochs=30,
                   validation_data=val_ds,
                   callbacks=[early_stopping])
```

```
Epoch 1/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 26s 350ms/step - accuracy: 0.3696 - loss:
5.8330 - val_accuracy: 0.5000 - val_loss: 1.0771
Epoch 2/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 9s 288ms/step - accuracy: 0.3932 - loss:
1.1052 - val_accuracy: 0.2727 - val_loss: 1.1007
Epoch 3/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 9s 286ms/step - accuracy: 0.3212 - loss:
1.1001 - val_accuracy: 0.2727 - val_loss: 1.0987
Epoch 4/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 9s 284ms/step - accuracy: 0.3616 - loss:
1.0981 - val_accuracy: 0.3636 - val_loss: 1.1015
Epoch 5/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 9s 285ms/step - accuracy: 0.3548 - loss:
1.0930 - val_accuracy: 0.3182 - val_loss: 1.0917
Epoch 6/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 9s 286ms/step - accuracy: 0.3872 - loss:
1.0938 - val_accuracy: 0.2727 - val_loss: 1.1054
```

```
#buat plot dengan menggunakan history supaya jumlahnya sesuai epoch
yang dilakukan
ephocs_range = range(1, len(history.history['loss']) + 1)
plt.figure(figsize=(10, 10))
plt.subplot(1, 2, 1)
plt.plot(ephocs_range, history.history['accuracy'], label='Training
Accuracy')
plt.plot(ephocs_range, history.history['val_accuracy'],
label='Validation Accuracy')
plt.legend(loc='lower right')
plt.title('Training and Validation Accuracy')

plt.subplot(1, 2, 2)
plt.plot(ephocs_range, history.history['loss'], label='Training Loss')
```

```
plt.plot(ephocs_range, history.history['val_loss'], label='Validation Loss')
plt.legend(loc='upper right')
plt.title('Training and Validation Loss')
plt.show()
```




```
model.save('gugelnet.h5')
```

```
WARNING:absl:You are saving your model as an HDF5 file via `model.save()` or `keras.saving.save_model(model)`. This file format is considered legacy. We recommend using instead the native Keras
```

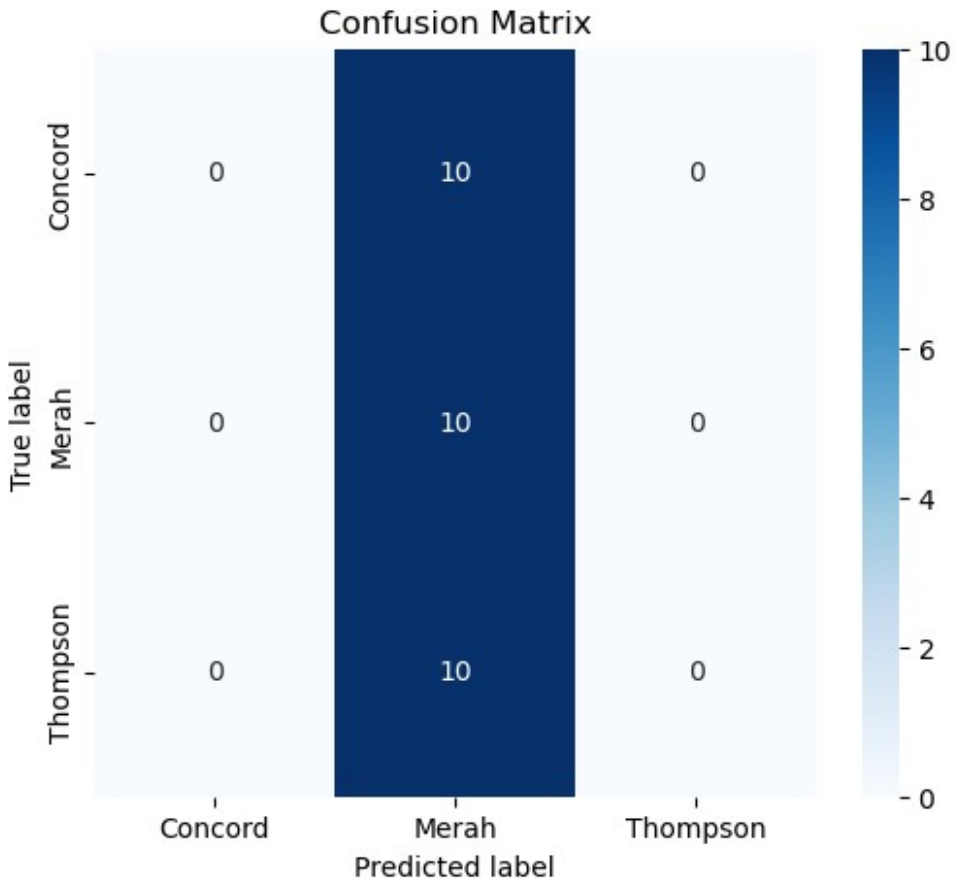
```
format, e.g. `model.save('my_model.keras')` or
`keras.saving.save_model(model, 'my_model.keras')`.

