Nama : Simen Ferdinand Djamhari

In [3]:
```
#!pip install split-folders

import pandas as pd
import numpy as np
import matplotlib.pyplot as plt

from sklearn.preprocessing import StandardScaler
from sklearn.model_selection import train_test_split

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

import cv2
import os
from PIL import Image
from skimage import io
```

```
Collecting split-folders
  Downloading split_folders-0.5.1-py3-none-any.whl (8.4 kB)
Installing collected packages: split-folders
Successfully installed split-folders-0.5.1
WARNING: Running pip as the 'root' user can result in broken permissions and
conflicting behaviour with the system package manager. It is recommended to u
se a virtual environment instead: https://pip.pypa.io/warnings/venv (https://
pip.pypa.io/warnings/venv)
```

Import Library yang dibutuhkan

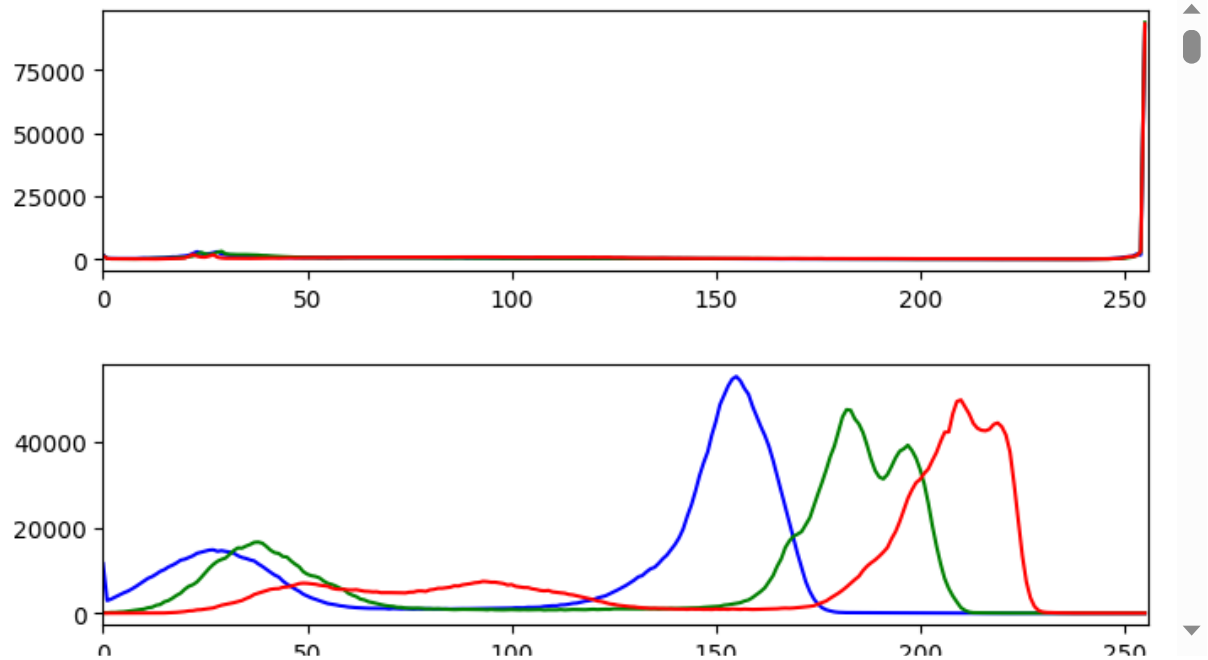
A

Histogram Batik Ceplok

In [4]:
```
path_ceplok = ('/kaggle/input/data-2a/Dataset2A/batik-ceplok')

for filename in os.listdir(path_ceplok):
    plt.figure(figsize = (8, 2))
    if filename.endswith('.jpg'):
        img_file = os.path.join(path_ceplok, filename)
        img = cv2.imread(img_file)
        if img is None:
            continue
        colors = ('b', 'g', 'r')
        for i, col in enumerate(colors):
            hist = cv2.calcHist([img], [i], None, [256], [0, 256])
            plt.plot(hist, color= col)
            plt.xlim([0, 256])

        plt.show()
```



