Data Mining

Final Project

Transfer Learning - ResNet50

(TensorFlow + Keras)

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GitHub Link - https://github.com/parth426/Data-Mining/tree/main/Final%20Project

About this Project -

Here I have made use of Transfer Learning Method to use pre-trained ResNet50 CNN as my model for Multi-Class Classification.

Part - 1

(Building CNN Model using TRANSFER LEARNING method)

Importing Libraries & other modules

In [1]:

```
import tensorflow as tf
```

In [2]:

```
print(tf.__version__)
```

```
2.2.0
```

In [3]:

```
import keras
```

In [4]:

```
print(keras.__version__)
```

```
2.4.3
```

In [5]:

```
from keras.layers import Input,Lambda,Dense,Flatten
from keras.models import Sequential
from keras.applications.resnet50 import ResNet50
# from keras.applications.vgg19 import VGG19
from keras.preprocessing import image
from keras.preprocessing.image import ImageDataGenerator,load_img
from keras.models import load_model,Model
```

ImageDataGenerator helps us to perform Data Augmentation

In [6]:

```
from IPython import get_ipython
```

In [7]:

```
import numpy as np
from glob import glob
import matplotlib.pyplot as plt
# %matplotlib inline
```

glob (short for global) is used to return all file paths that match a specific pattern

Fix image size

In [8]:

```
img_size = [224,224]
```

Decide Train Path & Test Path

In [9]:

```
train_path = 'Datasets/Train'
```

In [10]:

```
test_path = 'Datasets/Test'
```

Building CNN model

In [11]:

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

In [12]:

```
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]
```

```
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 (BatchNormali (None, 56, 56, 64)   256         conv2_block1_1_conv[0][0
]
__________________________________________________________________________________________
conv2_block1_1_relu (Activation (None, 56, 56, 64)   0           conv2_block1_1_bn[0][0]
__________________________________________________________________________________________
conv2_block1_2_conv (Conv2D)    (None, 56, 56, 64)   36928       conv2_block1_1_relu[0][0
]
__________________________________________________________________________________________
conv2_block1_2_bn (BatchNormali (None, 56, 56, 64)   256         conv2_block1_2_conv[0][0
]
__________________________________________________________________________________________
conv2_block1_2_relu (Activation (None, 56, 56, 64)   0           conv2_block1_2_bn[0][0]
__________________________________________________________________________________________
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 (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]
```

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__________
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_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]
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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
]
```

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__________
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
]
```

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__________
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
]
```

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__________
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_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]

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

In [13]:

```
# For not training the existing weights
for layer in resnet.layers:
    layer.trainable = False
```

glob is useful to get O/P classes

In [14]:

```
folders = glob('Datasets\\Train\\*')
```

In [15]:

```
folders
```

Out[15]:

```
['Datasets\\Train\\audi',
 'Datasets\\Train\\lamborghini',
 'Datasets\\Train\\mercedes']
```

In [16]:

```
len(folders)
```

Out[16]:

```
3
```

In [17]:

```
x = Flatten()(resnet.output)
```

In [18]:

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

In [19]:

```
model = Model(inputs = resnet.input, outputs=prediction)
```

In [20]:

```
model.summary()
```

```
Model: "model"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
input_1 (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           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 (BatchNormali (None, 56, 56, 64)   256         conv2_block1_1_conv[0][0
]
__________________________________________________________________________________________
__________
conv2_block1_1_relu (Activation (None, 56, 56, 64)   0           conv2_block1_1_bn[0][0]

__________________________________________________________________________________________
__________
conv2_block1_2_conv (Conv2D)    (None, 56, 56, 64)   36928       conv2_block1_1_relu[0][0
]
__________________________________________________________________________________________
__________
conv2_block1_2_bn (BatchNormali (None, 56, 56, 64)   256         conv2_block1_2_conv[0][0
]
__________________________________________________________________________________________
__________
conv2_block1_2_relu (Activation (None, 56, 56, 64)   0           conv2_block1_2_bn[0][0]

__________________________________________________________________________________________
__________
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 (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 (Flatten)               (None, 100352)       0           conv5_block3_out[0][0]

__________________________________________________________________________________________
```

```
_________
dense (Dense)                (None, 3)                 301059      flatten[0][0]

