Transfer Learning VGG 16 and VGG 19 using Keras

Please download the dataset from the below url

In [15]:

```
from tensorflow.compat.v1 import ConfigProto
from tensorflow.compat.v1 import InteractiveSession

config = ConfigProto()
config.gpu_options.per_process_gpu_memory_fraction = 0.5
config.gpu_options.allow_growth = True
session = InteractiveSession(config=config)
```

In [16]:

```
# import the libraries as shown below

from tensorflow.keras.layers import Input, Lambda, Dense, Flatten
from tensorflow.keras.models import Model
from tensorflow.keras.applications.resnet50 import ResNet50
#from keras.applications.vgg16 import VGG16
from tensorflow.keras.applications.resnet50 import 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 [17]:

```
# re-size all the images to this
IMAGE_SIZE = [224, 224]

train_path = 'Datasets/train'
valid_path = 'Datasets/test'
```

In [18]:

```
# Import the Vgg 16 library as shown below and add preprocessing layer to the front of VG
G
# Here we will be using imagenet weights

resnet = ResNet50(input_shape=IMAGE_SIZE + [3], weights='imagenet', include_top=False)
```

In [19]:

```
# don't train existing weights
for layer in resnet.layers:
    layer.trainable = False
```

In [20]:

```
# useful for getting number of output classes
folders = glob('Datasets/train/*')
```

In [21]:

```
# our layers - you can add more if you want
x = Flatten()(resnet.output)
```

In [22]:

```
prediction = Dense(len(folders), activation='softmax')(x)
```

```
# create a model object
model = Model(inputs=resnet.input, outputs=prediction)
```

In [23]:

```
# view the structure of the model
model.summary()
```

```
Model: "model_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
input_2 (InputLayer)         [(None, 224, 224, 3)      0
_________________________________________________________________
conv1_pad (ZeroPadding2D)    (None, 230, 230, 3)       0
_________________________________________________________________
conv1_conv (Conv2D)          (None, 112, 112, 64)      9472
_________________________________________________________________
conv1_bn (BatchNormalization (None, 112, 112, 64)      256
_________________________________________________________________
conv1_relu (Activation)      (None, 112, 112, 64)      0
_________________________________________________________________
pool1_pad (ZeroPadding2D)    (None, 114, 114, 64)      0
_________________________________________________________________
pool1_pool (MaxPooling2D)    (None, 56, 56, 64)        0
_________________________________________________________________
conv2_block1_1_conv (Conv2D) (None, 56, 56, 64)        4160
_________________________________________________________________
conv2_block1_1_bn (BatchNormali (None, 56, 56, 64)     256
_________________________________________________________________
conv2_block1_1_relu (Activation (None, 56, 56, 64)     0
_________________________________________________________________
conv2_block1_2_conv (Conv2D) (None, 56, 56, 64)        36928
_________________________________________________________________
conv2_block1_2_bn (BatchNormali (None, 56, 56, 64)     256
_________________________________________________________________
conv2_block1_2_relu (Activation (None, 56, 56, 64)     0
_________________________________________________________________
conv2_block1_0_conv (Conv2D) (None, 56, 56, 256)       16640
_________________________________________________________________
```

```
conv2_block1_3_conv (Conv2D)    (None, 56, 56, 256)  16640       conv2_block1_2_relu[0][0
]
__________________________________________________________________________________________
__________
conv2_block1_0_bn (BatchNormali (None, 56, 56, 256)  1024        conv2_block1_0_conv[0][0
]
__________________________________________________________________________________________
__________
conv2_block1_3_bn (BatchNormali (None, 56, 56, 256)  1024        conv2_block1_3_conv[0][0
]
__________________________________________________________________________________________
__________
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 (BatchNormali (None, 56, 56, 64)   256         conv2_block2_1_conv[0][0
]
__________________________________________________________________________________________
__________
conv2_block2_1_relu (Activation (None, 56, 56, 64)   0           conv2_block2_1_bn[0][0]
__________________________________________________________________________________________
__________
conv2_block2_2_conv (Conv2D)    (None, 56, 56, 64)   36928       conv2_block2_1_relu[0][0
]
__________________________________________________________________________________________
__________
conv2_block2_2_bn (BatchNormali (None, 56, 56, 64)   256         conv2_block2_2_conv[0][0
]
__________________________________________________________________________________________
__________
conv2_block2_2_relu (Activation (None, 56, 56, 64)   0           conv2_block2_2_bn[0][0]
__________________________________________________________________________________________
__________
conv2_block2_3_conv (Conv2D)    (None, 56, 56, 256)  16640       conv2_block2_2_relu[0][0
]
__________________________________________________________________________________________
__________
conv2_block2_3_bn (BatchNormali (None, 56, 56, 256)  1024        conv2_block2_3_conv[0][0
]
__________________________________________________________________________________________
__________
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 (BatchNormali (None, 56, 56, 64)   256         conv2_block3_1_conv[0][0
]
__________________________________________________________________________________________
__________
```