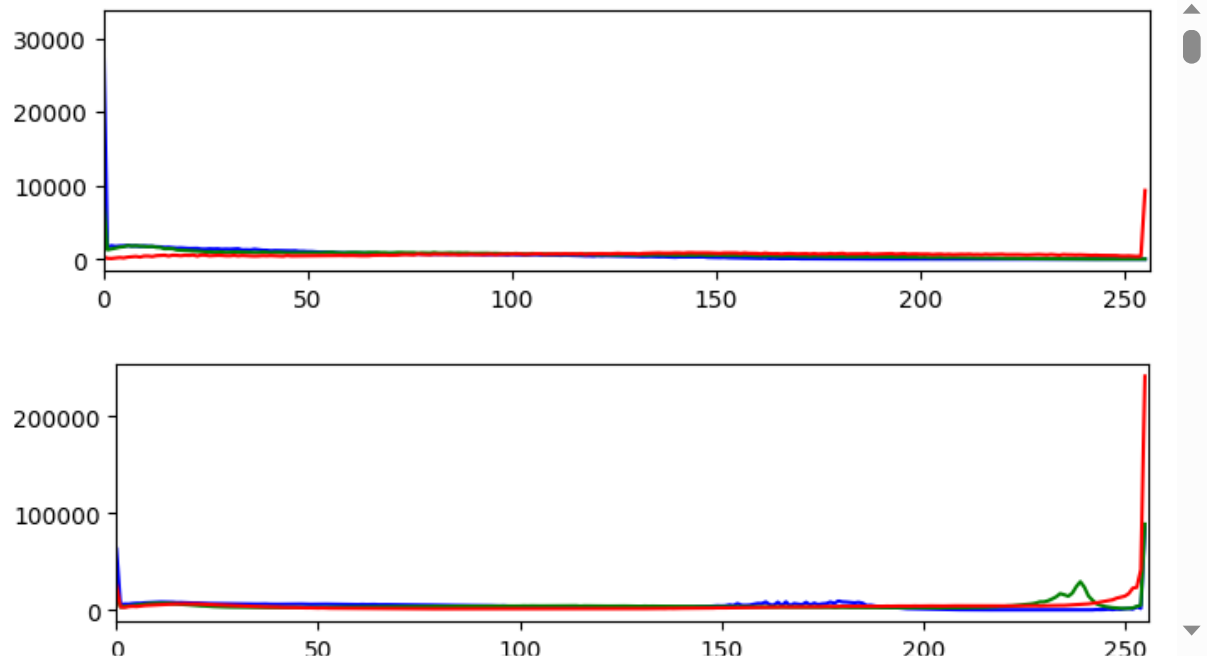
Histogram diatas adalah histogram warna untuk setiap gambar yang ada di batik-ceplok

Histogram Batik Bali

In [325]:
```
path_bali = ('/kaggle/input/data-2a/Dataset2A/batik-bali')


for filename in os.listdir(path_bali):
    plt.figure(figsize = (8, 2))
    if filename.endswith('.jpg'):
        img_file = os.path.join(path_bali, filename)
        img = cv2.imread(img_file)
        colors = ('b', 'g', 'r')
        for i, col in enumerate(colors):
            hist = cv2.calcHist([img], [i], None, [256], [0, 256])
            plt.plot(hist, color= col)
            plt.xlim([0, 256])

        plt.show()
```



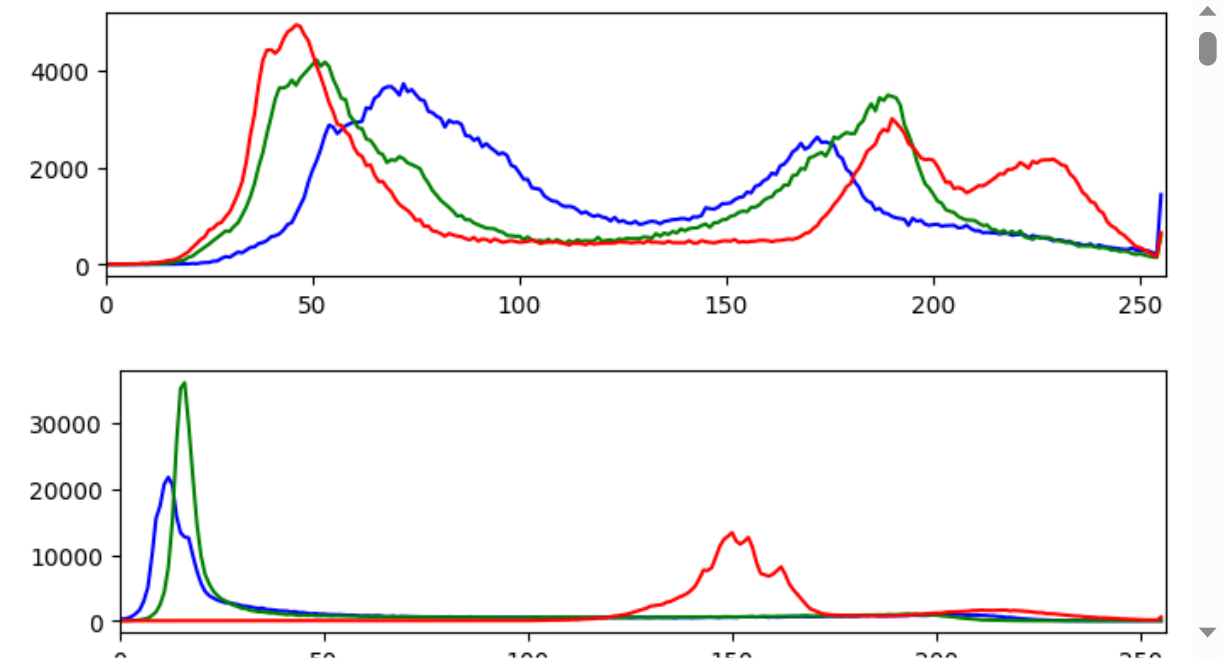
Histogram diatas adalah histogram warna untuk setiap gambar yang ada di batik-bali