import tensorflow as tf
import numpy as np
import matplotlib.pyplot as plt
from tensorflow.keras.models import load_model
from PIL import Image

# Load the trained model
model = load_model(r'C:\Users\bravo\Downloads\Documents\
pembelajaranMesin\gugelnet.h5')  # Ganti dengan path model Anda
class_names = ['Concord', 'Merah', 'Thompson']

# Function to classify images and save the original image
def classify_images(image_path, save_path='predicted_image.jpg'):
    try:
        # Load and preprocess the image
        input_image = tf.keras.utils.load_img(image_path,
target_size=(180, 180))
        input_image_array = tf.keras.utils.img_to_array(input_image)
        input_image_exp_dim = tf.expand_dims(input_image_array, 0)  #
Add batch dimension

        # Predict
        predictions = model.predict(input_image_exp_dim)
        result = tf.nn.softmax(predictions[0])
        class_idx = np.argmax(result)
        confidence = np.max(result) * 100

        # Display prediction and confidence in notebook
        print(f"Prediksi: {class_names[class_idx]}")
        print(f"Confidence: {confidence:.2f}%")

        # Save the original image (without text)
        input_image = Image.open(image_path)
        input_image.save(save_path)

        return f"Prediksi: {class_names[class_idx]} dengan confidence
{confidence:.2f}%. Gambar asli disimpan di {save_path}."
    except Exception as e:
        return f"Terjadi kesalahan: {e}"

# Contoh penggunaan fungsi
###Terdapat code yang hilang disini! lihat modul untuk menemukanya
result = classify_images(r'C:\Users\bravo\Downloads\Documents\
pembelajaranMesin\test_data\Merah\Merah_Grape_Original_Data02.JPG',
save_path='mentah2.jpg')
print(result)
```

```
WARNING:absl:Compiled the loaded model, but the compiled metrics have yet to be built. `model.compile_metrics` will be empty until you train or evaluate the model.

WARNING:tensorflow:6 out of the last 6 calls to <function TensorFlowTrainer.make_predict_function.<locals>.one_step_on_data_distributed at 0x0000024E79D4D3A0> triggered tf.function retracing. Tracing is expensive and the excessive number of tracings could be due to (1) creating @tf.function repeatedly in a loop, (2) passing tensors with different shapes, (3) passing Python objects instead of tensors. For (1), please define your @tf.function outside of the loop. For (2), @tf.function has reduce_retracing=True option that can avoid unnecessary retracing. For (3), please refer to https://www.tensorflow.org/guide/function#controlling_retracing and https://www.tensorflow.org/api_docs/python/tf/function for  more details.

WARNING:tensorflow:6 out of the last 6 calls to <function TensorFlowTrainer.make_predict_function.<locals>.one_step_on_data_distributed at 0x0000024E79D4D3A0> triggered tf.function retracing. Tracing is expensive and the excessive number of tracings could be due to (1) creating @tf.function repeatedly in a loop, (2) passing tensors with different shapes, (3) passing Python objects instead of tensors. For (1), please define your @tf.function outside of the loop. For (2), @tf.function has reduce_retracing=True option that can avoid unnecessary retracing. For (3), please refer to https://www.tensorflow.org/guide/function#controlling_retracing and https://www.tensorflow.org/api_docs/python/tf/function for  more details.