==================================================================================================
=========
Total params: 23,888,771
Trainable params: 301,059
Non-trainable params: 23,587,712
__________________________________________________________________________________________________
__________
```

In [21]:

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

In [22]:

```
train_datagen = ImageDataGenerator(rescale=1./255,shear_range=0.2,zoom_range=0.2,horizont
al_flip=True)

test_datagen = ImageDataGenerator(rescale=1./255,shear_range=0.2,zoom_range=0.2,horizonta
l_flip=True)
```

In [23]:

```
train_data = train_datagen.flow_from_directory('Datasets/Train',
                                               target_size=(224,224),
                                               batch_size=32,
                                               class_mode='categorical'
                                              )
```

```
Found 64 images belonging to 3 classes.
```

In [24]:

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

```
Found 59 images belonging to 3 classes.
```

Fit the model

In [25]:

```
r = model.fit_generator(train_data,
                        validation_data=test_data,
                        epochs=50,
                        steps_per_epoch = len(train_data),
                        validation_steps=len(test_data))
```

```
WARNING:tensorflow:From <ipython-input-25-5cfec6ea79ac>:5: Model.fit_generator (from tens
orflow.python.keras.engine.training) is deprecated and will be removed in a future versio
n.
Instructions for updating:
Please use Model.fit, which supports generators.
Epoch 1/50
2/2 [==============================] - 5s 2s/step - loss: 3.6913 - accuracy: 0.4062 - val
_loss: 4.8697 - val_accuracy: 0.5085
Epoch 2/50
2/2 [==============================] - 4s 2s/step - loss: 8.7853 - accuracy: 0.3438 - val
_loss: 4.7506 - val_accuracy: 0.3220
Epoch 3/50
2/2 [==============================] - 4s 2s/step - loss: 4.3800 - accuracy: 0.3125 - val
_loss: 4.6418 - val_accuracy: 0.1695
Epoch 4/50
2/2 [==============================] - 4s 2s/step - loss: 4.2591 - accuracy: 0.2969 - val
_loss: 3.9928 - val_accuracy: 0.5085
Epoch 5/50
2/2 [==============================] - 4s 2s/step - loss: 2.7371 - accuracy: 0.4844 - val
```