Histogram Batik Betawi

In [326]:
```
path_betawi = ('/kaggle/input/data-2a/Dataset2A/batik-betawi')


for filename in os.listdir(path_betawi):
    plt.figure(figsize = (8, 2))
    if filename.endswith('.jpg'):
        img_file = os.path.join(path_betawi, filename)
        img = cv2.imread(img_file)
        if img is None:
            continue
        colors = ('b', 'g', 'r')
        for i, col in enumerate(colors):
            hist = cv2.calcHist([img], [i], None, [256], [0, 256])
            plt.plot(hist, color= col)
            plt.xlim([0, 256])

        plt.show()
```



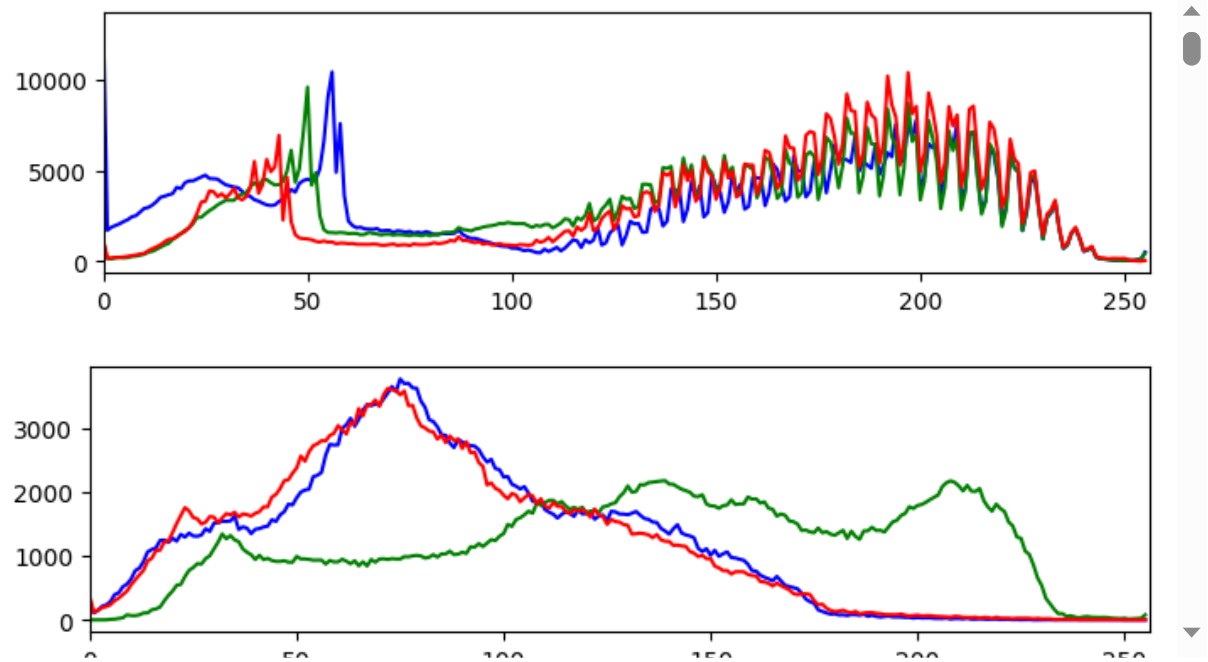
Histogram diatas adalah histogram warna untuk setiap gambar yang ada di batik-betawi

Histogram Batik Cendrawasih

In [327]:
```
path_cendrawasih = ('/kaggle/input/data-2a/Dataset2A/batik-cendrawasih')


for filename in os.listdir(path_cendrawasih):
    plt.figure(figsize = (8, 2))
    if filename.endswith('.jpg'):
        img_file = os.path.join(path_cendrawasih, filename)
        img = cv2.imread(img_file)
        if img is None:
            continue
        colors = ('b', 'g', 'r')
        for i, col in enumerate(colors):
            hist = cv2.calcHist([img], [i], None, [256], [0, 256])
            plt.plot(hist, color= col)
            plt.xlim([0, 256])

        plt.show()
```