```
conv2_block3_1_relu (Activation (None, 56, 56, 64)   0           conv2_block3_1_bn[0][0]
__________________________________________________________________________________________
__________
conv2_block3_2_conv (Conv2D)    (None, 56, 56, 64)   36928       conv2_block3_1_relu[0][0
]
__________________________________________________________________________________________
__________
conv2_block3_2_bn (BatchNormali (None, 56, 56, 64)   256         conv2_block3_2_conv[0][0
]
__________________________________________________________________________________________
__________
conv2_block3_2_relu (Activation (None, 56, 56, 64)   0           conv2_block3_2_bn[0][0]
__________________________________________________________________________________________
__________
conv2_block3_3_conv (Conv2D)    (None, 56, 56, 256)  16640       conv2_block3_2_relu[0][0
]
__________________________________________________________________________________________
__________
conv2_block3_3_bn (BatchNormali (None, 56, 56, 256)  1024        conv2_block3_3_conv[0][0
]
__________________________________________________________________________________________
__________
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 (BatchNormali (None, 28, 28, 128)  512         conv3_block1_1_conv[0][0
]
__________________________________________________________________________________________
__________
conv3_block1_1_relu (Activation (None, 28, 28, 128)  0           conv3_block1_1_bn[0][0]
__________________________________________________________________________________________
__________
conv3_block1_2_conv (Conv2D)    (None, 28, 28, 128)  147584      conv3_block1_1_relu[0][0
]
__________________________________________________________________________________________
__________
conv3_block1_2_bn (BatchNormali (None, 28, 28, 128)  512         conv3_block1_2_conv[0][0
]
__________________________________________________________________________________________
__________
conv3_block1_2_relu (Activation (None, 28, 28, 128)  0           conv3_block1_2_bn[0][0]
__________________________________________________________________________________________
__________
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 (BatchNormali (None, 28, 28, 512)  2048        conv3_block1_0_conv[0][0
]
__________________________________________________________________________________________
__________
conv3_block1_3_bn (BatchNormali (None, 28, 28, 512)  2048        conv3_block1_3_conv[0][0
]
```

```
__________________________________________________________________________________________________
__________
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 (BatchNormali (None, 28, 28, 128)  512         conv3_block2_1_conv[0][0
]
__________________________________________________________________________________________________
__________
conv3_block2_1_relu (Activation (None, 28, 28, 128)  0           conv3_block2_1_bn[0][0]

__________________________________________________________________________________________________
__________
conv3_block2_2_conv (Conv2D)    (None, 28, 28, 128)  147584      conv3_block2_1_relu[0][0
]
__________________________________________________________________________________________________
__________
conv3_block2_2_bn (BatchNormali (None, 28, 28, 128)  512         conv3_block2_2_conv[0][0
]
__________________________________________________________________________________________________
__________
conv3_block2_2_relu (Activation (None, 28, 28, 128)  0           conv3_block2_2_bn[0][0]

__________________________________________________________________________________________________
__________
conv3_block2_3_conv (Conv2D)    (None, 28, 28, 512)  66048       conv3_block2_2_relu[0][0
]
__________________________________________________________________________________________________
__________
conv3_block2_3_bn (BatchNormali (None, 28, 28, 512)  2048        conv3_block2_3_conv[0][0
]
__________________________________________________________________________________________________
__________
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 (BatchNormali (None, 28, 28, 128)  512         conv3_block3_1_conv[0][0
]
__________________________________________________________________________________________________
__________
conv3_block3_1_relu (Activation (None, 28, 28, 128)  0           conv3_block3_1_bn[0][0]

__________________________________________________________________________________________________
__________
conv3_block3_2_conv (Conv2D)    (None, 28, 28, 128)  147584      conv3_block3_1_relu[0][0
]
__________________________________________________________________________________________________
__________
conv3_block3_2_bn (BatchNormali (None, 28, 28, 128)  512         conv3_block3_2_conv[0][0
]
```

```
__________________________________________________________________________________________________
__________
conv3_block3_2_relu (Activation (None, 28, 28, 128)  0           conv3_block3_2_bn[0][0]

