In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import tensorflow as tf
from tensorflow import keras
import seaborn as sns
```

In [2]:
```
from tensorflow.keras.layers import Input, Lambda, Dense, Flatten
from tensorflow.keras.models import Model
from tensorflow.keras.applications.resnet50 import ResNet50, preprocess_input
from tensorflow.keras.preprocessing import image
from tensorflow.keras.preprocessing.image import ImageDataGenerator, load_img
from tensorflow.keras.models import Sequential

import numpy as np
from glob import glob
import matplotlib.pyplot as plt
```

In [3]:
```
train_Path = r'C:\Users\anshul\Desktop\MS\Subjects\Spring 2022\Data Analytics\FINAL PRO
test_Path = r'C:\Users\anshul\Desktop\MS\Subjects\Spring 2022\Data Analytics\FINAL PROJ
```

In [4]:
```
# Set Resize variable
IMAGE_SIZE = [224, 224] # This is my desired image size... and also ResNet50 accepts im
```

In [5]:
```
resnet = ResNet50(
    input_shape = IMAGE_SIZE + [3], # Making the image into 3 Channel, so concating 3.
    weights = 'imagenet', # Default weights.
    include_top = False   #
)
```

In [6]:
```
resnet.summary()
```

```
Model: "resnet50"
__________________________________________________________________________________________
 Layer (type)                   Output Shape         Param #     Connected to
==========================================================================================
 input_1 (InputLayer)           [(None, 224, 224, 3  0           []
                                )]

 conv1_pad (ZeroPadding2D)      (None, 230, 230, 3)  0           ['input_1[0][0]']

 conv1_conv (Conv2D)            (None, 112, 112, 64  9472        ['conv1_pad[0][0]']
                                )

 conv1_bn (BatchNormalization)  (None, 112, 112, 64  256         ['conv1_conv[0][0]']
                                )

 conv1_relu (Activation)        (None, 112, 112, 64  0           ['conv1_bn[0][0]']
                                )
```

```
 pool1_pad (ZeroPadding2D)      (None, 114, 114, 64  0           ['conv1_relu[0][0]']
                                )

 pool1_pool (MaxPooling2D)      (None, 56, 56, 64)   0           ['pool1_pad[0][0]']

 conv2_block1_1_conv (Conv2D)   (None, 56, 56, 64)   4160        ['pool1_pool[0][0]']

 conv2_block1_1_bn (BatchNormal  (None, 56, 56, 64)  256         ['conv2_block1_1_conv
[0][0]']
 ization)

 conv2_block1_1_relu (Activatio  (None, 56, 56, 64)  0           ['conv2_block1_1_bn[0]
[0]']
 n)

 conv2_block1_2_conv (Conv2D)   (None, 56, 56, 64)   36928       ['conv2_block1_1_relu
[0][0]']

 conv2_block1_2_bn (BatchNormal  (None, 56, 56, 64)  256         ['conv2_block1_2_conv
[0][0]']
 ization)

 conv2_block1_2_relu (Activatio  (None, 56, 56, 64)  0           ['conv2_block1_2_bn[0]
[0]']
 n)

 conv2_block1_0_conv (Conv2D)   (None, 56, 56, 256)  16640       ['pool1_pool[0][0]']

 conv2_block1_3_conv (Conv2D)   (None, 56, 56, 256)  16640       ['conv2_block1_2_relu
[0][0]']

 conv2_block1_0_bn (BatchNormal  (None, 56, 56, 256)  1024       ['conv2_block1_0_conv
[0][0]']
 ization)

 conv2_block1_3_bn (BatchNormal  (None, 56, 56, 256)  1024       ['conv2_block1_3_conv
[0][0]']
 ization)

 conv2_block1_add (Add)         (None, 56, 56, 256)  0           ['conv2_block1_0_bn[0]
[0]',
                                                                  'conv2_block1_3_bn[0]
[0]']

 conv2_block1_out (Activation)  (None, 56, 56, 256)  0           ['conv2_block1_add[0]
[0]']

 conv2_block2_1_conv (Conv2D)   (None, 56, 56, 64)   16448       ['conv2_block1_out[0]
[0]']

 conv2_block2_1_bn (BatchNormal  (None, 56, 56, 64)  256         ['conv2_block2_1_conv
[0][0]']
 ization)

 conv2_block2_1_relu (Activatio  (None, 56, 56, 64)  0           ['conv2_block2_1_bn[0]
[0]']
 n)

 conv2_block2_2_conv (Conv2D)   (None, 56, 56, 64)   36928       ['conv2_block2_1_relu
```

```
[0][0]']

 conv2_block2_2_bn (BatchNormal  (None, 56, 56, 64)  256         ['conv2_block2_2_conv
[0][0]']
 ization)

 conv2_block2_2_relu (Activatio  (None, 56, 56, 64)  0           ['conv2_block2_2_bn[0]
[0]']
 n)

 conv2_block2_3_conv (Conv2D)   (None, 56, 56, 256)  16640       ['conv2_block2_2_relu
[0][0]']

 conv2_block2_3_bn (BatchNormal  (None, 56, 56, 256)  1024       ['conv2_block2_3_conv
[0][0]']
 ization)

 conv2_block2_add (Add)         (None, 56, 56, 256)  0           ['conv2_block1_out[0]
[0]',
                                                                  'conv2_block2_3_bn[0]
[0]']

 conv2_block2_out (Activation)  (None, 56, 56, 256)  0           ['conv2_block2_add[0]
[0]']

 conv2_block3_1_conv (Conv2D)   (None, 56, 56, 64)   16448       ['conv2_block2_out[0]
[0]']

 conv2_block3_1_bn (BatchNormal  (None, 56, 56, 64)  256         ['conv2_block3_1_conv
[0][0]']
 ization)

 conv2_block3_1_relu (Activatio  (None, 56, 56, 64)  0           ['conv2_block3_1_bn[0]
[0]']
 n)

 conv2_block3_2_conv (Conv2D)   (None, 56, 56, 64)   36928       ['conv2_block3_1_relu
[0][0]']

 conv2_block3_2_bn (BatchNormal  (None, 56, 56, 64)  256         ['conv2_block3_2_conv
[0][0]']
 ization)

 conv2_block3_2_relu (Activatio  (None, 56, 56, 64)  0           ['conv2_block3_2_bn[0]
[0]']
 n)

 conv2_block3_3_conv (Conv2D)   (None, 56, 56, 256)  16640       ['conv2_block3_2_relu
[0][0]']

 conv2_block3_3_bn (BatchNormal  (None, 56, 56, 256)  1024       ['conv2_block3_3_conv
[0][0]']
 ization)

 conv2_block3_add (Add)         (None, 56, 56, 256)  0           ['conv2_block2_out[0]
[0]',
                                                                  'conv2_block3_3_bn[0]
[0]']

 conv2_block3_out (Activation)  (None, 56, 56, 256)  0           ['conv2_block3_add[0]
```

```
[0]']

 conv3_block1_1_conv (Conv2D)   (None, 28, 28, 128)  32896       ['conv2_block3_out[0]
[0]']

 conv3_block1_1_bn (BatchNormal  (None, 28, 28, 128)  512        ['conv3_block1_1_conv
[0][0]']
 ization)

 conv3_block1_1_relu (Activatio  (None, 28, 28, 128)  0          ['conv3_block1_1_bn[0]
[0]']
 n)

 conv3_block1_2_conv (Conv2D)   (None, 28, 28, 128)  147584      ['conv3_block1_1_relu
[0][0]']

 conv3_block1_2_bn (BatchNormal  (None, 28, 28, 128)  512        ['conv3_block1_2_conv
[0][0]']
 ization)

 conv3_block1_2_relu (Activatio  (None, 28, 28, 128)  0          ['conv3_block1_2_bn[0]
[0]']
 n)

 conv3_block1_0_conv (Conv2D)   (None, 28, 28, 512)  131584      ['conv2_block3_out[0]
[0]']

 conv3_block1_3_conv (Conv2D)   (None, 28, 28, 512)  66048       ['conv3_block1_2_relu
[0][0]']

 conv3_block1_0_bn (BatchNormal  (None, 28, 28, 512)  2048       ['conv3_block1_0_conv
[0][0]']
 ization)

 conv3_block1_3_bn (BatchNormal  (None, 28, 28, 512)  2048       ['conv3_block1_3_conv
[0][0]']
 ization)

 conv3_block1_add (Add)         (None, 28, 28, 512)  0           ['conv3_block1_0_bn[0]
[0]',
                                                                  'conv3_block1_3_bn[0]
[0]']

 conv3_block1_out (Activation)  (None, 28, 28, 512)  0           ['conv3_block1_add[0]
[0]']

 conv3_block2_1_conv (Conv2D)   (None, 28, 28, 128)  65664       ['conv3_block1_out[0]
[0]']

 conv3_block2_1_bn (BatchNormal  (None, 28, 28, 128)  512        ['conv3_block2_1_conv
[0][0]']
 ization)

 conv3_block2_1_relu (Activatio  (None, 28, 28, 128)  0          ['conv3_block2_1_bn[0]
[0]']
 n)

 conv3_block2_2_conv (Conv2D)   (None, 28, 28, 128)  147584      ['conv3_block2_1_relu
[0][0]']
```