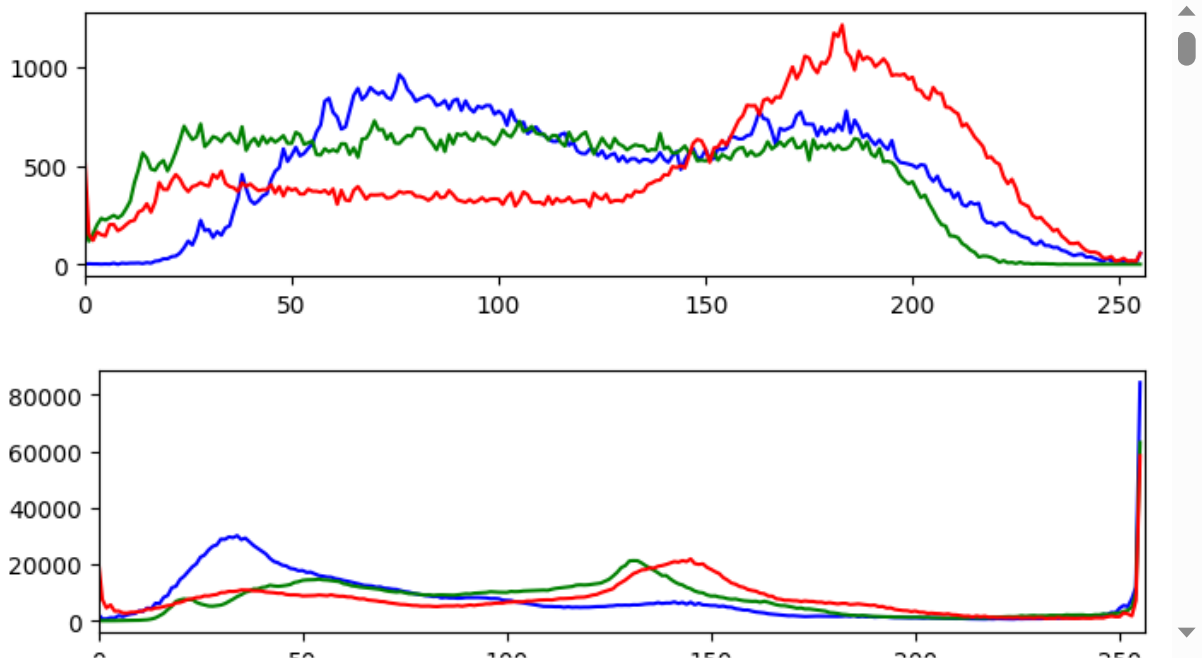
Histogram diatas adalah histogram warna untuk setiap gambar yang ada di batik-cendrawasih

Histogram Batik Celup

In [328]:
```
path_celup = ('/kaggle/input/data-2a/Dataset2A/batik-celup')


for filename in os.listdir(path_celup):
    plt.figure(figsize = (8, 2))
    if filename.endswith('.jpg'):
        img_file = os.path.join(path_celup, filename)
        img = cv2.imread(img_file)
        if img is None:
            continue
        colors = ('b', 'g', 'r')
        for i, col in enumerate(colors):
            hist = cv2.calcHist([img], [i], None, [256], [0, 256])
            plt.plot(hist, color= col)
            plt.xlim([0, 256])

        plt.show()
```



Histogram diatas adalah histogram warna untuk setiap gambar yang ada di batik-celup

B

In [329]:
```
# os.makedirs("./dataset")
splitfolders.ratio("/kaggle/input/data-2a/Dataset2A", output="/kaggle/working/d
```

Membuat directory output /dataset dan menasukan data yang telah dibagi menjadi 80% training, 10% validation, 10% testing di dalamnya

In [330]:
```
#Creating data generators for train, test and validation datasets
#train_datagen = ImageDataGenerator(rescale=1./255, shear_range=0.1, horizontal
train_datagen = ImageDataGenerator(rescale=1./255, shear_range=0.1, zoom_range=
val_datagen = ImageDataGenerator(rescale=1./255, shear_range=0.1, zoom_range=0.
test_datagen = ImageDataGenerator(rescale=1./255, shear_range=0.1, zoom_range=0

#Creating train, test and validation datasets
train = train_datagen.flow_from_directory('/kaggle/working/dataset/train', targ
val = val_datagen.flow_from_directory('/kaggle/working/dataset/val', target_siz
test = test_datagen.flow_from_directory('/kaggle/working/dataset/test', target_
```

```
Found 198 images belonging to 5 classes.
Found 24 images belonging to 5 classes.
Found 26 images belonging to 5 classes.
```