1/1 ━━━━━━━━━━━━━━━━━━━━ 1s 621ms/step
Prediksi: Merah
Confidence: 34.40%
Prediksi: Merah dengan confidence 34.40%. Gambar asli disimpan di mentah2.jpg.
```

```python
import tensorflow as tf
from tensorflow.keras.models import load_model
import seaborn as sns
import matplotlib.pyplot as plt

# Muat data test yang sebenarnya
test_data = tf.keras.preprocessing.image_dataset_from_directory(
    r'test_data',
    labels='inferred',
    label_mode='categorical',  # Menghasilkan label dalam bentuk one-hot encoding
    batch_size=32,
    image_size=(180, 180)
)
```

```
# Prediksi model
y_pred = model.predict(test_data)
y_pred_class = tf.argmax(y_pred, axis=1)  # Konversi ke kelas prediksi

# Ekstrak label sebenarnya dari test_data dan konversi ke bentuk
indeks kelas
true_labels = []
for _, labels in test_data:
    true_labels.extend(tf.argmax(labels, axis=1).numpy())  # Konversi
one-hot ke indeks kelas
true_labels = tf.convert_to_tensor(true_labels)

# Membuat matriks kebingungan
###Terdapat code yang hilang disini! lihat modul untuk menemukanya
conf_mat = tf.math.confusion_matrix(true_labels, y_pred_class)

# Menghitung akurasi
accuracy = tf.reduce_sum(tf.linalg.diag_part(conf_mat)) /
tf.reduce_sum(conf_mat)

# Menghitung presisi dan recall
precision = tf.linalg.diag_part(conf_mat) / tf.reduce_sum(conf_mat,
axis=0)
recall = tf.linalg.diag_part(conf_mat) / tf.reduce_sum(conf_mat,
axis=1)

# Menghitung F1 Score
f1_score = 2 * (precision * recall) / (precision + recall)

# Visualisasi Confusion Matrix
plt.figure(figsize=(6, 5))
sns.heatmap(conf_mat.numpy(), annot=True, fmt='d', cmap='Blues',
            xticklabels=["Concord", "Merah", "Thompson"],
yticklabels=["Concord", "Merah", "Thompson"])
plt.title('Confusion Matrix')
plt.xlabel('Predicted label')
plt.ylabel('True label')
plt.show()

# Menampilkan hasil
###Terdapat code yang hilang disini! lihat modul untuk menemukanya
print("Confusion Matrix:\n", conf_mat.numpy())
print("Akurasi:", accuracy.numpy())
print("Presisi:", precision.numpy())
print("Recall:", recall.numpy())
print("F1 Score:", f1_score. numpy () )
```

```
Found 30 files belonging to 3 classes.
1/1 ━━━━━━━━━━━━━━━━━━━━ 1s 1s/step
```




```
Confusion Matrix:
 [[ 0 10  0]
 [ 0 10  0]
 [ 0 10  0]]
Akurasi: 0.3333333333333333
Presisi: [       nan 0.33333333        nan]
Recall: [0. 1. 0.]
F1 Score: [nan 0.5 nan]
```

```python
import streamlit as st
import tensorflow as tf
import numpy as np
from tensorflow.keras.models import load_model
from PIL import Image
import time

st.set_page_config(
    page_title="Klasifikasi Jenis Anggur",
    page_icon="🍇",
    layout="wide"
)

st.markdown("""
    <style>
    .main {
        padding: 2rem;
        color: white;
    }
    .stButton>button {
        width: 100%;
        background-color: #4c4c6d;
        color: white;
        border-radius: 5px;
        padding: 0.5rem 1rem;
        border: none;
    }
    .stButton>button:hover {
        background-color: #1f1f2e;
    }
    .prediction-box {
        padding: 1.5rem;
        border-radius: 10px;
        background-color: #1f1f2e;
        margin: 1rem 0;
        color: white;
    }
    .confidence-bar {
        padding: 0.5rem;
        border-radius: 5px;
        margin: 0.5rem 0;
    }
    .stProgress > div > div > div > div {
        background-color: #7272a8;
    }
    .info-box {
        background-color: #1f1f2e;
        padding: 1rem;
        border-radius: 10px;
        margin: 1rem 0;
        border: 1px solid #4c4c6d;
    }
    .upload-box {
        border: 2px dashed #4c4c6d;
        border-radius: 10px;
        padding: 2rem;
        text-align: center;
    }
    .stAlert {
        background-color: #1f1f2e;
        color: white;
    }
    h1, h2, h3, h4, h5, h6, p {
        color: white !important;
    }
    .css-1dp5vir {
        background-color: #1f1f2e;
        border: 1px solid #4c4c6d;
    }
    ul, ol {
        color: white;
    }
    </style>
    """, unsafe_allow_html=True)