__________________________________________________________________________________________________
__________
conv3_block3_3_conv (Conv2D)    (None, 28, 28, 512)  66048       conv3_block3_2_relu[0][0
]
__________________________________________________________________________________________________
__________
conv3_block3_3_bn (BatchNormali (None, 28, 28, 512)  2048        conv3_block3_3_conv[0][0
]
__________________________________________________________________________________________________
__________
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 (BatchNormali (None, 28, 28, 128)  512         conv3_block4_1_conv[0][0
]
__________________________________________________________________________________________________
__________
conv3_block4_1_relu (Activation (None, 28, 28, 128)  0           conv3_block4_1_bn[0][0]

__________________________________________________________________________________________________
__________
conv3_block4_2_conv (Conv2D)    (None, 28, 28, 128)  147584      conv3_block4_1_relu[0][0
]
__________________________________________________________________________________________________
__________
conv3_block4_2_bn (BatchNormali (None, 28, 28, 128)  512         conv3_block4_2_conv[0][0
]
__________________________________________________________________________________________________
__________
conv3_block4_2_relu (Activation (None, 28, 28, 128)  0           conv3_block4_2_bn[0][0]

__________________________________________________________________________________________________
__________
conv3_block4_3_conv (Conv2D)    (None, 28, 28, 512)  66048       conv3_block4_2_relu[0][0
]
__________________________________________________________________________________________________
__________
conv3_block4_3_bn (BatchNormali (None, 28, 28, 512)  2048        conv3_block4_3_conv[0][0
]
__________________________________________________________________________________________________
__________
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 (BatchNormali (None, 14, 14, 256)  1024        conv4_block1_1_conv[0][0
]
```

```
__________________________________________________________________________________________________
__________
conv4_block1_1_relu (Activation (None, 14, 14, 256)  0           conv4_block1_1_bn[0][0]

__________________________________________________________________________________________________
__________
conv4_block1_2_conv (Conv2D)    (None, 14, 14, 256)  590080      conv4_block1_1_relu[0][0
]
__________________________________________________________________________________________________
__________
conv4_block1_2_bn (BatchNormali (None, 14, 14, 256)  1024        conv4_block1_2_conv[0][0
]
__________________________________________________________________________________________________
__________
conv4_block1_2_relu (Activation (None, 14, 14, 256)  0           conv4_block1_2_bn[0][0]

__________________________________________________________________________________________________
__________
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 (BatchNormali (None, 14, 14, 1024) 4096        conv4_block1_0_conv[0][0
]
__________________________________________________________________________________________________
__________
conv4_block1_3_bn (BatchNormali (None, 14, 14, 1024) 4096        conv4_block1_3_conv[0][0
]
__________________________________________________________________________________________________
__________
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 (BatchNormali (None, 14, 14, 256)  1024        conv4_block2_1_conv[0][0
]
__________________________________________________________________________________________________
__________
conv4_block2_1_relu (Activation (None, 14, 14, 256)  0           conv4_block2_1_bn[0][0]

__________________________________________________________________________________________________
__________
conv4_block2_2_conv (Conv2D)    (None, 14, 14, 256)  590080      conv4_block2_1_relu[0][0
]
__________________________________________________________________________________________________
__________
conv4_block2_2_bn (BatchNormali (None, 14, 14, 256)  1024        conv4_block2_2_conv[0][0
]
__________________________________________________________________________________________________
__________
conv4_block2_2_relu (Activation (None, 14, 14, 256)  0           conv4_block2_2_bn[0][0]