Meng-augmented data yang didapat dan meresizenya menjadi 64 x 64

C

In [317]:
```
from keras import models, layers

from keras.models import Sequential
from keras.preprocessing.image import ImageDataGenerator
from keras.layers import BatchNormalization, Dropout
from keras.layers import Conv2D, MaxPooling2D, Dense, Flatten
from keras.utils import normalize, to_categorical
from tensorflow.keras import regularizers
```

Mengimport library yang akan digunakan

In [318]:
```
def build_model():
    model = Sequential()
    model.add(layers.Conv2D(filters=64, kernel_size=(5, 5), strides=(1, 1), act
    model.add(MaxPooling2D(pool_size=(14,14), strides = (2,2)))

    model.add(Conv2D(filters = 256, kernel_size=(3, 3), strides=(1, 1), activat
    model.add(MaxPooling2D(pool_size=(2,2), strides = (2,2)))

    model.add(layers.Conv2D(filters = 384, kernel_size=(3, 3), strides=(1, 1),

    model.add(layers.Conv2D(filters = 384, kernel_size=(3, 3), strides=(1, 1),

    model.add(layers.Conv2D(filters = 192, kernel_size=(3, 3), strides=(1, 1),

    model.add(Flatten())
    model.add(Dense(4096,activation='relu'))
    model.add(Dense(4096,activation='relu'))
    model.add(Dense(5,activation = 'softmax'))
    return model
```

Unutk membuat model, pertama menggunakan Sequntial. lalu akan memasukkan Conv2D dengan filter = 64, kernel_size=(5, 5), strides=(1, 1), activation='relu', input_shape=(64,64,3), padding = "valid", sesuai dengan ketentuan soal. karena ukuran di soal berubah, akan dilakukan maxpooling dengan pool_size=(14,14), strides = (2,2). Setlah itu masukkan nilai Conv2Dnya kembali sesuai dengan ketentuan soal dst. Lalu akan dilakukan Flatten. Ditambahkan Dense 4096 2 kali dan Dense 5 karena ada 5 class yang tersedia di data.

referensi : https://github.com/krishnaik06/Advanced-CNN-Architectures/blob/master/Transfer%20Learning%20Alexnet.ipynb (https://github.com/krishnaik06/Advanced-CNN-Architectures/blob/master/Transfer%20Learning%20Alexnet.ipynb)

In [319]:
```
model = build_model()
model.compile(loss = 'categorical_crossentropy', metrics = ['accuracy'])
print(model.summary())
```

```
Model: "sequential_41"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d_205 (Conv2D)         (None, 60, 60, 64)        4864

 max_pooling2d_85 (MaxPoolin  (None, 24, 24, 64)       0
 g2D)

 conv2d_206 (Conv2D)         (None, 24, 24, 256)       147712

 max_pooling2d_86 (MaxPoolin  (None, 12, 12, 256)      0
 g2D)

 conv2d_207 (Conv2D)         (None, 12, 12, 384)       885120

 conv2d_208 (Conv2D)         (None, 12, 12, 384)       1327488

 conv2d_209 (Conv2D)         (None, 12, 12, 192)       663744

 flatten_41 (Flatten)        (None, 27648)             0

 dense_100 (Dense)           (None, 4096)              113250304

 dense_101 (Dense)           (None, 4096)              16781312

 dense_102 (Dense)           (None, 5)                 20485

=================================================================
Total params: 133,081,029
Trainable params: 133,081,029
Non-trainable params: 0
_________________________________________________________________
None
```

Mengcompile menggunakan loss categorical_crossentropy dan metrics accuracy. Total param yang dihasilkan sangat banyak yaitu 133,081,029