# Load model
@st.cache_resource
```

```python
def load_classification_model():
    return load_model(r'MobileNet_Bokeh.h5')

model = load_classification_model()
class_names = ['Merah', 'Thompson', 'Concord']

def classify_image(image_path):
    try:
        input_image = tf.keras.utils.load_img(image_path, target_size=(180, 180))
        input_image_array = tf.keras.utils.img_to_array(input_image)
        input_image_exp_dim = tf.expand_dims(input_image_array, 0)

        predictions = model.predict(input_image_exp_dim)
        result = tf.nn.softmax(predictions[0])

        class_idx = np.argmax(result)
        confidence_scores = result.numpy()
        return class_names[class_idx], confidence_scores
    except Exception as e:
        return "Error", str(e)

st.title("🍇 Sistem Klasifikasi Jenis Anggur")
st.markdown("""
    <div class='info-box'>
        <h4>Tentang Aplikasi</h4>
        <p>Aplikasi ini menggunakan model yang dilatih untuk mengklasifikasikan 3 jenis anggur:</p>
        <ul>
            <li>Anggur Merah</li>
            <li>Anggur Thompson</li>
            <li>Anggur Concord</li>
        </ul>
    </div>
""", unsafe_allow_html=True)

col1, col2 = st.columns([2, 1])

with col1:
    st.markdown("### 📸 Upload Gambar")
    st.markdown("""
        <div class='upload-box'>
            <p>Format yang didukung: JPG, PNG, JPEG</p>
            <p>Anda dapat memilih beberapa gambar sekaligus</p>
        </div>
    """, unsafe_allow_html=True)

    uploaded_files = st.file_uploader(
        "Unggah Gambar Anggur",
        type=["jpg", "png", "jpeg"],
        accept_multiple_files=True,
        label_visibility="collapsed"
    )

    if uploaded_files:
        st.markdown("### 🖼️ Preview Gambar")
        for idx, uploaded_file in enumerate(uploaded_files):
            col_a, col_b, col_c = st.columns([1, 2, 1])
            with col_b:
                image = Image.open(uploaded_file)
                st.image(image, caption=uploaded_file.name, use_column_width=True)

with col2:
    st.markdown("### 🎯 Kontrol Prediksi")

    predict_button = st.button("🔍 Mulai Prediksi", use_container_width=True)

    if predict_button:
        if uploaded_files:
            for uploaded_file in uploaded_files:
                st.markdown(f"#### 📊 Analisis: {uploaded_file.name}")

                with st.spinner('Menganalisis gambar...'):
                    with open(uploaded_file.name, "wb") as f:
                        f.write(uploaded_file.getbuffer())

                    label, confidence = classify_image(uploaded_file.name)
                    time.sleep(0.5)
```

```
            if label != "Error":
                st.markdown("""
                    <div style='padding: 1rem; border-radius: 10px; background-color: #2e2e4d; margin: 1rem 0;'>
                        ✨ Prediksi Berhasil!
                    </div>
                """, unsafe_allow_html=True)

                st.markdown(f"""
                    <div class='prediction-box'>
                        <h4>Hasil Prediksi:</h4>
                        <h2 style='color: #7272a8;'>{label}</h2>
                    </div>
                """, unsafe_allow_html=True)

                st.markdown("### Tingkat Kepercayaan:")
                for idx, (class_name, conf) in enumerate(zip(class_names, confidence)):
                    confidence_percentage = float(conf * 100)
                    st.markdown(f"**{class_name}**")
                    st.progress(confidence_percentage / 100)
                    st.markdown(f"**{confidence_percentage:.1f}%**")

                st.markdown("<hr style='border-color: #4c4c6d;'>", unsafe_allow_html=True)
            else:
                st.error(f"Terjadi kesalahan: {confidence}")
    else:
        st.warning("⚠ Silakan unggah gambar terlebih dahulu!")

st.markdown("""
    <div class='info-box' style='margin-top: 2rem;'>
        <h4>📌 Petunjuk Penggunaan:</h4>
        <ol>
            <li>Upload satu atau beberapa gambar anggur</li>
            <li>Klik tombol "Mulai Prediksi"</li>
            <li>Tunggu hasil analisis</li>
            <li>Lihat hasil prediksi dan tingkat kepercayaan</li>
        </ol>
    </div>
""", unsafe_allow_html=True)
```