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

```
conv4_block2_3_bn (BatchNormali (None, 14, 14, 1024) 4096        conv4_block2_3_conv[0][0
]
__________________________________________________________________________________________
_________
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 (BatchNormali (None, 14, 14, 256)  1024        conv4_block3_1_conv[0][0
]
__________________________________________________________________________________________
_________
conv4_block3_1_relu (Activation (None, 14, 14, 256)  0           conv4_block3_1_bn[0][0]

__________________________________________________________________________________________
_________
conv4_block3_2_conv (Conv2D)    (None, 14, 14, 256)  590080      conv4_block3_1_relu[0][0
]
__________________________________________________________________________________________
_________
conv4_block3_2_bn (BatchNormali (None, 14, 14, 256)  1024        conv4_block3_2_conv[0][0
]
__________________________________________________________________________________________
_________
conv4_block3_2_relu (Activation (None, 14, 14, 256)  0           conv4_block3_2_bn[0][0]

__________________________________________________________________________________________
_________
conv4_block3_3_conv (Conv2D)    (None, 14, 14, 1024) 263168      conv4_block3_2_relu[0][0
]
__________________________________________________________________________________________
_________
conv4_block3_3_bn (BatchNormali (None, 14, 14, 1024) 4096        conv4_block3_3_conv[0][0
]
__________________________________________________________________________________________
_________
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 (BatchNormali (None, 14, 14, 256)  1024        conv4_block4_1_conv[0][0
]
__________________________________________________________________________________________
_________
conv4_block4_1_relu (Activation (None, 14, 14, 256)  0           conv4_block4_1_bn[0][0]

__________________________________________________________________________________________
_________
conv4_block4_2_conv (Conv2D)    (None, 14, 14, 256)  590080      conv4_block4_1_relu[0][0
]
__________________________________________________________________________________________
_________
```

```
conv4_block4_2_bn (BatchNormali (None, 14, 14, 256)  1024        conv4_block4_2_conv[0][0
]
__________________________________________________________________________________________
__________
conv4_block4_2_relu (Activation (None, 14, 14, 256)  0           conv4_block4_2_bn[0][0]

__________________________________________________________________________________________
__________
conv4_block4_3_conv (Conv2D)    (None, 14, 14, 1024) 263168      conv4_block4_2_relu[0][0
]
__________________________________________________________________________________________
__________
conv4_block4_3_bn (BatchNormali (None, 14, 14, 1024) 4096        conv4_block4_3_conv[0][0
]
__________________________________________________________________________________________
__________
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 (BatchNormali (None, 14, 14, 256)  1024        conv4_block5_1_conv[0][0
]
__________________________________________________________________________________________
__________
conv4_block5_1_relu (Activation (None, 14, 14, 256)  0           conv4_block5_1_bn[0][0]

__________________________________________________________________________________________
__________
conv4_block5_2_conv (Conv2D)    (None, 14, 14, 256)  590080      conv4_block5_1_relu[0][0
]
__________________________________________________________________________________________
__________
conv4_block5_2_bn (BatchNormali (None, 14, 14, 256)  1024        conv4_block5_2_conv[0][0
]
__________________________________________________________________________________________
__________
conv4_block5_2_relu (Activation (None, 14, 14, 256)  0           conv4_block5_2_bn[0][0]

__________________________________________________________________________________________
__________
conv4_block5_3_conv (Conv2D)    (None, 14, 14, 1024) 263168      conv4_block5_2_relu[0][0
]
__________________________________________________________________________________________
__________
conv4_block5_3_bn (BatchNormali (None, 14, 14, 1024) 4096        conv4_block5_3_conv[0][0
]
__________________________________________________________________________________________
__________
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 (BatchNormali (None, 14, 14, 256)  1024        conv4_block6_1_conv[0][0
]
__________________________________________________________________________________________
__________
conv4_block6_1_relu (Activation (None, 14, 14, 256)  0           conv4_block6_1_bn[0][0]

__________________________________________________________________________________________
__________
conv4_block6_2_conv (Conv2D)    (None, 14, 14, 256)  590080      conv4_block6_1_relu[0][0
]
__________________________________________________________________________________________
__________
conv4_block6_2_bn (BatchNormali (None, 14, 14, 256)  1024        conv4_block6_2_conv[0][0
]
__________________________________________________________________________________________
__________
conv4_block6_2_relu (Activation (None, 14, 14, 256)  0           conv4_block6_2_bn[0][0]

__________________________________________________________________________________________
__________
conv4_block6_3_conv (Conv2D)    (None, 14, 14, 1024) 263168      conv4_block6_2_relu[0][0
]
__________________________________________________________________________________________
__________
conv4_block6_3_bn (BatchNormali (None, 14, 14, 1024) 4096        conv4_block6_3_conv[0][0
]
__________________________________________________________________________________________
__________
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 (BatchNormali (None, 7, 7, 512)    2048        conv5_block1_1_conv[0][0
]
__________________________________________________________________________________________
__________
conv5_block1_1_relu (Activation (None, 7, 7, 512)    0           conv5_block1_1_bn[0][0]

__________________________________________________________________________________________
__________
conv5_block1_2_conv (Conv2D)    (None, 7, 7, 512)    2359808     conv5_block1_1_relu[0][0
]
__________________________________________________________________________________________
__________
conv5_block1_2_bn (BatchNormali (None, 7, 7, 512)    2048        conv5_block1_2_conv[0][0
]
__________________________________________________________________________________________
__________
conv5_block1_2_relu (Activation (None, 7, 7, 512)    0           conv5_block1_2_bn[0][0]

__________________________________________________________________________________________
__________
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 (BatchNormali (None, 7, 7, 2048)   8192        conv5_block1_0_conv[0][0
]
```

```
__________________________________________________________________________________________________
__________
conv5_block1_3_bn (BatchNormali (None, 7, 7, 2048)   8192        conv5_block1_3_conv[0][0
]
__________________________________________________________________________________________________
__________
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 (BatchNormali (None, 7, 7, 512)    2048        conv5_block2_1_conv[0][0
]
__________________________________________________________________________________________________
__________
conv5_block2_1_relu (Activation (None, 7, 7, 512)    0           conv5_block2_1_bn[0][0]

__________________________________________________________________________________________________
__________
conv5_block2_2_conv (Conv2D)    (None, 7, 7, 512)    2359808     conv5_block2_1_relu[0][0
]
__________________________________________________________________________________________________
__________
conv5_block2_2_bn (BatchNormali (None, 7, 7, 512)    2048        conv5_block2_2_conv[0][0
]
__________________________________________________________________________________________________
__________
conv5_block2_2_relu (Activation (None, 7, 7, 512)    0           conv5_block2_2_bn[0][0]

__________________________________________________________________________________________________
__________
conv5_block2_3_conv (Conv2D)    (None, 7, 7, 2048)   1050624     conv5_block2_2_relu[0][0
]
__________________________________________________________________________________________________
__________
conv5_block2_3_bn (BatchNormali (None, 7, 7, 2048)   8192        conv5_block2_3_conv[0][0
]
__________________________________________________________________________________________________
__________
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 (BatchNormali (None, 7, 7, 512)    2048        conv5_block3_1_conv[0][0
]
__________________________________________________________________________________________________
__________
conv5_block3_1_relu (Activation (None, 7, 7, 512)    0           conv5_block3_1_bn[0][0]

__________________________________________________________________________________________________
__________
conv5_block3_2_conv (Conv2D)    (None, 7, 7, 512)    2359808     conv5_block3_1_relu[0][0
]
```

```
__________________________________________________________________________________________________
__________
conv5_block3_2_bn (BatchNormali (None, 7, 7, 512)    2048        conv5_block3_2_conv[0][0
]
__________________________________________________________________________________________________
__________
conv5_block3_2_relu (Activation (None, 7, 7, 512)    0           conv5_block3_2_bn[0][0]

__________________________________________________________________________________________________
__________
conv5_block3_3_conv (Conv2D)    (None, 7, 7, 2048)   1050624     conv5_block3_2_relu[0][0
]
__________________________________________________________________________________________________
__________
conv5_block3_3_bn (BatchNormali (None, 7, 7, 2048)   8192        conv5_block3_3_conv[0][0
]
__________________________________________________________________________________________________
__________
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_1 (Flatten)             (None, 100352)       0           conv5_block3_out[0][0]

__________________________________________________________________________________________________
__________
dense_1 (Dense)                 (None, 4)            401412      flatten_1[0][0]

==================================================================================================
=========
Total params: 23,989,124
Trainable params: 401,412
Non-trainable params: 23,587,712
__________________________________________________________________________________________________
__________
```