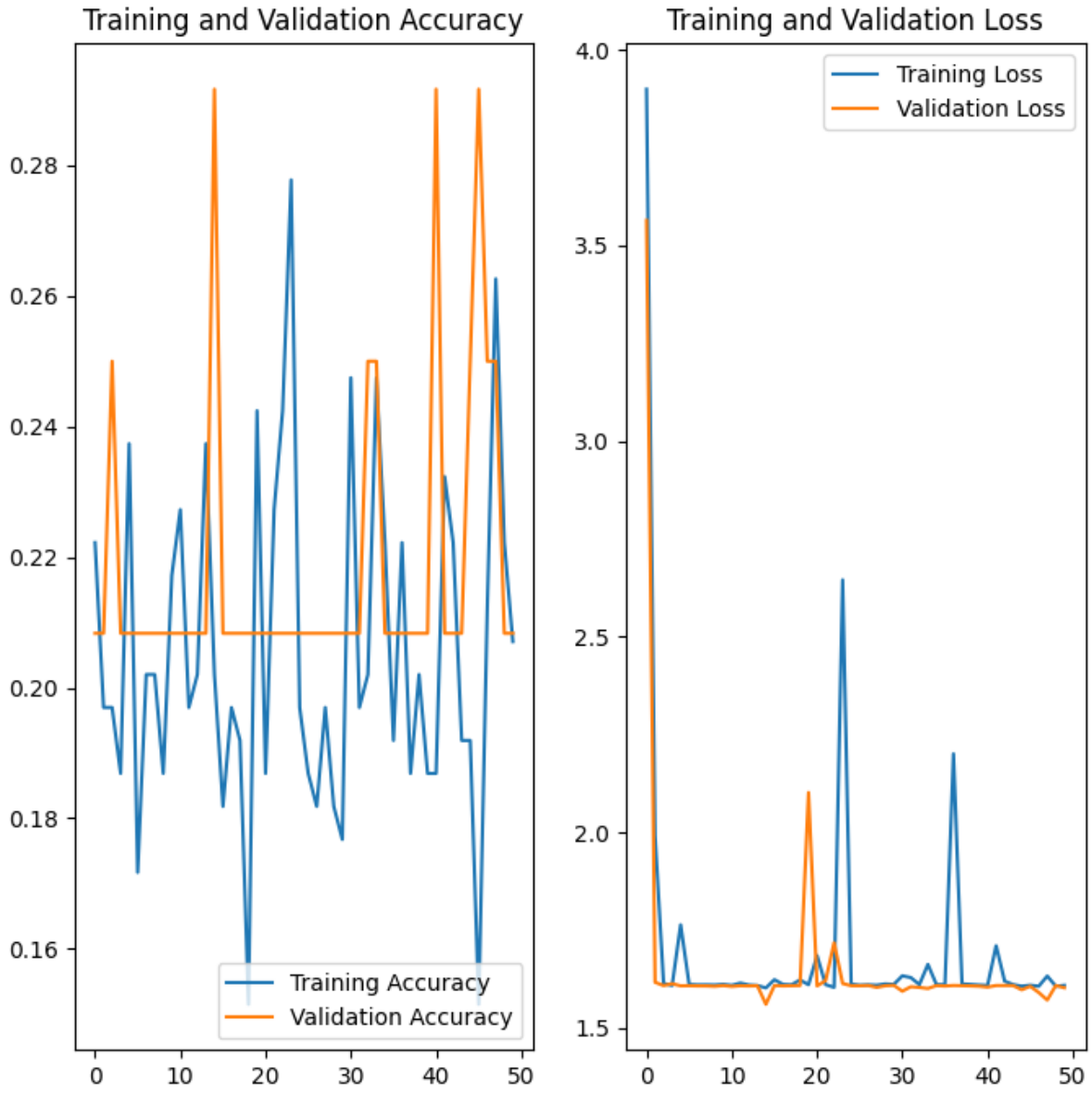
In [320]:
```
history = model.fit(train, epochs = 50, validation_data = val)
```

```
Epoch 1/50
7/7 [==============================] - 5s 443ms/step - loss: 3.8989 - accur
acy: 0.2222 - val_loss: 3.5638 - val_accuracy: 0.2083
Epoch 2/50
7/7 [==============================] - 3s 384ms/step - loss: 1.9908 - accur
acy: 0.1970 - val_loss: 1.6171 - val_accuracy: 0.2083
Epoch 3/50
7/7 [==============================] - 3s 439ms/step - loss: 1.6142 - accur
acy: 0.1970 - val_loss: 1.6086 - val_accuracy: 0.2500
Epoch 4/50
7/7 [==============================] - 3s 415ms/step - loss: 1.6088 - accur
acy: 0.1869 - val_loss: 1.6134 - val_accuracy: 0.2083
Epoch 5/50
7/7 [==============================] - 3s 340ms/step - loss: 1.7639 - accur
acy: 0.2374 - val_loss: 1.6080 - val_accuracy: 0.2083
Epoch 6/50
7/7 [==============================] - 3s 357ms/step - loss: 1.6115 - accur
acy: 0.1717 - val_loss: 1.6083 - val_accuracy: 0.2083
Epoch 7/50
```

akan memasukkan model yang telah dibuat ke data val dengan epochs 50

In [321]:
```
plt.figure(figsize=(8, 8))
plt.subplot(1, 2, 1)
plt.plot(history.history['accuracy'], label = 'Training Accuracy')
plt.plot(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(history.history['loss'], label = 'Training Loss')
plt.plot(history.history['val_loss'], label = 'Validation Loss')
plt.legend(loc = 'upper right')
plt.title('Training and Validation Loss')
plt.show()
```



memplot accuracy dan loss dari training dan validation. Dari yang bisa dilihat kalau baseline arsitektur tidak terlalu bagus

In [322]:
```
model.evaluate(test)
```

```
1/1 [==============================] - 0s 338ms/step - loss: 1.6047 - accurac
y: 0.1923
```