```
_loss: 1.8109 - val_accuracy: 0.2203
Epoch 6/50
2/2 [==============================] - 4s 2s/step - loss: 1.8715 - accuracy: 0.4688 - val
_loss: 4.1066 - val_accuracy: 0.3220
Epoch 7/50
2/2 [==============================] - 4s 2s/step - loss: 2.3578 - accuracy: 0.4688 - val
_loss: 2.1959 - val_accuracy: 0.1695
Epoch 8/50
2/2 [==============================] - 4s 2s/step - loss: 0.9405 - accuracy: 0.6250 - val
_loss: 2.1444 - val_accuracy: 0.5254
Epoch 9/50
2/2 [==============================] - 5s 3s/step - loss: 1.7167 - accuracy: 0.5156 - val
_loss: 1.4118 - val_accuracy: 0.5932
Epoch 10/50
2/2 [==============================] - 5s 3s/step - loss: 0.8717 - accuracy: 0.6875 - val
_loss: 1.9018 - val_accuracy: 0.4237
Epoch 11/50
2/2 [==============================] - 5s 2s/step - loss: 1.2838 - accuracy: 0.5938 - val
_loss: 2.2905 - val_accuracy: 0.2542
Epoch 12/50
2/2 [==============================] - 5s 2s/step - loss: 0.9418 - accuracy: 0.6562 - val
_loss: 0.9617 - val_accuracy: 0.5932
Epoch 13/50
2/2 [==============================] - 5s 2s/step - loss: 0.9670 - accuracy: 0.6562 - val
_loss: 1.4103 - val_accuracy: 0.5932
Epoch 14/50
2/2 [==============================] - 5s 2s/step - loss: 0.8510 - accuracy: 0.7031 - val
_loss: 1.1694 - val_accuracy: 0.5254
Epoch 15/50
2/2 [==============================] - 5s 2s/step - loss: 0.7651 - accuracy: 0.7188 - val
_loss: 1.6106 - val_accuracy: 0.4746
Epoch 16/50
2/2 [==============================] - 5s 2s/step - loss: 0.6978 - accuracy: 0.7656 - val
_loss: 0.8482 - val_accuracy: 0.6610
Epoch 17/50
2/2 [==============================] - 5s 2s/step - loss: 0.5622 - accuracy: 0.7969 - val
_loss: 1.1983 - val_accuracy: 0.6271
Epoch 18/50
2/2 [==============================] - 5s 2s/step - loss: 0.7001 - accuracy: 0.7188 - val
_loss: 0.9796 - val_accuracy: 0.6271
Epoch 19/50
2/2 [==============================] - 5s 2s/step - loss: 0.6066 - accuracy: 0.7656 - val
_loss: 1.0764 - val_accuracy: 0.5254
Epoch 20/50
2/2 [==============================] - 5s 2s/step - loss: 0.4264 - accuracy: 0.8594 - val
_loss: 0.8865 - val_accuracy: 0.6271
Epoch 21/50
2/2 [==============================] - 5s 2s/step - loss: 0.4814 - accuracy: 0.7812 - val
_loss: 0.8511 - val_accuracy: 0.6441
Epoch 22/50
2/2 [==============================] - 5s 2s/step - loss: 0.4226 - accuracy: 0.7969 - val
_loss: 0.9190 - val_accuracy: 0.6441
Epoch 23/50
2/2 [==============================] - 5s 2s/step - loss: 0.4434 - accuracy: 0.7812 - val
_loss: 1.0350 - val_accuracy: 0.5424
Epoch 24/50
2/2 [==============================] - 5s 2s/step - loss: 0.3911 - accuracy: 0.8594 - val
_loss: 0.8785 - val_accuracy: 0.6271
Epoch 25/50
2/2 [==============================] - 4s 2s/step - loss: 0.4757 - accuracy: 0.7656 - val
_loss: 0.8444 - val_accuracy: 0.7458
Epoch 26/50
2/2 [==============================] - 4s 2s/step - loss: 0.3463 - accuracy: 0.8750 - val
_loss: 0.9161 - val_accuracy: 0.5593
Epoch 27/50
2/2 [==============================] - 4s 2s/step - loss: 0.4283 - accuracy: 0.7969 - val
_loss: 0.8418 - val_accuracy: 0.5932
Epoch 28/50
2/2 [==============================] - 4s 2s/step - loss: 0.3229 - accuracy: 0.8906 - val