In [24]:

```
# tell the model what cost and optimization method to use
model.compile(
  loss='categorical_crossentropy',
  optimizer='adam',
  metrics=['accuracy']
)
```

In [25]:

```
# Use the Image Data Generator to import the images from the dataset
from tensorflow.keras.preprocessing.image import ImageDataGenerator

train_datagen = ImageDataGenerator(rescale = 1./255,
                                   shear_range = 0.2,
                                   zoom_range = 0.2,
                                   horizontal_flip = True)

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

In [26]:

```
# Make sure you provide the same target size as initialied for the image size
training_set = train_datagen.flow_from_directory('Datasets/train',
                                                 target_size = (224, 224),
                                                 batch_size = 32,
                                                 class_mode = 'categorical')
```

```
Found 1951 images belonging to 4 classes.
```

Found 1951 images belonging to 4 classes.

In [27]:

```
test_set = test_datagen.flow_from_directory('Datasets/test',
                                            target_size = (224, 224),
                                            batch_size = 32,
                                            class_mode = 'categorical')
```

```
Found 18 images belonging to 4 classes.
```

In [29]:

```
# fit the model
# Run the cell. It will take some time to execute
r = model.fit_generator(
  training_set,
  validation_data=test_set,
  epochs=20,
  steps_per_epoch=len(training_set),
  validation_steps=len(test_set)
)
```

```
Epoch 1/20
61/61 [==============================] - 31s 503ms/step - loss: 1.2868 - accuracy: 0.4936
- val_loss: 1.1249 - val_accuracy: 0.5556
Epoch 2/20
61/61 [==============================] - 18s 297ms/step - loss: 0.9862 - accuracy: 0.6053
- val_loss: 1.1933 - val_accuracy: 0.6111
Epoch 3/20
61/61 [==============================] - 18s 297ms/step - loss: 0.9024 - accuracy: 0.6412
- val_loss: 0.7966 - val_accuracy: 0.7778
Epoch 4/20
61/61 [==============================] - 18s 297ms/step - loss: 0.8691 - accuracy: 0.6627
- val_loss: 0.8158 - val_accuracy: 0.6667
Epoch 5/20
61/61 [==============================] - 18s 298ms/step - loss: 0.9322 - accuracy: 0.6361
- val_loss: 1.0051 - val_accuracy: 0.6667
Epoch 6/20
61/61 [==============================] - 18s 297ms/step - loss: 0.8368 - accuracy: 0.6730
- val_loss: 0.6658 - val_accuracy: 0.7778
Epoch 7/20
61/61 [==============================] - 19s 305ms/step - loss: 0.8500 - accuracy: 0.6694
- val_loss: 0.8086 - val_accuracy: 0.7222
Epoch 8/20
61/61 [==============================] - 18s 303ms/step - loss: 0.7391 - accuracy: 0.7176
- val_loss: 0.6687 - val_accuracy: 0.7778
Epoch 9/20
61/61 [==============================] - 18s 300ms/step - loss: 0.7539 - accuracy: 0.6914
- val_loss: 0.5906 - val_accuracy: 0.7778
Epoch 10/20
61/61 [==============================] - 18s 296ms/step - loss: 0.6641 - accuracy: 0.7381
- val_loss: 1.0657 - val_accuracy: 0.7222
Epoch 11/20
61/61 [==============================] - 18s 298ms/step - loss: 0.9751 - accuracy: 0.6674
- val_loss: 0.8098 - val_accuracy: 0.7778
Epoch 12/20
61/61 [==============================] - 18s 298ms/step - loss: 0.7192 - accuracy: 0.7258
- val_loss: 0.7715 - val_accuracy: 0.7778
Epoch 13/20
61/61 [==============================] - 19s 307ms/step - loss: 0.7212 - accuracy: 0.7283
- val_loss: 1.2519 - val_accuracy: 0.7222
Epoch 14/20
61/61 [==============================] - 23s 369ms/step - loss: 0.6548 - accuracy: 0.7509
- val_loss: 0.7284 - val_accuracy: 0.7778
Epoch 15/20
61/61 [==============================] - 18s 295ms/step - loss: 0.6957 - accuracy: 0.7278
- val_loss: 0.5299 - val_accuracy: 0.8333
Epoch 16/20
61/61 [==============================] - 18s 296ms/step - loss: 0.7172 - accuracy: 0.7191
- val_loss: 0.7328 - val_accuracy: 0.7778
Epoch 17/20
61/61 [==============================] - 18s 294ms/step - loss: 0.6455 - accuracy: 0.7509
```

```
- val_loss: 0.6202 - val_accuracy: 0.7778
Epoch 18/20
61/61 [==============================] - 18s 294ms/step - loss: 0.6164 - accuracy: 0.7565
- val_loss: 0.4560 - val_accuracy: 0.8333
Epoch 19/20
61/61 [==============================] - 18s 295ms/step - loss: 0.6614 - accuracy: 0.7576
- val_loss: 0.9876 - val_accuracy: 0.7222
Epoch 20/20
61/61 [==============================] - 18s 294ms/step - loss: 0.7661 - accuracy: 0.7355
- val_loss: 0.5443 - val_accuracy: 0.7778
```

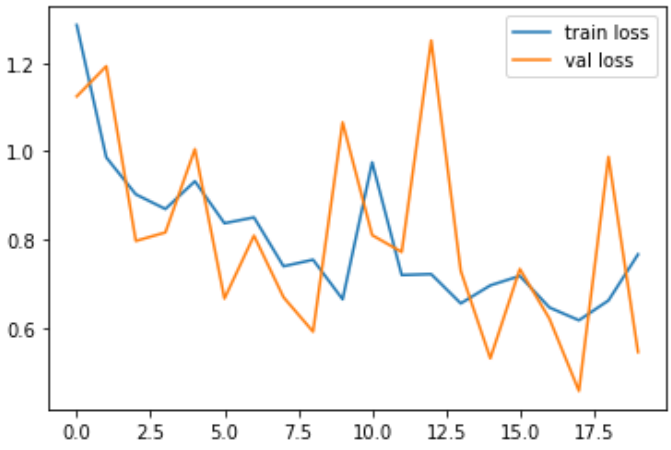
In [32]:

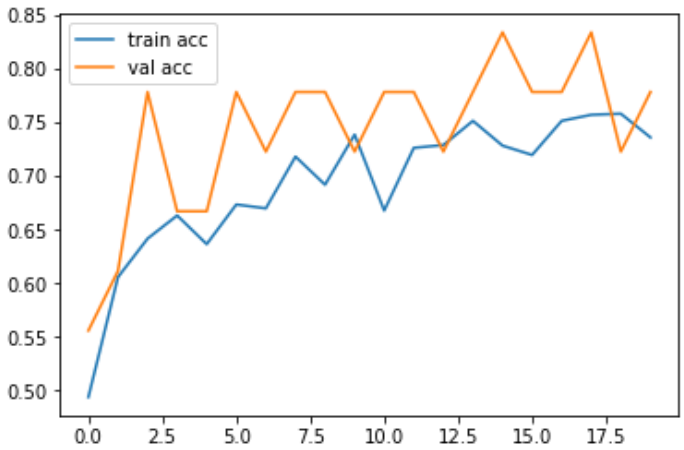
```
import matplotlib.pyplot as plt
```

In [33]:

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

# plot the accuracy
plt.plot(r.history['accuracy'], label='train acc')
plt.plot(r.history['val_accuracy'], label='val acc')
plt.legend()
plt.show()
plt.savefig('AccVal_acc')
```






```
<Figure size 432x288 with 0 Axes>
```

In [34]:

```
# save it as a h5 file


from tensorflow.keras.models import load_model
```

```
model.save('model_resnet50.h5')
```

In [ ]:

```

```

In [35]:

```
y_pred = model.predict(test_set)
```

In [36]:

```
y_pred
```

Out[36]:

```
array([[1.08071638e-03, 3.28080803e-02, 1.40938358e-02, 9.52017426e-01],
       [6.48212081e-05, 3.76272453e-07, 9.98108983e-01, 1.82576303e-03],
       [9.98069108e-01, 4.38354881e-08, 2.79694970e-04, 1.65126985e-03],
       [1.90574420e-03, 6.20834953e-07, 9.98076916e-01, 1.66221180e-05],
       [2.93544168e-03, 2.18342058e-03, 1.03987521e-02, 9.84482408e-01],
       [1.23585598e-03, 1.37195078e-04, 9.93926585e-01, 4.70046466e-03],
       [5.18485345e-03, 9.52562571e-01, 1.32831134e-04, 4.21197526e-02],
       [4.34744754e-04, 1.28285792e-02, 3.98747995e-03, 9.82749104e-01],
       [8.25350955e-02, 3.11684459e-01, 3.73537302e-01, 2.32243121e-01],
       [7.13894069e-01, 1.14700936e-01, 1.23989824e-02, 1.59005970e-01],
       [1.23955928e-01, 3.05530787e-01, 3.02462336e-02, 5.40267050e-01],
       [2.72632996e-03, 2.09897235e-02, 2.10788921e-02, 9.55205083e-01],
       [5.82802715e-03, 4.64445323e-01, 3.76655348e-02, 4.92061198e-01],
       [2.54945271e-03, 2.06118330e-06, 3.14365199e-04, 9.97134089e-01],
       [1.11564873e-02, 2.96992337e-04, 9.86988664e-01, 1.55796099e-03],
       [4.65637725e-03, 8.08736682e-01, 4.15630117e-02, 1.45043999e-01],
       [3.95378843e-03, 7.04863906e-01, 1.88800885e-04, 2.90993541e-01],
       [1.24013796e-02, 8.02336668e-04, 9.60396826e-01, 2.63994653e-02]],
      dtype=float32)
```

In [37]:

```
import numpy as np
y_pred = np.argmax(y_pred, axis=1)
```

In [38]:

```
y_pred
```

Out[38]:

```
array([3, 2, 0, 2, 3, 2, 1, 3, 2, 0, 3, 3, 3, 3, 2, 1, 1, 2], dtype=int64)
```

In [ ]:

```

```

In [1]:

```
from tensorflow.keras.models import load_model
from tensorflow.keras.preprocessing import image
```

In [2]:

```
model=load_model('model_resnet50.h5')
```

In [39]:

```
img_data
```

Out[39]:

```
array([[[[ 6.7060997e+01,  5.4221001e+01,  4.7320000e+01],
         [ 6.9060997e+01,  5.6221001e+01,  4.9320000e+01],
         [ 7.3060997e+01,  6.0221001e+01,  5.3320000e+01],
```

```
         ...,
         [ 7.4060997e+01,  5.6221001e+01,  4.6320000e+01],
         [ 5.5060997e+01,  3.7221001e+01,  2.7320000e+01],
         [ 4.1060997e+01,  2.3221001e+01,  1.3320000e+01]],

        [[ 7.5060997e+01,  6.2221001e+01,  5.5320000e+01],
         [ 7.8060997e+01,  6.5221001e+01,  5.8320000e+01],
         [ 8.1060997e+01,  6.8221001e+01,  6.1320000e+01],
         ...,
         [ 9.7060997e+01,  7.9221001e+01,  6.9320000e+01],
         [ 7.3060997e+01,  5.5221001e+01,  4.5320000e+01],
         [ 4.9060997e+01,  3.1221001e+01,  2.1320000e+01]],

        [[ 8.7060997e+01,  7.4221001e+01,  6.7320000e+01],
         [ 9.0060997e+01,  7.7221001e+01,  7.0320000e+01],
         [ 9.3060997e+01,  8.0221001e+01,  7.3320000e+01],
         ...,
         [ 1.0106100e+02,  8.3221001e+01,  7.3320000e+01],
         [ 7.5060997e+01,  5.7221001e+01,  4.7320000e+01],
         [ 5.0060997e+01,  3.2221001e+01,  2.2320000e+01]],

        ...,

        [[ 1.0406100e+02,  8.9221001e+01,  9.4320000e+01],
         [ 1.0206100e+02,  8.7221001e+01,  9.2320000e+01],
         [ 9.9060997e+01,  8.4221001e+01,  8.9320000e+01],
         ...,
         [-1.0939003e+01, -1.6778999e+01, -1.4680000e+01],
         [-1.0939003e+01, -1.6778999e+01, -1.4680000e+01],
         [-1.0939003e+01, -1.6778999e+01, -1.4680000e+01]],

        [[ 1.0606100e+02,  9.1221001e+01,  9.6320000e+01],
         [ 1.0406100e+02,  8.9221001e+01,  9.4320000e+01],
         [ 1.0006100e+02,  8.5221001e+01,  9.0320000e+01],
         ...,
         [-5.9390030e+00, -1.1778999e+01, -9.6800003e+00],
         [-5.9390030e+00, -1.1778999e+01, -9.6800003e+00],
         [-5.9390030e+00, -1.1778999e+01, -9.6800003e+00]],

        [[ 1.0806100e+02,  9.4221001e+01,  9.6320000e+01],
         [ 1.0606100e+02,  9.2221001e+01,  9.4320000e+01],
         [ 1.0206100e+02,  8.8221001e+01,  9.0320000e+01],
         ...,
         [ 6.0997009e-02, -5.7789993e+00, -3.6800003e+00],
         [ 6.0997009e-02, -5.7789993e+00, -3.6800003e+00],
         [ 6.0997009e-02, -5.7789993e+00, -3.6800003e+00]]]],
      dtype=float32)
```

In [11]:

```
img=image.load_img('Datasets/Test/Coffee/download (2).jpg',target_size=(224,224))
```

In [12]:

```
x=image.img_to_array(img)
x
```

Out[12]:

```
array([[[254., 254., 254.],
        [254., 254., 254.],
        [254., 254., 254.],
        ...,
        [254., 254., 254.],
        [255., 255., 255.],
        [255., 255., 255.]],

       [[254., 254., 254.],
        [254., 254., 254.],
        [254., 254., 254.],
        ...,
        [254., 254., 254.],
```

```
        [255., 255., 255.],
        [255., 255., 255.]],

       [[254., 254., 254.],
        [254., 254., 254.],
        [254., 254., 254.],
        ...,
        [254., 254., 254.],
        [255., 255., 255.],
        [255., 255., 255.]],

       ...,

       [[255., 255., 255.],
        [255., 255., 255.],
        [255., 255., 255.],
        ...,
        [255., 255., 255.],
        [255., 255., 255.],
        [255., 255., 255.]],

       [[255., 255., 255.],
        [255., 255., 255.],
        [255., 255., 255.],
        ...,
        [255., 255., 255.],
        [255., 255., 255.],
        [255., 255., 255.]],

       [[255., 255., 255.],
        [255., 255., 255.],
        [255., 255., 255.],
        ...,
        [255., 255., 255.],
        [255., 255., 255.],
        [255., 255., 255.]]], dtype=float32)
```

In [13]:

```
x.shape
```

Out[13]:

```
(224, 224, 3)
```

In [14]:

```
x=x/255
```

In [15]:

```
import numpy as np
x=np.expand_dims(x,axis=0)
img_data=preprocess_input(x)
img_data.shape
```

Out[15]:

```
(1, 224, 224, 3)
```

In [16]:

```
model.predict(img_data)
```

Out[16]:

```
array([[0.9745471, 0.0254529]], dtype=float32)
```

In [17]:

```
a=np.argmax(model.predict(img_data), axis=1)
```

In [102]:

```
a==1
```

Out[102]:

```
array([ True])
```

In [18]:

```
import tensorflow as tf
```

In [19]:

```
tf.__version__
```

Out[19]:

```
'2.2.0'
```

In [ ]:

```

```