Out[322]:
```
[1.6047009229660034, 0.19230769574642181]
```

Model baseline artisitektur memiliki loss 1,6 dan akurasi sekitar 19%. Hal ini disebakan karena model yang dibuat sangat kompleks tetapi data yang didapatkan hanya sedikti sehingga sulit untuk memprediksi kebenarannya

D

Fine Tuning Parameter

In [312]:
```
def build_model_FT():
    model = Sequential()
    model.add(layers.Conv2D(filters=64, kernel_size=(5, 5), strides=(1, 1), act
    model.add(MaxPooling2D(pool_size=(14,14), strides = (2,2)))
    model.add(BatchNormalization())

    model.add(Conv2D(filters = 30, kernel_size=(3, 3), strides=(1, 1), activati
    model.add(MaxPooling2D(pool_size=(2,2), strides = (2,2)))

    model.add(layers.Conv2D(filters = 40, kernel_size=(3, 3), strides=(1, 1), a

    model.add(layers.Conv2D(filters = 40, kernel_size=(3, 3), strides=(1, 1), a

    model.add(layers.Conv2D(filters = 25, kernel_size=(3, 3), strides=(1, 1), a

    model.add(Flatten())
    model.add(Dense(50,activation='relu'))
    model.add(Dense(5,activation = 'softmax'))
    return model
```

Mengganti baseline arsitektur menjadi lebih simpel untuk menyesuaikan dengan kedikitan data. Dikurangkan filter yang akan digunakan dan menambahkan BatchingNormalization.

In [313]:
```
modelFT = build_model_FT()
modelFT.compile(optimizer = tf.keras.optimizers.Adam(learning_rate = 0.00001),l
print(modelFT.summary())
```

```
Model: "sequential_40"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d_200 (Conv2D)         (None, 60, 60, 64)        4864

 max_pooling2d_83 (MaxPoolin  (None, 24, 24, 64)       0
 g2D)

 batch_normalization_73 (Bat  (None, 24, 24, 64)       256
 chNormalization)

 conv2d_201 (Conv2D)         (None, 24, 24, 30)        17310

 max_pooling2d_84 (MaxPoolin  (None, 12, 12, 30)       0
 g2D)

 conv2d_202 (Conv2D)         (None, 12, 12, 40)        10840

 conv2d_203 (Conv2D)         (None, 12, 12, 40)        14440

 conv2d_204 (Conv2D)         (None, 12, 12, 25)        9025

 flatten_40 (Flatten)        (None, 3600)              0

 dense_98 (Dense)            (None, 50)                180050

 dense_99 (Dense)            (None, 5)                 255

=================================================================
Total params: 237,040
Trainable params: 236,912
Non-trainable params: 128
_________________________________________________________________
None
```

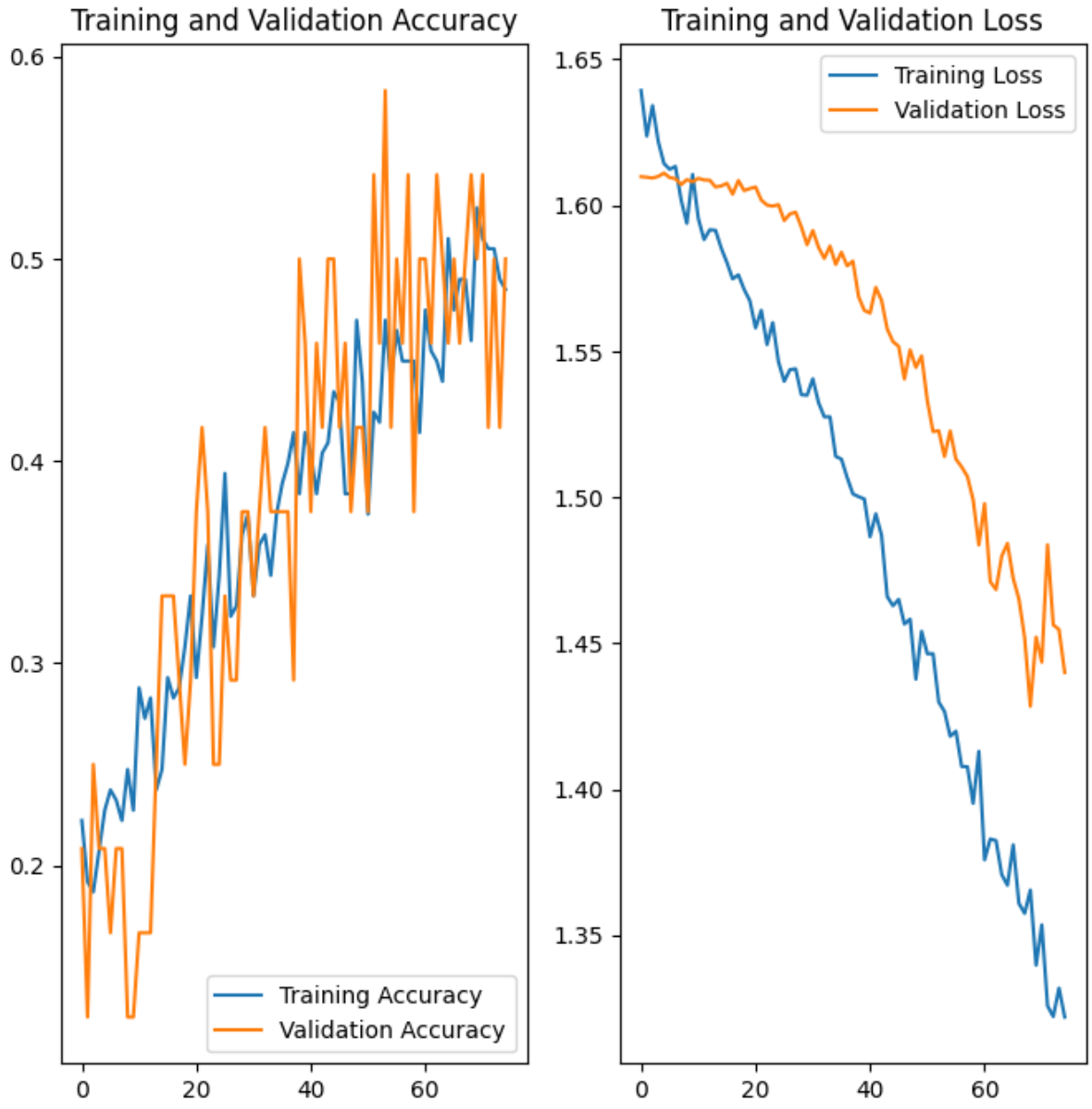
Menggunakan optimizer adam dan menambahkan learning rate menjadi 0.00001. Bisa terlihat dari summary kalau param yang dihasilkan menurun jadi hanya 237,040

In [314]:
```
history = modelFT.fit(train, epochs = 75, validation_data = val, batch_size = 4
```

```
Epoch 1/75
7/7 [==============================] - 5s 431ms/step - loss: 1.6393 - accur
acy: 0.2222 - val_loss: 1.6098 - val_accuracy: 0.2083
Epoch 2/75
7/7 [==============================] - 3s 373ms/step - loss: 1.6238 - accur
acy: 0.1919 - val_loss: 1.6096 - val_accuracy: 0.1250
Epoch 3/75
7/7 [==============================] - 3s 397ms/step - loss: 1.6342 - accur
acy: 0.1869 - val_loss: 1.6094 - val_accuracy: 0.2500
Epoch 4/75
7/7 [==============================] - 3s 410ms/step - loss: 1.6219 - accur
acy: 0.2071 - val_loss: 1.6099 - val_accuracy: 0.2083
Epoch 5/75
7/7 [==============================] - 3s 369ms/step - loss: 1.6143 - accur
acy: 0.2273 - val_loss: 1.6110 - val_accuracy: 0.2083
Epoch 6/75
7/7 [==============================] - 3s 375ms/step - loss: 1.6124 - accur
acy: 0.2374 - val_loss: 1.6095 - val_accuracy: 0.1667
Epoch 7/75
```

In [315]:
```
plt.figure(figsize=(8, 8))
plt.subplot(1, 2, 1)
plt.plot(history.history['accuracy'], label = 'Training Accuracy')
plt.plot(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(history.history['loss'], label = 'Training Loss')
plt.plot(history.history['val_loss'], label = 'Validation Loss')
plt.legend(loc = 'upper right')
plt.title('Training and Validation Loss')
plt.show()
```



Setelah diganti baseline arsitekturnya dan diganti parameter, gambar yang dihasilkan berubah menjadi seperti diatas

E

In [316]:
```
modelFT.evaluate(test)
```

```
1/1 [==============================] - 0s 329ms/step - loss: 1.4231 - accurac
y: 0.5385
```

Out[316]:
```
[1.4231200218200684, 0.5384615659713745]
```

Bisa dilihat setelah diganti baseline arsitektur dan parameternya kalau hasil loss menurun menjadi 1,4 dan akurasi naik menjadi sekitar 53%. Hal ini disebabkan karena model arsitektur terlalu kompleks untuk data sehingga data tidak terprediksi dengan akurat. Dengan membuat baseline arsitektur yang lebih sederhana, hasil yang diberikan akan menjadi lebih baik daripada jika tidak diganti. Dengan ditambahkannya epoch juga membantu model deep learning untuk medeteksi pola.