_loss: 0.7786 - val_accuracy: 0.6949
Epoch 29/50
2/2 [==============================] - 4s 2s/step - loss: 0.3374 - accuracy: 0.8594 - val
_loss: 0.8218 - val_accuracy: 0.6102
```

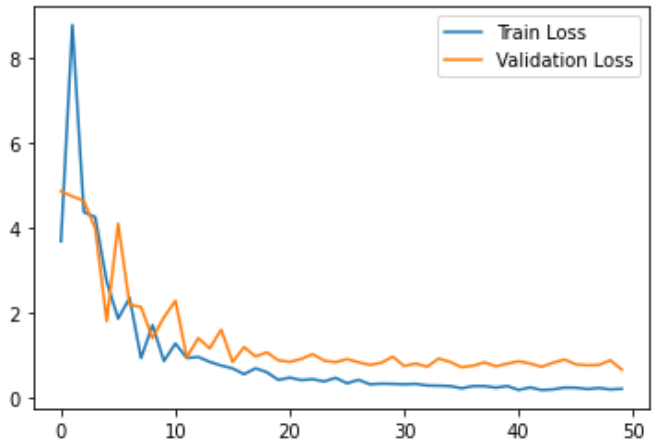
```
_loss: 0.8318 - val_accuracy: 0.6102
Epoch 30/50
2/2 [==============================] - 4s 2s/step - loss: 0.3324 - accuracy: 0.8906 - val
_loss: 0.9738 - val_accuracy: 0.5932
Epoch 31/50
2/2 [==============================] - 4s 2s/step - loss: 0.3225 - accuracy: 0.8906 - val
_loss: 0.7541 - val_accuracy: 0.6949
Epoch 32/50
2/2 [==============================] - 4s 2s/step - loss: 0.3330 - accuracy: 0.8906 - val
_loss: 0.8126 - val_accuracy: 0.7797
Epoch 33/50
2/2 [==============================] - 4s 2s/step - loss: 0.2955 - accuracy: 0.8906 - val
_loss: 0.7369 - val_accuracy: 0.6610
Epoch 34/50
2/2 [==============================] - 4s 2s/step - loss: 0.2895 - accuracy: 0.9062 - val
_loss: 0.9289 - val_accuracy: 0.6102
Epoch 35/50
2/2 [==============================] - 5s 3s/step - loss: 0.2819 - accuracy: 0.9219 - val
_loss: 0.8507 - val_accuracy: 0.6949
Epoch 36/50
2/2 [==============================] - 5s 2s/step - loss: 0.2297 - accuracy: 0.9375 - val
_loss: 0.7270 - val_accuracy: 0.7119
Epoch 37/50
2/2 [==============================] - 5s 3s/step - loss: 0.2810 - accuracy: 0.9219 - val
_loss: 0.7602 - val_accuracy: 0.6610
Epoch 38/50
2/2 [==============================] - 5s 2s/step - loss: 0.2811 - accuracy: 0.9219 - val
_loss: 0.8388 - val_accuracy: 0.6102
Epoch 39/50
2/2 [==============================] - 5s 2s/step - loss: 0.2459 - accuracy: 0.9219 - val
_loss: 0.7475 - val_accuracy: 0.7119
Epoch 40/50
2/2 [==============================] - 5s 2s/step - loss: 0.2829 - accuracy: 0.9062 - val
_loss: 0.8104 - val_accuracy: 0.7797
Epoch 41/50
2/2 [==============================] - 5s 2s/step - loss: 0.1907 - accuracy: 0.9688 - val
_loss: 0.8660 - val_accuracy: 0.6102
Epoch 42/50
2/2 [==============================] - 6s 3s/step - loss: 0.2507 - accuracy: 0.9531 - val
_loss: 0.8113 - val_accuracy: 0.7288
Epoch 43/50
2/2 [==============================] - 5s 2s/step - loss: 0.1881 - accuracy: 0.9531 - val
_loss: 0.7363 - val_accuracy: 0.7458
Epoch 44/50
2/2 [==============================] - 5s 3s/step - loss: 0.2045 - accuracy: 0.9375 - val
_loss: 0.8308 - val_accuracy: 0.7458
Epoch 45/50
2/2 [==============================] - 5s 3s/step - loss: 0.2459 - accuracy: 0.9062 - val
_loss: 0.9075 - val_accuracy: 0.6102
Epoch 46/50
2/2 [==============================] - 5s 3s/step - loss: 0.2426 - accuracy: 0.8906 - val
_loss: 0.7929 - val_accuracy: 0.6780
Epoch 47/50
2/2 [==============================] - 5s 3s/step - loss: 0.2111 - accuracy: 0.9375 - val
_loss: 0.7736 - val_accuracy: 0.7119
Epoch 48/50
2/2 [==============================] - 5s 3s/step - loss: 0.2361 - accuracy: 0.9062 - val
_loss: 0.7803 - val_accuracy: 0.7627
Epoch 49/50
2/2 [==============================] - 5s 3s/step - loss: 0.2031 - accuracy: 0.9531 - val
_loss: 0.8892 - val_accuracy: 0.6780
Epoch 50/50
2/2 [==============================] - 5s 3s/step - loss: 0.2173 - accuracy: 0.9531 - val
_loss: 0.6702 - val_accuracy: 0.7797
```

Plot Loss

In [26]:

```
# Plot loss
```

```
plt.plot(r.history['loss'], label='Train Loss')
plt.plot(r.history['val_loss'], label = 'Validation Loss')
plt.legend()
plt.show()
plt.savefig('LossVal_loss')
```

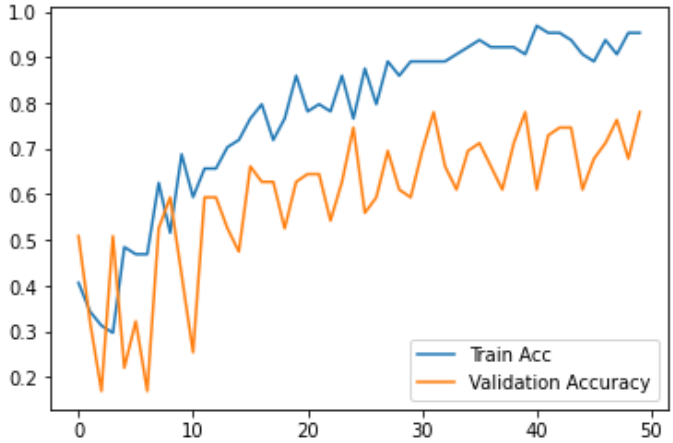



```
<Figure size 432x288 with 0 Axes>
```

Plot Accuracy

In [27]:

```
plt.plot(r.history['accuracy'], label='Train Acc')
plt.plot(r.history['val_accuracy'],label='Validation Accuracy')
plt.legend()
plt.show()
```



Saving the model

In [28]:

```
from keras.models import load_model
```

Save the model

In [29]:

```
model.save('resnet50_car.h5')
```

Make Predictions using saved model

In [30]:

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

In [31]:

```
y_pred
```

Out[31]:

```
array([[2.38734260e-02, 8.98539543e-01, 7.75870681e-02],
       [1.62084866e-03, 9.93303239e-01, 5.07589011e-03],
       [1.89177727e-03, 3.73944677e-02, 9.60713804e-01],
       [2.57445853e-02, 2.60095417e-01, 7.14159966e-01],
       [1.85642224e-02, 7.81721950e-01, 1.99713945e-01],
       [1.10856607e-03, 9.95410621e-01, 3.48084932e-03],
       [1.85142420e-02, 6.56165838e-01, 3.25319946e-01],
       [3.59551400e-01, 3.97454090e-02, 6.00703120e-01],
       [4.11018550e-01, 1.28598344e-02, 5.76121569e-01],
       [8.04796442e-02, 6.57400608e-01, 2.62119740e-01],
       [6.53265864e-02, 6.72876418e-01, 2.61796921e-01],
       [5.01069427e-01, 4.30547059e-01, 6.83834925e-02],
       [5.61556756e-01, 2.93807209e-01, 1.44636005e-01],
       [8.85245085e-01, 7.27891773e-02, 4.19657677e-02],
       [1.15725794e-03, 8.41580033e-01, 1.57262713e-01],
       [5.68083003e-02, 8.00118744e-01, 1.43072948e-01],
       [6.05463564e-01, 1.94975123e-01, 1.99561313e-01],
       [6.54331744e-02, 2.44752094e-01, 6.89814746e-01],
       [5.31241931e-02, 7.77968347e-01, 1.68907404e-01],
       [6.16992339e-02, 3.53175730e-01, 5.85125089e-01],
       [1.31620290e-02, 8.91838133e-01, 9.49997902e-02],
       [1.96857855e-01, 7.07643479e-02, 7.32377827e-01],
       [5.85894361e-02, 8.61803830e-01, 7.96066970e-02],
       [5.84531436e-03, 9.37485933e-01, 5.66687547e-02],
       [1.39170736e-01, 7.91760802e-01, 6.90684840e-02],
       [1.64777130e-01, 6.00170076e-01, 2.35052824e-01],
       [2.29923129e-02, 9.18763757e-01, 5.82439117e-02],
       [4.02432233e-02, 9.48109806e-01, 1.16469497e-02],
       [4.92310226e-02, 4.03614968e-01, 5.47153950e-01],
       [1.68878630e-01, 2.41513893e-01, 5.89607418e-01],
       [4.78464663e-02, 9.35216427e-01, 1.69371739e-02],
       [4.21578763e-03, 9.52644467e-01, 4.31396775e-02],
       [8.04731064e-03, 9.73370016e-01, 1.85825657e-02],
       [8.10409151e-03, 9.84988093e-01, 6.90786121e-03],
       [2.04923972e-02, 3.34529370e-01, 6.44978166e-01],
       [3.75688672e-01, 2.29127519e-03, 6.22020006e-01],
       [4.14291620e-01, 5.61232984e-01, 2.44753901e-02],
       [4.73443344e-02, 5.57657540e-01, 3.94998163e-01],
       [1.67411759e-01, 5.57973504e-01, 2.74614722e-01],
       [3.05082686e-02, 6.13277912e-01, 3.56213748e-01],
       [2.38242699e-03, 9.66688335e-01, 3.09292022e-02],
       [2.44183224e-02, 8.94602597e-01, 8.09791535e-02],
       [6.15035258e-02, 8.22698534e-01, 1.15797952e-01],
       [1.86687391e-02, 8.82069886e-01, 9.92614031e-02],
       [2.62986235e-02, 3.42384130e-02, 9.39463019e-01],
       [1.44644618e-01, 8.56043920e-02, 7.69751012e-01],
       [5.03230989e-01, 4.62195158e-01, 3.45738307e-02],
       [4.35880013e-02, 6.34016216e-01, 3.22395712e-01],
       [1.82216913e-02, 7.55994499e-01, 2.25783840e-01],
       [3.61292452e-01, 5.49879000e-02, 5.83719611e-01],
       [8.64354819e-02, 6.07486367e-01, 3.06078196e-01],
       [7.22237229e-02, 5.22025287e-01, 4.05750960e-01],
       [3.06943003e-02, 4.30077851e-01, 5.39227843e-01],
       [3.80844660e-02, 7.41494775e-01, 2.20420733e-01],
       [9.40021932e-01, 4.78423685e-02, 1.21357432e-02],
       [1.19026616e-01, 7.52036095e-01, 1.28937215e-01],
       [4.75782552e-04, 9.98810768e-01, 7.13441055e-04],
       [6.53789891e-03, 9.50274944e-01, 4.31870855e-02],
       [2.11396649e-01, 3.91871966e-02, 7.49416173e-01]], dtype=float32)
```

In [32]:

```
y_pred = np.argmax(y_pred,axis=1)
```

In [33]:

```
y_pred
```

Out[33]:

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

Load the saved model

In [34]:

```
model = load_model('resnet50_car.h5')
```

Load a new image

In [35]:

```
img = image.load_img('Datasets/Test/audi/22.jpg',target_size=(224,224))
```

In [36]:

```
img
```

Out[36]:

In [37]:

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

In [38]:

```
x
```

Out[38]:

```
array([[[160., 170., 197.],
        [160., 170., 197.],
        [159., 169., 196.],
        ...,
        [158., 164., 190.],
        [158., 162., 187.],
        [156., 160., 185.]],

       [[159., 169., 196.],
        [159., 169., 196.],
        [158., 168., 195.],
        ...,
        [157., 163., 189.],
        [158., 162., 187.],
        [156., 160., 185.]],

       [[159., 169., 196.],
        [159., 169., 196.],
        [158., 168., 195.],
        ...,
```

```
        [157., 163., 189.],
        [158., 162., 187.],
        [156., 160., 185.]],

       ...,

       [[ 53.,  53.,  61.],
        [ 54.,  54.,  62.],
        [ 58.,  58.,  66.],
        ...,
        [ 41.,  41.,  49.],
        [ 44.,  44.,  52.],
        [ 46.,  46.,  54.]],

       [[ 53.,  53.,  61.],
        [ 54.,  54.,  62.],
        [ 58.,  58.,  66.],
        ...,
        [ 41.,  41.,  49.],
        [ 44.,  44.,  52.],
        [ 46.,  46.,  54.]],

       [[ 54.,  54.,  62.],
        [ 56.,  56.,  64.],
        [ 59.,  59.,  67.],
        ...,
        [ 36.,  36.,  44.],
        [ 41.,  41.,  49.],
        [ 44.,  44.,  52.]]], dtype=float32)
```

In [39]:

```
x = x/255
x
```

Out[39]:

```
array([[[0.627451  , 0.6666667 , 0.77254903],
        [0.627451  , 0.6666667 , 0.77254903],
        [0.62352943, 0.6627451 , 0.76862746],
        ...,
        [0.61960787, 0.6431373 , 0.74509805],
        [0.61960787, 0.63529414, 0.73333335],
        [0.6117647 , 0.627451  , 0.7254902 ]],

       [[0.62352943, 0.6627451 , 0.76862746],
        [0.62352943, 0.6627451 , 0.76862746],
        [0.61960787, 0.65882355, 0.7647059 ],
        ...,
        [0.6156863 , 0.6392157 , 0.7411765 ],
        [0.61960787, 0.63529414, 0.73333335],
        [0.6117647 , 0.627451  , 0.7254902 ]],

       [[0.62352943, 0.6627451 , 0.76862746],
        [0.62352943, 0.6627451 , 0.76862746],
        [0.61960787, 0.65882355, 0.7647059 ],
        ...,
        [0.6156863 , 0.6392157 , 0.7411765 ],
        [0.61960787, 0.63529414, 0.73333335],
        [0.6117647 , 0.627451  , 0.7254902 ]],