```
 conv3_block2_2_bn (BatchNormal  (None, 28, 28, 128)  512         ['conv3_block2_2_conv
[0][0]']
 ization)

 conv3_block2_2_relu (Activatio  (None, 28, 28, 128)  0           ['conv3_block2_2_bn[0]
[0]']
 n)

 conv3_block2_3_conv (Conv2D)   (None, 28, 28, 512)  66048       ['conv3_block2_2_relu
[0][0]']

 conv3_block2_3_bn (BatchNormal  (None, 28, 28, 512)  2048       ['conv3_block2_3_conv
[0][0]']
 ization)

 conv3_block2_add (Add)         (None, 28, 28, 512)  0           ['conv3_block1_out[0]
[0]',
                                                                  'conv3_block2_3_bn[0]
[0]']

 conv3_block2_out (Activation)  (None, 28, 28, 512)  0           ['conv3_block2_add[0]
[0]']

 conv3_block3_1_conv (Conv2D)   (None, 28, 28, 128)  65664       ['conv3_block2_out[0]
[0]']

 conv3_block3_1_bn (BatchNormal  (None, 28, 28, 128)  512        ['conv3_block3_1_conv
[0][0]']
 ization)

 conv3_block3_1_relu (Activatio  (None, 28, 28, 128)  0          ['conv3_block3_1_bn[0]
[0]']
 n)

 conv3_block3_2_conv (Conv2D)   (None, 28, 28, 128)  147584      ['conv3_block3_1_relu
[0][0]']

 conv3_block3_2_bn (BatchNormal  (None, 28, 28, 128)  512        ['conv3_block3_2_conv
[0][0]']
 ization)

 conv3_block3_2_relu (Activatio  (None, 28, 28, 128)  0          ['conv3_block3_2_bn[0]
[0]']
 n)

 conv3_block3_3_conv (Conv2D)   (None, 28, 28, 512)  66048       ['conv3_block3_2_relu
[0][0]']

 conv3_block3_3_bn (BatchNormal  (None, 28, 28, 512)  2048       ['conv3_block3_3_conv
[0][0]']
 ization)

 conv3_block3_add (Add)         (None, 28, 28, 512)  0           ['conv3_block2_out[0]
[0]',
                                                                  'conv3_block3_3_bn[0]
[0]']

 conv3_block3_out (Activation)  (None, 28, 28, 512)  0           ['conv3_block3_add[0]
[0]']
```

```
 conv3_block4_1_conv (Conv2D)   (None, 28, 28, 128)  65664       ['conv3_block3_out[0]
[0]']

 conv3_block4_1_bn (BatchNormal  (None, 28, 28, 128)  512        ['conv3_block4_1_conv
[0][0]']
 ization)

 conv3_block4_1_relu (Activatio  (None, 28, 28, 128)  0          ['conv3_block4_1_bn[0]
[0]']
 n)

 conv3_block4_2_conv (Conv2D)   (None, 28, 28, 128)  147584      ['conv3_block4_1_relu
[0][0]']

 conv3_block4_2_bn (BatchNormal  (None, 28, 28, 128)  512        ['conv3_block4_2_conv
[0][0]']
 ization)

 conv3_block4_2_relu (Activatio  (None, 28, 28, 128)  0          ['conv3_block4_2_bn[0]
[0]']
 n)

 conv3_block4_3_conv (Conv2D)   (None, 28, 28, 512)  66048       ['conv3_block4_2_relu
[0][0]']

 conv3_block4_3_bn (BatchNormal  (None, 28, 28, 512)  2048       ['conv3_block4_3_conv
[0][0]']
 ization)

 conv3_block4_add (Add)         (None, 28, 28, 512)  0           ['conv3_block3_out[0]
[0]',
                                                                  'conv3_block4_3_bn[0]
[0]']

 conv3_block4_out (Activation)  (None, 28, 28, 512)  0           ['conv3_block4_add[0]
[0]']

 conv4_block1_1_conv (Conv2D)   (None, 14, 14, 256)  131328      ['conv3_block4_out[0]
[0]']

 conv4_block1_1_bn (BatchNormal  (None, 14, 14, 256)  1024       ['conv4_block1_1_conv
[0][0]']
 ization)

 conv4_block1_1_relu (Activatio  (None, 14, 14, 256)  0          ['conv4_block1_1_bn[0]
[0]']
 n)

 conv4_block1_2_conv (Conv2D)   (None, 14, 14, 256)  590080      ['conv4_block1_1_relu
[0][0]']

 conv4_block1_2_bn (BatchNormal  (None, 14, 14, 256)  1024       ['conv4_block1_2_conv
[0][0]']
 ization)

 conv4_block1_2_relu (Activatio  (None, 14, 14, 256)  0          ['conv4_block1_2_bn[0]
[0]']
 n)

 conv4_block1_0_conv (Conv2D)   (None, 14, 14, 1024  525312      ['conv3_block4_out[0]
```

```
[0]']
                                )

 conv4_block1_3_conv (Conv2D)   (None, 14, 14, 1024  263168      ['conv4_block1_2_relu
[0][0]']
                                )

 conv4_block1_0_bn (BatchNormal  (None, 14, 14, 1024  4096       ['conv4_block1_0_conv
[0][0]']
 ization)                       )

 conv4_block1_3_bn (BatchNormal  (None, 14, 14, 1024  4096       ['conv4_block1_3_conv
[0][0]']
 ization)                       )

 conv4_block1_add (Add)         (None, 14, 14, 1024  0           ['conv4_block1_0_bn[0]
[0]',
                                )                                 'conv4_block1_3_bn[0]
[0]']

 conv4_block1_out (Activation)  (None, 14, 14, 1024  0           ['conv4_block1_add[0]
[0]']
                                )

 conv4_block2_1_conv (Conv2D)   (None, 14, 14, 256)  262400      ['conv4_block1_out[0]
[0]']

 conv4_block2_1_bn (BatchNormal  (None, 14, 14, 256)  1024       ['conv4_block2_1_conv
[0][0]']
 ization)

 conv4_block2_1_relu (Activatio  (None, 14, 14, 256)  0          ['conv4_block2_1_bn[0]
[0]']
 n)

 conv4_block2_2_conv (Conv2D)   (None, 14, 14, 256)  590080      ['conv4_block2_1_relu
[0][0]']

 conv4_block2_2_bn (BatchNormal  (None, 14, 14, 256)  1024       ['conv4_block2_2_conv
[0][0]']
 ization)

 conv4_block2_2_relu (Activatio  (None, 14, 14, 256)  0          ['conv4_block2_2_bn[0]
[0]']
 n)

 conv4_block2_3_conv (Conv2D)   (None, 14, 14, 1024  263168      ['conv4_block2_2_relu
[0][0]']
                                )

 conv4_block2_3_bn (BatchNormal  (None, 14, 14, 1024  4096       ['conv4_block2_3_conv
[0][0]']
 ization)                       )

 conv4_block2_add (Add)         (None, 14, 14, 1024  0           ['conv4_block1_out[0]
[0]',
                                )                                 'conv4_block2_3_bn[0]
[0]']

 conv4_block2_out (Activation)  (None, 14, 14, 1024  0           ['conv4_block2_add[0]
```

```
[0]']
                                )

 conv4_block3_1_conv (Conv2D)   (None, 14, 14, 256)  262400      ['conv4_block2_out[0]
[0]']

 conv4_block3_1_bn (BatchNormal  (None, 14, 14, 256)  1024       ['conv4_block3_1_conv
[0][0]']
 ization)

 conv4_block3_1_relu (Activatio  (None, 14, 14, 256)  0          ['conv4_block3_1_bn[0]
[0]']
 n)

 conv4_block3_2_conv (Conv2D)   (None, 14, 14, 256)  590080      ['conv4_block3_1_relu
[0][0]']

 conv4_block3_2_bn (BatchNormal  (None, 14, 14, 256)  1024       ['conv4_block3_2_conv
[0][0]']
 ization)

 conv4_block3_2_relu (Activatio  (None, 14, 14, 256)  0          ['conv4_block3_2_bn[0]
[0]']
 n)

 conv4_block3_3_conv (Conv2D)   (None, 14, 14, 1024  263168      ['conv4_block3_2_relu
[0][0]']
                                )

 conv4_block3_3_bn (BatchNormal  (None, 14, 14, 1024  4096       ['conv4_block3_3_conv
[0][0]']
 ization)                       )

 conv4_block3_add (Add)         (None, 14, 14, 1024  0           ['conv4_block2_out[0]
[0]',
                                )                                 'conv4_block3_3_bn[0]
[0]']

 conv4_block3_out (Activation)  (None, 14, 14, 1024  0           ['conv4_block3_add[0]
[0]']
                                )

 conv4_block4_1_conv (Conv2D)   (None, 14, 14, 256)  262400      ['conv4_block3_out[0]
[0]']

 conv4_block4_1_bn (BatchNormal  (None, 14, 14, 256)  1024       ['conv4_block4_1_conv
[0][0]']
 ization)

 conv4_block4_1_relu (Activatio  (None, 14, 14, 256)  0          ['conv4_block4_1_bn[0]
[0]']
 n)

 conv4_block4_2_conv (Conv2D)   (None, 14, 14, 256)  590080      ['conv4_block4_1_relu
[0][0]']

 conv4_block4_2_bn (BatchNormal  (None, 14, 14, 256)  1024       ['conv4_block4_2_conv
[0][0]']
 ization)
```

```
 conv4_block4_2_relu (Activatio  (None, 14, 14, 256)  0          ['conv4_block4_2_bn[0]
[0]']
 n)

 conv4_block4_3_conv (Conv2D)   (None, 14, 14, 1024  263168      ['conv4_block4_2_relu
[0][0]']
                                )

 conv4_block4_3_bn (BatchNormal  (None, 14, 14, 1024  4096       ['conv4_block4_3_conv
[0][0]']
 ization)                       )

 conv4_block4_add (Add)         (None, 14, 14, 1024  0           ['conv4_block3_out[0]
[0]',
                                )                                 'conv4_block4_3_bn[0]
[0]']

 conv4_block4_out (Activation)  (None, 14, 14, 1024  0           ['conv4_block4_add[0]
[0]']
                                )

 conv4_block5_1_conv (Conv2D)   (None, 14, 14, 256)  262400      ['conv4_block4_out[0]
[0]']

 conv4_block5_1_bn (BatchNormal  (None, 14, 14, 256)  1024       ['conv4_block5_1_conv
[0][0]']
 ization)

 conv4_block5_1_relu (Activatio  (None, 14, 14, 256)  0          ['conv4_block5_1_bn[0]
[0]']
 n)

 conv4_block5_2_conv (Conv2D)   (None, 14, 14, 256)  590080      ['conv4_block5_1_relu
[0][0]']

 conv4_block5_2_bn (BatchNormal  (None, 14, 14, 256)  1024       ['conv4_block5_2_conv
[0][0]']
 ization)

 conv4_block5_2_relu (Activatio  (None, 14, 14, 256)  0          ['conv4_block5_2_bn[0]
[0]']
 n)

 conv4_block5_3_conv (Conv2D)   (None, 14, 14, 1024  263168      ['conv4_block5_2_relu
[0][0]']
                                )

 conv4_block5_3_bn (BatchNormal  (None, 14, 14, 1024  4096       ['conv4_block5_3_conv
[0][0]']
 ization)                       )

 conv4_block5_add (Add)         (None, 14, 14, 1024  0           ['conv4_block4_out[0]
[0]',
                                )                                 'conv4_block5_3_bn[0]
[0]']

 conv4_block5_out (Activation)  (None, 14, 14, 1024  0           ['conv4_block5_add[0]
[0]']
                                )
```

```
 conv4_block6_1_conv (Conv2D)   (None, 14, 14, 256)  262400      ['conv4_block5_out[0]
[0]']

 conv4_block6_1_bn (BatchNormal  (None, 14, 14, 256)  1024       ['conv4_block6_1_conv
[0][0]']
 ization)

 conv4_block6_1_relu (Activatio  (None, 14, 14, 256)  0          ['conv4_block6_1_bn[0]
[0]']
 n)

 conv4_block6_2_conv (Conv2D)   (None, 14, 14, 256)  590080      ['conv4_block6_1_relu
[0][0]']

 conv4_block6_2_bn (BatchNormal  (None, 14, 14, 256)  1024       ['conv4_block6_2_conv
[0][0]']
 ization)

 conv4_block6_2_relu (Activatio  (None, 14, 14, 256)  0          ['conv4_block6_2_bn[0]
[0]']
 n)

 conv4_block6_3_conv (Conv2D)   (None, 14, 14, 1024  263168      ['conv4_block6_2_relu
[0][0]']
                                )

 conv4_block6_3_bn (BatchNormal  (None, 14, 14, 1024  4096       ['conv4_block6_3_conv
[0][0]']
 ization)                       )

 conv4_block6_add (Add)         (None, 14, 14, 1024  0           ['conv4_block5_out[0]
[0]',
                                )                                 'conv4_block6_3_bn[0]
[0]']

 conv4_block6_out (Activation)  (None, 14, 14, 1024  0           ['conv4_block6_add[0]
[0]']
                                )

 conv5_block1_1_conv (Conv2D)   (None, 7, 7, 512)    524800      ['conv4_block6_out[0]
[0]']

 conv5_block1_1_bn (BatchNormal  (None, 7, 7, 512)   2048        ['conv5_block1_1_conv
[0][0]']
 ization)

 conv5_block1_1_relu (Activatio  (None, 7, 7, 512)   0           ['conv5_block1_1_bn[0]
[0]']
 n)

 conv5_block1_2_conv (Conv2D)   (None, 7, 7, 512)    2359808     ['conv5_block1_1_relu
[0][0]']

 conv5_block1_2_bn (BatchNormal  (None, 7, 7, 512)   2048        ['conv5_block1_2_conv
[0][0]']
 ization)

 conv5_block1_2_relu (Activatio  (None, 7, 7, 512)   0           ['conv5_block1_2_bn[0]
[0]']
 n)
```

```
 conv5_block1_0_conv (Conv2D)   (None, 7, 7, 2048)   2099200     ['conv4_block6_out[0]
[0]']

 conv5_block1_3_conv (Conv2D)   (None, 7, 7, 2048)   1050624     ['conv5_block1_2_relu
[0][0]']

 conv5_block1_0_bn (BatchNormal  (None, 7, 7, 2048)  8192        ['conv5_block1_0_conv
[0][0]']
 ization)

 conv5_block1_3_bn (BatchNormal  (None, 7, 7, 2048)  8192        ['conv5_block1_3_conv
[0][0]']
 ization)

 conv5_block1_add (Add)         (None, 7, 7, 2048)   0           ['conv5_block1_0_bn[0]
[0]',
                                                                  'conv5_block1_3_bn[0]
[0]']

 conv5_block1_out (Activation)  (None, 7, 7, 2048)   0           ['conv5_block1_add[0]
[0]']

 conv5_block2_1_conv (Conv2D)   (None, 7, 7, 512)    1049088     ['conv5_block1_out[0]
[0]']

 conv5_block2_1_bn (BatchNormal  (None, 7, 7, 512)   2048        ['conv5_block2_1_conv
[0][0]']
 ization)

 conv5_block2_1_relu (Activatio  (None, 7, 7, 512)   0           ['conv5_block2_1_bn[0]
[0]']
 n)

 conv5_block2_2_conv (Conv2D)   (None, 7, 7, 512)    2359808     ['conv5_block2_1_relu
[0][0]']

 conv5_block2_2_bn (BatchNormal  (None, 7, 7, 512)   2048        ['conv5_block2_2_conv
[0][0]']
 ization)

 conv5_block2_2_relu (Activatio  (None, 7, 7, 512)   0           ['conv5_block2_2_bn[0]
[0]']
 n)

 conv5_block2_3_conv (Conv2D)   (None, 7, 7, 2048)   1050624     ['conv5_block2_2_relu
[0][0]']

 conv5_block2_3_bn (BatchNormal  (None, 7, 7, 2048)  8192        ['conv5_block2_3_conv
[0][0]']
 ization)

 conv5_block2_add (Add)         (None, 7, 7, 2048)   0           ['conv5_block1_out[0]
[0]',
                                                                  'conv5_block2_3_bn[0]
[0]']

 conv5_block2_out (Activation)  (None, 7, 7, 2048)   0           ['conv5_block2_add[0]
[0]']
```

```
 conv5_block3_1_conv (Conv2D)   (None, 7, 7, 512)    1049088     ['conv5_block2_out[0]
[0]']

 conv5_block3_1_bn (BatchNormal  (None, 7, 7, 512)   2048        ['conv5_block3_1_conv
[0][0]']
 ization)

 conv5_block3_1_relu (Activatio  (None, 7, 7, 512)   0           ['conv5_block3_1_bn[0]
[0]']
 n)

 conv5_block3_2_conv (Conv2D)   (None, 7, 7, 512)    2359808     ['conv5_block3_1_relu
[0][0]']

 conv5_block3_2_bn (BatchNormal  (None, 7, 7, 512)   2048        ['conv5_block3_2_conv
[0][0]']
 ization)

 conv5_block3_2_relu (Activatio  (None, 7, 7, 512)   0           ['conv5_block3_2_bn[0]
[0]']
 n)

 conv5_block3_3_conv (Conv2D)   (None, 7, 7, 2048)   1050624     ['conv5_block3_2_relu
[0][0]']

 conv5_block3_3_bn (BatchNormal  (None, 7, 7, 2048)  8192        ['conv5_block3_3_conv
[0][0]']
 ization)

 conv5_block3_add (Add)         (None, 7, 7, 2048)   0           ['conv5_block2_out[0]
[0]',
                                                                  'conv5_block3_3_bn[0]
[0]']

 conv5_block3_out (Activation)  (None, 7, 7, 2048)   0           ['conv5_block3_add[0]
[0]']

==================================================================================
==========
Total params: 23,587,712
Trainable params: 23,534,592
Non-trainable params: 53,120
__________________________________________________________________________________
__________
```

In [7]:

```
for layer in resnet.layers:
    layer.trainable = False

# This will let us use the default weights used by the imagenet.
```

In [8]:

```
# Usefule for getting number of output classes.
# folders = glob('../input/car-brand-images-dataset/Train/*')
folders = glob(train_Path + '/*')
folders
```

Out[8]:

```
['C:\\Users\\anshul\\Desktop\\MS\\Subjects\\Spring 2022\\Data Analytics\\FINAL PROJECT
```

```
\\Image recognition\\ImageDataSet\\Adult',
 'C:\\Users\\anshul\\Desktop\\MS\\Subjects\\Spring 2022\\Data Analytics\\FINAL PROJECT
\\Image recognition\\ImageDataSet\\Airplane',
 'C:\\Users\\anshul\\Desktop\\MS\\Subjects\\Spring 2022\\Data Analytics\\FINAL PROJECT
\\Image recognition\\ImageDataSet\\Alpaca',
 'C:\\Users\\anshul\\Desktop\\MS\\Subjects\\Spring 2022\\Data Analytics\\FINAL PROJECT
\\Image recognition\\ImageDataSet\\Bird',
 'C:\\Users\\anshul\\Desktop\\MS\\Subjects\\Spring 2022\\Data Analytics\\FINAL PROJECT
\\Image recognition\\ImageDataSet\\Bus',
 'C:\\Users\\anshul\\Desktop\\MS\\Subjects\\Spring 2022\\Data Analytics\\FINAL PROJECT
\\Image recognition\\ImageDataSet\\Car',
 'C:\\Users\\anshul\\Desktop\\MS\\Subjects\\Spring 2022\\Data Analytics\\FINAL PROJECT
\\Image recognition\\ImageDataSet\\Cat',
 'C:\\Users\\anshul\\Desktop\\MS\\Subjects\\Spring 2022\\Data Analytics\\FINAL PROJECT
\\Image recognition\\ImageDataSet\\Child',
 'C:\\Users\\anshul\\Desktop\\MS\\Subjects\\Spring 2022\\Data Analytics\\FINAL PROJECT
\\Image recognition\\ImageDataSet\\Dog',
 'C:\\Users\\anshul\\Desktop\\MS\\Subjects\\Spring 2022\\Data Analytics\\FINAL PROJECT
\\Image recognition\\ImageDataSet\\Elephant',
 'C:\\Users\\anshul\\Desktop\\MS\\Subjects\\Spring 2022\\Data Analytics\\FINAL PROJECT
\\Image recognition\\ImageDataSet\\Flower',
 'C:\\Users\\anshul\\Desktop\\MS\\Subjects\\Spring 2022\\Data Analytics\\FINAL PROJECT
\\Image recognition\\ImageDataSet\\Giraffe',
 'C:\\Users\\anshul\\Desktop\\MS\\Subjects\\Spring 2022\\Data Analytics\\FINAL PROJECT
\\Image recognition\\ImageDataSet\\Horse',
 'C:\\Users\\anshul\\Desktop\\MS\\Subjects\\Spring 2022\\Data Analytics\\FINAL PROJECT
\\Image recognition\\ImageDataSet\\Monkey',
 'C:\\Users\\anshul\\Desktop\\MS\\Subjects\\Spring 2022\\Data Analytics\\FINAL PROJECT
\\Image recognition\\ImageDataSet\\Panda',
 'C:\\Users\\anshul\\Desktop\\MS\\Subjects\\Spring 2022\\Data Analytics\\FINAL PROJECT
\\Image recognition\\ImageDataSet\\Reptile',
 'C:\\Users\\anshul\\Desktop\\MS\\Subjects\\Spring 2022\\Data Analytics\\FINAL PROJECT
\\Image recognition\\ImageDataSet\\Train',
 'C:\\Users\\anshul\\Desktop\\MS\\Subjects\\Spring 2022\\Data Analytics\\FINAL PROJECT
\\Image recognition\\ImageDataSet\\Vessel',
 'C:\\Users\\anshul\\Desktop\\MS\\Subjects\\Spring 2022\\Data Analytics\\FINAL PROJECT
\\Image recognition\\ImageDataSet\\Zebra']
```

In [9]:
```
labels = ['Adult', 'Airplane', 'Alpaca','Bird', 'Bus', 'Car', 'Cat', 'Child', 'Dog', 'E
```

In [10]:
```
# Set the flatten layer.
x = Flatten() (resnet.output)
```

In [11]:
```
prediction = Dense(len(folders), activation = 'softmax')(x)
```

In [12]:
```
# Create a model Object
model = Model(inputs = resnet.input, outputs = prediction)
```

In [13]:
```
model.summary()
```

```
Model: "model"
_________________________________________________________________
 Layer (type)                Output Shape              Param #     Connected to
_________________
```

```
==================================================================================================
 input_1 (InputLayer)           [(None, 224, 224, 3  0           []
                                )]

 conv1_pad (ZeroPadding2D)      (None, 230, 230, 3)  0           ['input_1[0][0]']

 conv1_conv (Conv2D)            (None, 112, 112, 64  9472        ['conv1_pad[0][0]']
                                )

 conv1_bn (BatchNormalization)  (None, 112, 112, 64  256         ['conv1_conv[0][0]']
                                )

 conv1_relu (Activation)        (None, 112, 112, 64  0           ['conv1_bn[0][0]']
                                )

 pool1_pad (ZeroPadding2D)      (None, 114, 114, 64  0           ['conv1_relu[0][0]']
                                )

 pool1_pool (MaxPooling2D)      (None, 56, 56, 64)   0           ['pool1_pad[0][0]']

 conv2_block1_1_conv (Conv2D)   (None, 56, 56, 64)   4160        ['pool1_pool[0][0]']

 conv2_block1_1_bn (BatchNormal  (None, 56, 56, 64)  256         ['conv2_block1_1_conv
[0][0]']
 ization)

 conv2_block1_1_relu (Activatio  (None, 56, 56, 64)  0           ['conv2_block1_1_bn[0]
[0]']
 n)

 conv2_block1_2_conv (Conv2D)   (None, 56, 56, 64)   36928       ['conv2_block1_1_relu
[0][0]']

 conv2_block1_2_bn (BatchNormal  (None, 56, 56, 64)  256         ['conv2_block1_2_conv
[0][0]']
 ization)

 conv2_block1_2_relu (Activatio  (None, 56, 56, 64)  0           ['conv2_block1_2_bn[0]
[0]']
 n)

 conv2_block1_0_conv (Conv2D)   (None, 56, 56, 256)  16640       ['pool1_pool[0][0]']

 conv2_block1_3_conv (Conv2D)   (None, 56, 56, 256)  16640       ['conv2_block1_2_relu
[0][0]']

 conv2_block1_0_bn (BatchNormal  (None, 56, 56, 256)  1024       ['conv2_block1_0_conv
[0][0]']
 ization)

 conv2_block1_3_bn (BatchNormal  (None, 56, 56, 256)  1024       ['conv2_block1_3_conv
[0][0]']
 ization)

 conv2_block1_add (Add)         (None, 56, 56, 256)  0           ['conv2_block1_0_bn[0]
[0]',
                                                                  'conv2_block1_3_bn[0]
[0]']
```

```
 conv2_block1_out (Activation)  (None, 56, 56, 256)  0           ['conv2_block1_add[0]
[0]']

 conv2_block2_1_conv (Conv2D)   (None, 56, 56, 64)   16448       ['conv2_block1_out[0]
[0]']

 conv2_block2_1_bn (BatchNormal  (None, 56, 56, 64)  256         ['conv2_block2_1_conv
[0][0]']
 ization)

 conv2_block2_1_relu (Activatio  (None, 56, 56, 64)  0           ['conv2_block2_1_bn[0]
[0]']
 n)

 conv2_block2_2_conv (Conv2D)   (None, 56, 56, 64)   36928       ['conv2_block2_1_relu
[0][0]']

 conv2_block2_2_bn (BatchNormal  (None, 56, 56, 64)  256         ['conv2_block2_2_conv
[0][0]']
 ization)

 conv2_block2_2_relu (Activatio  (None, 56, 56, 64)  0           ['conv2_block2_2_bn[0]
[0]']
 n)

 conv2_block2_3_conv (Conv2D)   (None, 56, 56, 256)  16640       ['conv2_block2_2_relu
[0][0]']

 conv2_block2_3_bn (BatchNormal  (None, 56, 56, 256)  1024       ['conv2_block2_3_conv
[0][0]']
 ization)

 conv2_block2_add (Add)         (None, 56, 56, 256)  0           ['conv2_block1_out[0]
[0]',
                                                                  'conv2_block2_3_bn[0]
[0]']

 conv2_block2_out (Activation)  (None, 56, 56, 256)  0           ['conv2_block2_add[0]
[0]']

 conv2_block3_1_conv (Conv2D)   (None, 56, 56, 64)   16448       ['conv2_block2_out[0]
[0]']

 conv2_block3_1_bn (BatchNormal  (None, 56, 56, 64)  256         ['conv2_block3_1_conv
[0][0]']
 ization)

 conv2_block3_1_relu (Activatio  (None, 56, 56, 64)  0           ['conv2_block3_1_bn[0]
[0]']
 n)

 conv2_block3_2_conv (Conv2D)   (None, 56, 56, 64)   36928       ['conv2_block3_1_relu
[0][0]']

 conv2_block3_2_bn (BatchNormal  (None, 56, 56, 64)  256         ['conv2_block3_2_conv
[0][0]']
 ization)

 conv2_block3_2_relu (Activatio  (None, 56, 56, 64)  0           ['conv2_block3_2_bn[0]
[0]']
```

```
 n)

 conv2_block3_3_conv (Conv2D)   (None, 56, 56, 256)  16640       ['conv2_block3_2_relu
[0][0]']

 conv2_block3_3_bn (BatchNormal  (None, 56, 56, 256)  1024       ['conv2_block3_3_conv
[0][0]']
 ization)

 conv2_block3_add (Add)         (None, 56, 56, 256)  0           ['conv2_block2_out[0]
[0]',
                                                                  'conv2_block3_3_bn[0]
[0]']

 conv2_block3_out (Activation)  (None, 56, 56, 256)  0           ['conv2_block3_add[0]
[0]']

 conv3_block1_1_conv (Conv2D)   (None, 28, 28, 128)  32896       ['conv2_block3_out[0]
[0]']

 conv3_block1_1_bn (BatchNormal  (None, 28, 28, 128)  512        ['conv3_block1_1_conv
[0][0]']
 ization)

 conv3_block1_1_relu (Activatio  (None, 28, 28, 128)  0          ['conv3_block1_1_bn[0]
[0]']
 n)

 conv3_block1_2_conv (Conv2D)   (None, 28, 28, 128)  147584      ['conv3_block1_1_relu
[0][0]']

 conv3_block1_2_bn (BatchNormal  (None, 28, 28, 128)  512        ['conv3_block1_2_conv
[0][0]']
 ization)

 conv3_block1_2_relu (Activatio  (None, 28, 28, 128)  0          ['conv3_block1_2_bn[0]
[0]']
 n)

 conv3_block1_0_conv (Conv2D)   (None, 28, 28, 512)  131584      ['conv2_block3_out[0]
[0]']

 conv3_block1_3_conv (Conv2D)   (None, 28, 28, 512)  66048       ['conv3_block1_2_relu
[0][0]']

 conv3_block1_0_bn (BatchNormal  (None, 28, 28, 512)  2048       ['conv3_block1_0_conv
[0][0]']
 ization)

 conv3_block1_3_bn (BatchNormal  (None, 28, 28, 512)  2048       ['conv3_block1_3_conv
[0][0]']
 ization)

 conv3_block1_add (Add)         (None, 28, 28, 512)  0           ['conv3_block1_0_bn[0]
[0]',
                                                                  'conv3_block1_3_bn[0]
[0]']

 conv3_block1_out (Activation)  (None, 28, 28, 512)  0           ['conv3_block1_add[0]
[0]']
```

```
 conv3_block2_1_conv (Conv2D)   (None, 28, 28, 128)  65664       ['conv3_block1_out[0]
[0]']

 conv3_block2_1_bn (BatchNormal  (None, 28, 28, 128)  512        ['conv3_block2_1_conv
[0][0]']
 ization)

 conv3_block2_1_relu (Activatio  (None, 28, 28, 128)  0          ['conv3_block2_1_bn[0]
[0]']
 n)

 conv3_block2_2_conv (Conv2D)   (None, 28, 28, 128)  147584      ['conv3_block2_1_relu
[0][0]']

 conv3_block2_2_bn (BatchNormal  (None, 28, 28, 128)  512        ['conv3_block2_2_conv
[0][0]']
 ization)

 conv3_block2_2_relu (Activatio  (None, 28, 28, 128)  0          ['conv3_block2_2_bn[0]
[0]']
 n)

 conv3_block2_3_conv (Conv2D)   (None, 28, 28, 512)  66048       ['conv3_block2_2_relu
[0][0]']

 conv3_block2_3_bn (BatchNormal  (None, 28, 28, 512)  2048       ['conv3_block2_3_conv
[0][0]']
 ization)

 conv3_block2_add (Add)         (None, 28, 28, 512)  0           ['conv3_block1_out[0]
[0]',
                                                                  'conv3_block2_3_bn[0]
[0]']

 conv3_block2_out (Activation)  (None, 28, 28, 512)  0           ['conv3_block2_add[0]
[0]']

 conv3_block3_1_conv (Conv2D)   (None, 28, 28, 128)  65664       ['conv3_block2_out[0]
[0]']

 conv3_block3_1_bn (BatchNormal  (None, 28, 28, 128)  512        ['conv3_block3_1_conv
[0][0]']
 ization)

 conv3_block3_1_relu (Activatio  (None, 28, 28, 128)  0          ['conv3_block3_1_bn[0]
[0]']
 n)

 conv3_block3_2_conv (Conv2D)   (None, 28, 28, 128)  147584      ['conv3_block3_1_relu
[0][0]']

 conv3_block3_2_bn (BatchNormal  (None, 28, 28, 128)  512        ['conv3_block3_2_conv
[0][0]']
 ization)

 conv3_block3_2_relu (Activatio  (None, 28, 28, 128)  0          ['conv3_block3_2_bn[0]
[0]']
 n)
```

```
 conv3_block3_3_conv (Conv2D)   (None, 28, 28, 512)  66048       ['conv3_block3_2_relu
[0][0]']

 conv3_block3_3_bn (BatchNormal  (None, 28, 28, 512)  2048       ['conv3_block3_3_conv
[0][0]']
 ization)

 conv3_block3_add (Add)         (None, 28, 28, 512)  0           ['conv3_block2_out[0]
[0]',
                                                                  'conv3_block3_3_bn[0]
[0]']

 conv3_block3_out (Activation)  (None, 28, 28, 512)  0           ['conv3_block3_add[0]
[0]']

 conv3_block4_1_conv (Conv2D)   (None, 28, 28, 128)  65664       ['conv3_block3_out[0]
[0]']

 conv3_block4_1_bn (BatchNormal  (None, 28, 28, 128)  512        ['conv3_block4_1_conv
[0][0]']
 ization)

 conv3_block4_1_relu (Activatio  (None, 28, 28, 128)  0          ['conv3_block4_1_bn[0]
[0]']
 n)

 conv3_block4_2_conv (Conv2D)   (None, 28, 28, 128)  147584      ['conv3_block4_1_relu
[0][0]']

 conv3_block4_2_bn (BatchNormal  (None, 28, 28, 128)  512        ['conv3_block4_2_conv
[0][0]']
 ization)

 conv3_block4_2_relu (Activatio  (None, 28, 28, 128)  0          ['conv3_block4_2_bn[0]
[0]']
 n)

 conv3_block4_3_conv (Conv2D)   (None, 28, 28, 512)  66048       ['conv3_block4_2_relu
[0][0]']

 conv3_block4_3_bn (BatchNormal  (None, 28, 28, 512)  2048       ['conv3_block4_3_conv
[0][0]']
 ization)

 conv3_block4_add (Add)         (None, 28, 28, 512)  0           ['conv3_block3_out[0]
[0]',
                                                                  'conv3_block4_3_bn[0]
[0]']

 conv3_block4_out (Activation)  (None, 28, 28, 512)  0           ['conv3_block4_add[0]
[0]']

 conv4_block1_1_conv (Conv2D)   (None, 14, 14, 256)  131328      ['conv3_block4_out[0]
[0]']

 conv4_block1_1_bn (BatchNormal  (None, 14, 14, 256)  1024       ['conv4_block1_1_conv
[0][0]']
 ization)

 conv4_block1_1_relu (Activatio  (None, 14, 14, 256)  0          ['conv4_block1_1_bn[0]
```

```
[0]']
 n)

 conv4_block1_2_conv (Conv2D)   (None, 14, 14, 256)  590080      ['conv4_block1_1_relu
[0][0]']

 conv4_block1_2_bn (BatchNormal  (None, 14, 14, 256)  1024       ['conv4_block1_2_conv
[0][0]']
 ization)

 conv4_block1_2_relu (Activatio  (None, 14, 14, 256)  0          ['conv4_block1_2_bn[0]
[0]']
 n)

 conv4_block1_0_conv (Conv2D)   (None, 14, 14, 1024  525312      ['conv3_block4_out[0]
[0]']
                                )

 conv4_block1_3_conv (Conv2D)   (None, 14, 14, 1024  263168      ['conv4_block1_2_relu
[0][0]']
                                )

 conv4_block1_0_bn (BatchNormal  (None, 14, 14, 1024  4096       ['conv4_block1_0_conv
[0][0]']
 ization)                       )

 conv4_block1_3_bn (BatchNormal  (None, 14, 14, 1024  4096       ['conv4_block1_3_conv
[0][0]']
 ization)                       )

 conv4_block1_add (Add)         (None, 14, 14, 1024  0           ['conv4_block1_0_bn[0]
[0]',
                                )                                 'conv4_block1_3_bn[0]
[0]']

 conv4_block1_out (Activation)  (None, 14, 14, 1024  0           ['conv4_block1_add[0]
[0]']
                                )

 conv4_block2_1_conv (Conv2D)   (None, 14, 14, 256)  262400      ['conv4_block1_out[0]
[0]']

 conv4_block2_1_bn (BatchNormal  (None, 14, 14, 256)  1024       ['conv4_block2_1_conv
[0][0]']
 ization)

 conv4_block2_1_relu (Activatio  (None, 14, 14, 256)  0          ['conv4_block2_1_bn[0]
[0]']
 n)

 conv4_block2_2_conv (Conv2D)   (None, 14, 14, 256)  590080      ['conv4_block2_1_relu
[0][0]']

 conv4_block2_2_bn (BatchNormal  (None, 14, 14, 256)  1024       ['conv4_block2_2_conv
[0][0]']
 ization)

 conv4_block2_2_relu (Activatio  (None, 14, 14, 256)  0          ['conv4_block2_2_bn[0]
[0]']
 n)
```

```
 conv4_block2_3_conv (Conv2D)   (None, 14, 14, 1024  263168      ['conv4_block2_2_relu
[0][0]']
                                )

 conv4_block2_3_bn (BatchNormal  (None, 14, 14, 1024  4096       ['conv4_block2_3_conv
[0][0]']
 ization)                       )

 conv4_block2_add (Add)         (None, 14, 14, 1024  0           ['conv4_block1_out[0]
[0]',
                                )                                 'conv4_block2_3_bn[0]
[0]']

 conv4_block2_out (Activation)  (None, 14, 14, 1024  0           ['conv4_block2_add[0]
[0]']
                                )

 conv4_block3_1_conv (Conv2D)   (None, 14, 14, 256)  262400      ['conv4_block2_out[0]
[0]']

 conv4_block3_1_bn (BatchNormal  (None, 14, 14, 256)  1024       ['conv4_block3_1_conv
[0][0]']
 ization)

 conv4_block3_1_relu (Activatio  (None, 14, 14, 256)  0          ['conv4_block3_1_bn[0]
[0]']
 n)

 conv4_block3_2_conv (Conv2D)   (None, 14, 14, 256)  590080      ['conv4_block3_1_relu
[0][0]']

 conv4_block3_2_bn (BatchNormal  (None, 14, 14, 256)  1024       ['conv4_block3_2_conv
[0][0]']
 ization)

 conv4_block3_2_relu (Activatio  (None, 14, 14, 256)  0          ['conv4_block3_2_bn[0]
[0]']
 n)

 conv4_block3_3_conv (Conv2D)   (None, 14, 14, 1024  263168      ['conv4_block3_2_relu
[0][0]']
                                )

 conv4_block3_3_bn (BatchNormal  (None, 14, 14, 1024  4096       ['conv4_block3_3_conv
[0][0]']
 ization)                       )

 conv4_block3_add (Add)         (None, 14, 14, 1024  0           ['conv4_block2_out[0]
[0]',
                                )                                 'conv4_block3_3_bn[0]
[0]']

 conv4_block3_out (Activation)  (None, 14, 14, 1024  0           ['conv4_block3_add[0]
[0]']
                                )

 conv4_block4_1_conv (Conv2D)   (None, 14, 14, 256)  262400      ['conv4_block3_out[0]
[0]']
```

```
 conv4_block4_1_bn (BatchNormal  (None, 14, 14, 256)  1024       ['conv4_block4_1_conv
[0][0]']
 ization)

 conv4_block4_1_relu (Activatio  (None, 14, 14, 256)  0          ['conv4_block4_1_bn[0]
[0]']
 n)

 conv4_block4_2_conv (Conv2D)   (None, 14, 14, 256)  590080     ['conv4_block4_1_relu
[0][0]']

 conv4_block4_2_bn (BatchNormal  (None, 14, 14, 256)  1024       ['conv4_block4_2_conv
[0][0]']
 ization)

 conv4_block4_2_relu (Activatio  (None, 14, 14, 256)  0          ['conv4_block4_2_bn[0]
[0]']
 n)

 conv4_block4_3_conv (Conv2D)   (None, 14, 14, 1024  263168     ['conv4_block4_2_relu
[0][0]']
                                )

 conv4_block4_3_bn (BatchNormal  (None, 14, 14, 1024  4096       ['conv4_block4_3_conv
[0][0]']
 ization)                       )

 conv4_block4_add (Add)         (None, 14, 14, 1024  0          ['conv4_block3_out[0]
[0]',
                                )                                 'conv4_block4_3_bn[0]
[0]']

 conv4_block4_out (Activation)  (None, 14, 14, 1024  0          ['conv4_block4_add[0]
[0]']
                                )

 conv4_block5_1_conv (Conv2D)   (None, 14, 14, 256)  262400     ['conv4_block4_out[0]
[0]']

 conv4_block5_1_bn (BatchNormal  (None, 14, 14, 256)  1024       ['conv4_block5_1_conv
[0][0]']
 ization)

 conv4_block5_1_relu (Activatio  (None, 14, 14, 256)  0          ['conv4_block5_1_bn[0]
[0]']
 n)

 conv4_block5_2_conv (Conv2D)   (None, 14, 14, 256)  590080     ['conv4_block5_1_relu
[0][0]']

 conv4_block5_2_bn (BatchNormal  (None, 14, 14, 256)  1024       ['conv4_block5_2_conv
[0][0]']
 ization)

 conv4_block5_2_relu (Activatio  (None, 14, 14, 256)  0          ['conv4_block5_2_bn[0]
[0]']
 n)

 conv4_block5_3_conv (Conv2D)   (None, 14, 14, 1024  263168     ['conv4_block5_2_relu
[0][0]']
```

```
                                 )

 conv4_block5_3_bn (BatchNormal  (None, 14, 14, 1024  4096       ['conv4_block5_3_conv
[0][0]']
 ization)                        )

 conv4_block5_add (Add)          (None, 14, 14, 1024  0          ['conv4_block4_out[0]
[0]',
                                 )                                'conv4_block5_3_bn[0]
[0]']

 conv4_block5_out (Activation)   (None, 14, 14, 1024  0          ['conv4_block5_add[0]
[0]']
                                 )

 conv4_block6_1_conv (Conv2D)    (None, 14, 14, 256)  262400     ['conv4_block5_out[0]
[0]']

 conv4_block6_1_bn (BatchNormal  (None, 14, 14, 256)  1024       ['conv4_block6_1_conv
[0][0]']
 ization)

 conv4_block6_1_relu (Activatio  (None, 14, 14, 256)  0          ['conv4_block6_1_bn[0]
[0]']
 n)

 conv4_block6_2_conv (Conv2D)    (None, 14, 14, 256)  590080     ['conv4_block6_1_relu
[0][0]']

 conv4_block6_2_bn (BatchNormal  (None, 14, 14, 256)  1024       ['conv4_block6_2_conv
[0][0]']
 ization)

 conv4_block6_2_relu (Activatio  (None, 14, 14, 256)  0          ['conv4_block6_2_bn[0]
[0]']
 n)

 conv4_block6_3_conv (Conv2D)    (None, 14, 14, 1024  263168     ['conv4_block6_2_relu
[0][0]']
                                 )

 conv4_block6_3_bn (BatchNormal  (None, 14, 14, 1024  4096       ['conv4_block6_3_conv
[0][0]']
 ization)                        )

 conv4_block6_add (Add)          (None, 14, 14, 1024  0          ['conv4_block5_out[0]
[0]',
                                 )                                'conv4_block6_3_bn[0]
[0]']

 conv4_block6_out (Activation)   (None, 14, 14, 1024  0          ['conv4_block6_add[0]
[0]']
                                 )

 conv5_block1_1_conv (Conv2D)    (None, 7, 7, 512)    524800     ['conv4_block6_out[0]
[0]']

 conv5_block1_1_bn (BatchNormal  (None, 7, 7, 512)   2048       ['conv5_block1_1_conv
[0][0]']
 ization)
```

```
 conv5_block1_1_relu (Activatio  (None, 7, 7, 512)   0           ['conv5_block1_1_bn[0]
[0]']
 n)

 conv5_block1_2_conv (Conv2D)   (None, 7, 7, 512)    2359808     ['conv5_block1_1_relu
[0][0]']

 conv5_block1_2_bn (BatchNormal  (None, 7, 7, 512)   2048        ['conv5_block1_2_conv
[0][0]']
 ization)

 conv5_block1_2_relu (Activatio  (None, 7, 7, 512)   0           ['conv5_block1_2_bn[0]
[0]']
 n)

 conv5_block1_0_conv (Conv2D)   (None, 7, 7, 2048)   2099200     ['conv4_block6_out[0]
[0]']

 conv5_block1_3_conv (Conv2D)   (None, 7, 7, 2048)   1050624     ['conv5_block1_2_relu
[0][0]']

 conv5_block1_0_bn (BatchNormal  (None, 7, 7, 2048)  8192        ['conv5_block1_0_conv
[0][0]']
 ization)

 conv5_block1_3_bn (BatchNormal  (None, 7, 7, 2048)  8192        ['conv5_block1_3_conv
[0][0]']
 ization)

 conv5_block1_add (Add)         (None, 7, 7, 2048)   0           ['conv5_block1_0_bn[0]
[0]',
                                                                  'conv5_block1_3_bn[0]
[0]']

 conv5_block1_out (Activation)  (None, 7, 7, 2048)   0           ['conv5_block1_add[0]
[0]']

 conv5_block2_1_conv (Conv2D)   (None, 7, 7, 512)    1049088     ['conv5_block1_out[0]
[0]']

 conv5_block2_1_bn (BatchNormal  (None, 7, 7, 512)   2048        ['conv5_block2_1_conv
[0][0]']
 ization)

 conv5_block2_1_relu (Activatio  (None, 7, 7, 512)   0           ['conv5_block2_1_bn[0]
[0]']
 n)

 conv5_block2_2_conv (Conv2D)   (None, 7, 7, 512)    2359808     ['conv5_block2_1_relu
[0][0]']

 conv5_block2_2_bn (BatchNormal  (None, 7, 7, 512)   2048        ['conv5_block2_2_conv
[0][0]']
 ization)

 conv5_block2_2_relu (Activatio  (None, 7, 7, 512)   0           ['conv5_block2_2_bn[0]
[0]']
 n)
```

```
 conv5_block2_3_conv (Conv2D)   (None, 7, 7, 2048)   1050624     ['conv5_block2_2_relu
[0][0]']

 conv5_block2_3_bn (BatchNormal  (None, 7, 7, 2048)  8192        ['conv5_block2_3_conv
[0][0]']
 ization)

 conv5_block2_add (Add)         (None, 7, 7, 2048)   0           ['conv5_block1_out[0]
[0]',
                                                                  'conv5_block2_3_bn[0]
[0]']

 conv5_block2_out (Activation)  (None, 7, 7, 2048)   0           ['conv5_block2_add[0]
[0]']

 conv5_block3_1_conv (Conv2D)   (None, 7, 7, 512)    1049088     ['conv5_block2_out[0]
[0]']

 conv5_block3_1_bn (BatchNormal  (None, 7, 7, 512)   2048        ['conv5_block3_1_conv
[0][0]']
 ization)

 conv5_block3_1_relu (Activatio  (None, 7, 7, 512)   0           ['conv5_block3_1_bn[0]
[0]']
 n)

 conv5_block3_2_conv (Conv2D)   (None, 7, 7, 512)    2359808     ['conv5_block3_1_relu
[0][0]']

 conv5_block3_2_bn (BatchNormal  (None, 7, 7, 512)   2048        ['conv5_block3_2_conv
[0][0]']
 ization)

 conv5_block3_2_relu (Activatio  (None, 7, 7, 512)   0           ['conv5_block3_2_bn[0]
[0]']
 n)

 conv5_block3_3_conv (Conv2D)   (None, 7, 7, 2048)   1050624     ['conv5_block3_2_relu
[0][0]']

 conv5_block3_3_bn (BatchNormal  (None, 7, 7, 2048)  8192        ['conv5_block3_3_conv
[0][0]']
 ization)

 conv5_block3_add (Add)         (None, 7, 7, 2048)   0           ['conv5_block2_out[0]
[0]',
                                                                  'conv5_block3_3_bn[0]
[0]']

 conv5_block3_out (Activation)  (None, 7, 7, 2048)   0           ['conv5_block3_add[0]
[0]']

 flatten (Flatten)              (None, 100352)       0           ['conv5_block3_out[0]
[0]']

 dense (Dense)                  (None, 19)           1906707     ['flatten[0][0]']

==================================================================================
==========
Total params: 25,494,419
```

```
Trainable params: 1,906,707
Non-trainable params: 23,587,712
_________________________________________________________________
```

In [14]:
```
model.compile (
    loss = 'categorical_crossentropy',
    optimizer = 'adam',
    metrics = ['accuracy']
)
```

In [15]:
```
import tensorflow as tf
from tensorflow import keras
from keras_preprocessing import image
from keras.preprocessing.image import ImageDataGenerator
```

In [16]:
```
train_datagen = ImageDataGenerator(
    rescale = 1./255,
    shear_range = 0.2,
    zoom_range = 0.2,
    horizontal_flip = True
)

test_datagen = ImageDataGenerator(
    rescale = 1./255
)
```

In [17]:
```
training_set = train_datagen.flow_from_directory(
    train_Path,
    target_size = IMAGE_SIZE,
    batch_size = 32,
    class_mode = 'categorical' # As we have more than 2 so using categorical.. for 2 we
)
```

```
Found 2223 images belonging to 19 classes.
```

In [18]:
```
test_set = train_datagen.flow_from_directory(
    test_Path,
    target_size = IMAGE_SIZE,
    batch_size = 32,
    class_mode = 'categorical'
)
```

```
Found 570 images belonging to 19 classes.
```

In [19]:
```
# Fir the model.

history = model.fit_generator(
    training_set,
    validation_data = test_set,
    epochs = 10,
    steps_per_epoch = len(training_set),
```

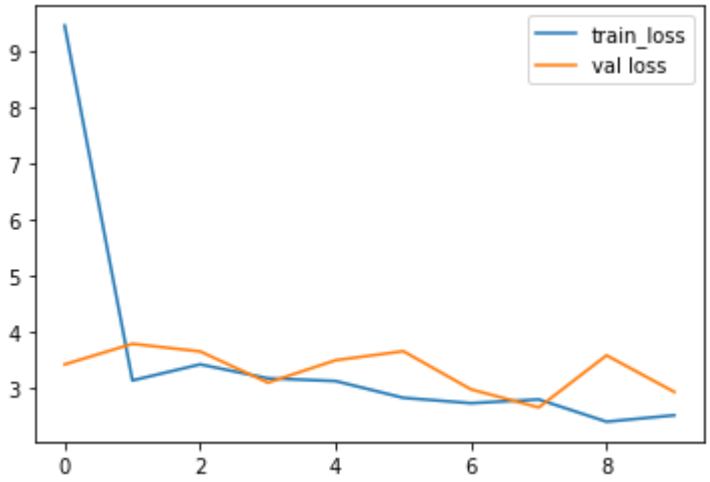
```
    validation_steps = len(test_set)
)
```

```
C:\Users\anshul\AppData\Local\Temp/ipykernel_16452/2330314088.py:3: UserWarning: `Model.
fit_generator` is deprecated and will be removed in a future version. Please use `Model.
fit`, which supports generators.
  history = model.fit_generator(
Epoch 1/10
70/70 [==============================] - 223s 3s/step - loss: 9.4701 - accuracy: 0.1129
- val_loss: 3.4073 - val_accuracy: 0.1544
Epoch 2/10
70/70 [==============================] - 211s 3s/step - loss: 3.1209 - accuracy: 0.2087
- val_loss: 3.7761 - val_accuracy: 0.1614
Epoch 3/10
70/70 [==============================] - 212s 3s/step - loss: 3.4080 - accuracy: 0.2227
- val_loss: 3.6396 - val_accuracy: 0.2456
Epoch 4/10
70/70 [==============================] - 219s 3s/step - loss: 3.1590 - accuracy: 0.2659
- val_loss: 3.0815 - val_accuracy: 0.2421
Epoch 5/10
70/70 [==============================] - 211s 3s/step - loss: 3.1098 - accuracy: 0.2753
- val_loss: 3.4824 - val_accuracy: 0.2281
Epoch 6/10
70/70 [==============================] - 221s 3s/step - loss: 2.8098 - accuracy: 0.3198
- val_loss: 3.6436 - val_accuracy: 0.2789
Epoch 7/10
70/70 [==============================] - 218s 3s/step - loss: 2.7143 - accuracy: 0.3311
- val_loss: 2.9604 - val_accuracy: 0.3105
Epoch 8/10
70/70 [==============================] - 219s 3s/step - loss: 2.7805 - accuracy: 0.3315
- val_loss: 2.6378 - val_accuracy: 0.3316
Epoch 9/10
70/70 [==============================] - 217s 3s/step - loss: 2.3830 - accuracy: 0.3765
- val_loss: 3.5697 - val_accuracy: 0.2246
Epoch 10/10
70/70 [==============================] - 210s 3s/step - loss: 2.4973 - accuracy: 0.3581
- val_loss: 2.9159 - val_accuracy: 0.3123
```

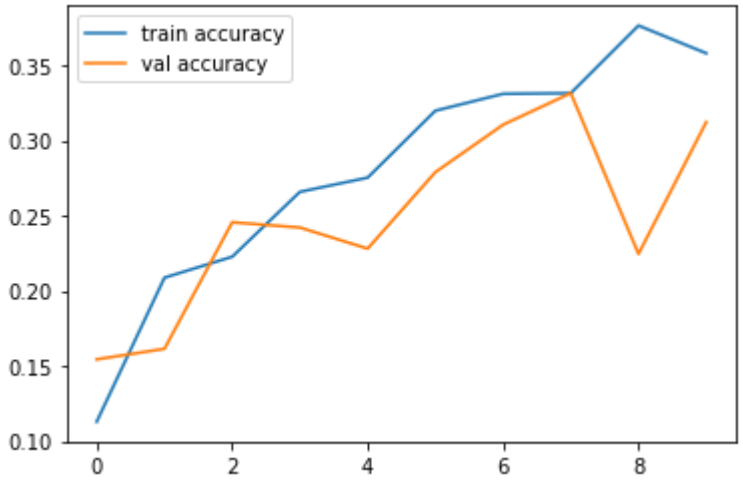
In [20]:

```
# Plot the Loss

plt.plot(history.history['loss'], label = 'train_loss')
plt.plot(history.history['val_loss'], label ='val loss')
plt.legend()
plt.show()
# plt.savefig('LossVal_loss')
```



In [21]:
```
# Plot the Accuracy
plt.plot(history.history['accuracy'], label = 'train accuracy')
plt.plot(history.history['val_accuracy'], label ='val accuracy')
plt.legend()
plt.show()
# plt.savefig('valAccuracy')
```



In [22]:
```
# Save it as a h5 file
#from tensorflow.keras.models import load_model

#model.save('car_brand_clf_resnet50.h5')
```

In [23]:
```
prediction = model.predict(test_set)
prediction
```

Out[23]:
```
array([[1.7684707e-02, 2.3744770e-03, 3.2644984e-03, ..., 1.4114640e-04,
        7.2915584e-04, 4.0266007e-02],
       [1.0861672e-02, 1.3919543e-04, 2.0479525e-03, ..., 7.3114214e-05,
        8.3394647e-05, 2.4074072e-01],
       [1.5224538e-05, 3.0367182e-06, 1.1507813e-01, ..., 1.1757830e-06,
        5.1004987e-05, 1.5659194e-03],
       ...,
       [6.6621643e-03, 6.3844973e-06, 4.6602841e-02, ..., 1.7579905e-06,
        8.7941444e-06, 2.6358003e-03],
```

```
       [2.2869783e-03, 3.1113421e-04, 1.4972646e-03, ..., 9.4501111e-06,
        7.5181356e-06, 2.6822672e-04],
       [9.9644205e-03, 1.7404910e-02, 7.7631153e-02, ..., 2.4107335e-02,
        2.2532651e-02, 3.9044460e-03]], dtype=float32)
```

In [24]:
```
prediction = np.argmax(prediction, axis = 1)
prediction
```

Out[24]:
```
array([10, 10,  9,  9, 10, 11,  5, 11,  9, 11, 10, 18, 14,  2,  9,  5,  9,
       18, 10,  8, 18,  9, 11, 11,  8, 11,  8, 17, 17,  8, 10,  8,  1,  8,
        8,  5, 11,  8, 10, 18,  8,  8,  2, 11, 11, 15, 11,  3,  8, 10,  8,
        1,  1, 11, 18, 11, 11, 11,  9,  8,  8, 10, 12, 11, 17, 11,  3,  9,
       11,  4, 11,  1,  9, 11,  2, 11, 12, 10, 11, 17,  1,  8,  3,  1, 15,
       10, 11,  9, 10, 10, 11,  9,  8,  1,  2, 17, 10, 10, 17, 18,  8, 18,
       11,  3, 15,  3, 10,  9, 16,  8,  1,  8,  3, 11,  8, 15,  6, 10,  1,
       11, 11, 11,  1, 11, 11, 18,  8,  3,  8, 15, 11, 11, 10,  9, 11, 18,
       18, 14, 12, 17, 18,  8, 10,  8,  1,  8,  9, 11, 15, 18,  1, 18, 10,
       10, 17, 10, 10, 11,  8, 10,  8, 11,  8, 11, 18,  8,  9,  9, 10,  8,
        8, 11,  9, 11,  8, 18,  8,  2, 10, 10, 10, 10, 10, 10, 11,  1, 10,
        9,  8,  4,  8, 11, 11, 11, 11,  8, 15,  2,  1, 10, 12, 10,  8, 10,
        3, 11,  8, 10,  1, 18, 15,  8,  3,  9, 11,  5, 15, 10,  8,  1,  9,
       15, 16,  8,  8, 11, 11, 10,  8, 10, 10,  8, 18,  8, 11, 11,  3, 15,
        8, 17,  3,  9,  9,  2,  8, 11, 10,  8,  8, 10, 10, 11,  8,  6,  8,
        8, 11,  1, 11,  8, 11,  1,  1,  2,  1,  1,  8, 11,  8,  5,  8,  1,
       11,  8, 11,  8,  2, 10,  8, 11,  8,  8,  8, 18, 11,  8, 18,  8,  9,
        8,  2, 17, 10, 16, 17,  8, 10, 11,  8, 11, 15, 12, 12, 10,  1, 10,
       11, 15, 11, 10,  8, 15, 11,  8,  1,  1,  1,  9, 11,  8, 15,  9,  9,
       11, 11, 12, 17,  8,  3, 15, 18, 11, 15, 11, 10,  1,  8, 11,  8,  7,
        8,  9,  8,  2,  9, 11, 11,  2,  3, 11, 15, 18, 12, 11,  8,  8,  8,
       11, 11,  6, 11, 11,  9,  8, 14, 11,  8,  8, 10, 10, 10, 11, 10, 11,
       18, 18, 15, 10,  2, 10,  9,  1,  2, 11, 15, 12, 11,  8, 10, 17,  8,
        1, 12, 10,  3,  1,  1, 11, 18, 10, 11, 12, 12, 11, 18,  9,  8, 10,
       17,  9,  9,  9,  8, 10,  8, 11,  1,  8,  8, 14, 15,  8,  2, 10, 17,
       18,  9, 10,  8,  2, 18,  8, 11,  8,  8,  2, 15, 11, 11, 11, 10,  1,
       17,  9,  2, 10,  3,  8, 11,  8, 10,  1, 11,  2,  1,  2,  8,  3, 12,
       11, 15, 17, 15, 11, 10, 10,  1, 15,  1,  9, 17, 15, 11,  9,  3, 11,
       11,  8,  3,  1, 11, 11, 15, 11, 11,  1, 11, 11, 15, 10,  8,  1,  9,
        1, 18,  4, 15,  9,  8,  5, 10,  3, 14, 10,  8, 17, 10, 11, 12, 15,
        1, 10, 15, 10, 15,  8,  8,  2,  2,  2, 11, 11, 15,  2,  9,  9,  3,
       10, 15, 10, 10, 15,  8, 11, 10,  7, 18, 11,  3, 17, 10, 18,  6, 11,
       11,  8, 18, 10,  9,  1,  8,  3,  2, 18, 11,  8, 10,  2, 17,  8, 15,
       17,  9,  4, 11, 15,  9,  8, 10, 15], dtype=int64)
```

In [25]:
```
model.evaluate(test_set,batch_size=512)
```

Out[25]:
```
18/18 [==============================] - 43s 2s/step - loss: 2.8674 - accuracy: 0.2965
[2.867422580718994, 0.29649123549461365]
```

In [26]:
```
from sklearn.metrics import accuracy_score,classification_report,confusion_matrix
import numpy as np
```

In [27]:
```
#predict
y_pred=model.predict(test_set)
y_pred=np.argmax(y_pred,axis=1)
```

In [29]:
```
cm = confusion_matrix(test_set.classes, y_pred)
print(cm)
```

```
[[ 0  4  0  1  0  0  0  0  8  0  7  6  0  0  1  1  0  1  1]
 [ 0  4  3  1  0  0  0  0  3  3  4  5  1  0  0  1  0  4  1]
 [ 0  2  1  1  0  0  1  0  4  1  7  4  2  0  0  1  0  3  3]
 [ 0  1  3  1  0  0  0  0  5  0  6  9  2  0  1  0  1  1  0]
 [ 0  3  0  2  0  1  0  0  8  1  3  6  2  0  1  0  0  1  2]
 [ 0  2  1  0  0  1  0  1  3  3  9  6  1  0  0  1  0  1  1]
 [ 0  1  2  1  0  0  0  1  7  2  5  7  0  0  0  1  0  1  2]
 [ 0  1  1  0  0  1  0  0  3  2  6  7  2  0  0  2  1  2  2]
 [ 0  1  1  0  0  1  1  0  8  4  2  6  1  0  1  2  0  1  1]
 [ 0  4  1  1  0  0  0  0  5  3  7  1  2  0  0  3  0  1  2]
 [ 1  0  0  1  0  1  0  0  3  3  3 13  0  0  0  2  0  1  2]
 [ 0  3  2  0  0  0  0  0  1  1  3 11  1  0  1  1  0  1  5]
 [ 0  3  3  1  0  1  0  0  6  1  4  3  0  0  0  3  0  3  2]
 [ 0  2  1  1  1  1  0  0  6  4  7  1  1  0  0  2  0  2  1]
 [ 0  0  3  0  1  0  0  0  9  4  3  5  2  0  0  0  0  0  3]
 [ 0  0  0  2  1  1  1  0  5  2  3  6  2  0  0  3  0  3  1]
 [ 0  2  1  0  0  0  1  0  6  2  4 11  1  0  0  0  0  2  0]
 [ 0  0  1  3  0  0  0  0  3  4  9  4  1  0  0  4  0  0  1]
 [ 0  2  3  3  0  1  0  0  6  2  1  3  1  0  0  2  1  1  4]]
```

In [ ]:
```

```