       ...,

       [[0.20784314, 0.20784314, 0.23921569],
        [0.21176471, 0.21176471, 0.24313726],
        [0.22745098, 0.22745098, 0.25882354],
        ...,
        [0.16078432, 0.16078432, 0.19215687],
        [0.17254902, 0.17254902, 0.20392157],
        [0.18039216, 0.18039216, 0.21176471]],

       [[0.20784314, 0.20784314, 0.23921569],
```

```
        [0.21176471, 0.21176471, 0.24313726],
        [0.22745098, 0.22745098, 0.25882354],
        ...,
        [0.16078432, 0.16078432, 0.19215687],
        [0.17254902, 0.17254902, 0.20392157],
        [0.18039216, 0.18039216, 0.21176471]],

       [[0.21176471, 0.21176471, 0.24313726],
        [0.21960784, 0.21960784, 0.2509804 ],
        [0.23137255, 0.23137255, 0.2627451 ],
        ...,
        [0.14117648, 0.14117648, 0.17254902],
        [0.16078432, 0.16078432, 0.19215687],
        [0.17254902, 0.17254902, 0.20392157]]], dtype=float32)
```

In [40]:

```
x.shape
```

Out[40]:

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

In [41]:

```
x = np.expand_dims(x,axis=0)
```

In [42]:

```
x.shape
```

Out[42]:

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

In [43]:

```
from keras.applications.resnet50 import preprocess_input
```

In [44]:

```
img_data = preprocess_input(x)
```

In [45]:

```
img_data
```

Out[45]:

```
array([[[[-103.16645 , -116.112335, -123.05255 ],
         [-103.16645 , -116.112335, -123.05255 ],
         [-103.17037 , -116.11626 , -123.05647 ],
         ...,
         [-103.19391 , -116.135864, -123.060394],
         [-103.20567 , -116.14371 , -123.060394],
         [-103.21352 , -116.15155 , -123.06824 ]],

        [[-103.17037 , -116.11626 , -123.05647 ],
         [-103.17037 , -116.11626 , -123.05647 ],
         [-103.17429 , -116.12018 , -123.060394],
         ...,
         [-103.19783 , -116.139786, -123.064316],
         [-103.20567 , -116.14371 , -123.060394],
         [-103.21352 , -116.15155 , -123.06824 ]],

        [[-103.17037 , -116.11626 , -123.05647 ],
         [-103.17037 , -116.11626 , -123.05647 ],
         [-103.17429 , -116.12018 , -123.060394],
         ...,
         [-103.19783 , -116.139786, -123.064316],
         [-103.20567 , -116.14371 , -123.060394],
         [-103.21352 , -116.15155 , -123.06824 ]],
```

```
        ...,

        [[-103.69979 , -116.57116 , -123.47216 ],
         [-103.69587 , -116.56724 , -123.46824 ],
         [-103.680176, -116.55155 , -123.45255 ],
         ...,
         [-103.74685 , -116.61822 , -123.51922 ],
         [-103.735085, -116.60645 , -123.507454],
         [-103.72724 , -116.59861 , -123.49961 ]],

        [[-103.69979 , -116.57116 , -123.47216 ],
         [-103.69587 , -116.56724 , -123.46824 ],
         [-103.680176, -116.55155 , -123.45255 ],
         ...,
         [-103.74685 , -116.61822 , -123.51922 ],
         [-103.735085, -116.60645 , -123.507454],
         [-103.72724 , -116.59861 , -123.49961 ]],

        [[-103.69587 , -116.56724 , -123.46824 ],
         [-103.68802 , -116.559395, -123.460396],
         [-103.676254, -116.54763 , -123.44863 ],
         ...,
         [-103.76646 , -116.637825, -123.538826],
         [-103.74685 , -116.61822 , -123.51922 ],
         [-103.735085, -116.60645 , -123.507454]]]], dtype=float32)
```

In [46]:

```
img_data.shape
```

Out[46]:

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

In [47]:

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

Out[47]:

```
array([[0.00459535, 0.0135097 , 0.9818949 ]], dtype=float32)
```

In [48]:

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

Prediction of Model on a new image

In [49]:

```
print('Predicted car-brand class as per model: ',a)
```

```
Predicted car-brand class as per model:  [2]
```

In [ ]:

In [ ]:

In [ ]: