CS867 Computer Vision

Assignment 2			
Maximum Marks:		Instructor: Dr. Muhammad Moazam Fraz	
Submission Date: 18/11/2021		Type: Code Report	
Name: Muhammad Ali	Reg. #: 329159	Degree: MS DS F20	Section: Fall 2020

Chest Xray Dataset

ResNet50

<u>Parameter</u>

Epochs = 10   Batch size = 12 Validation split = 0.1(training dataset)   Actual Training data=0.9(training dataset

Learning Rate = 0.0001

<u>Training Accuracy Validation Accuracy</u>

```
Epoch 1/10
393/393 [==============================] - 167s 327ms/step - loss: 0.5492 -
accuracy: 0.8369 - val_loss: 5.2917 - val_accuracy: 0.8053
Epoch 2/10
393/393 [==============================] - 125s 319ms/step - loss: 0.3372 -
accuracy: 0.8925 - val_loss: 0.5670 - val_accuracy: 0.6966
Epoch 3/10
393/393 [==============================] - 125s 318ms/step - loss: 0.2465 -
accuracy: 0.9212 - val_loss: 2.7405 - val_accuracy: 0.3187
Epoch 4/10
393/393 [==============================] - 125s 318ms/step - loss: 0.1965 -
accuracy: 0.9350 - val_loss: 0.2560 - val_accuracy: 0.9008
Epoch 5/10
393/393 [==============================] - 125s 318ms/step - loss: 0.1516 -
accuracy: 0.9473 - val_loss: 0.0882 - val_accuracy: 0.9676
Epoch 6/10
393/393 [==============================] - 126s 320ms/step - loss: 0.1499 -
accuracy: 0.9501 - val_loss: 0.0984 - val_accuracy: 0.9599
Epoch 7/10
393/393 [==============================] - 125s 319ms/step - loss: 0.0990 -
accuracy: 0.9641 - val_loss: 0.1058 - val_accuracy: 0.9504
Epoch 8/10
393/393 [==============================] - 125s 319ms/step - loss: 0.1010 -
accuracy: 0.9645 - val_loss: 1.4767 - val_accuracy: 0.5954
Epoch 9/10
393/393 [==============================] - 125s 319ms/step - loss: 0.0832 -
accuracy: 0.9667 - val_loss: 0.0954 - val_accuracy: 0.9771
Epoch 10/10
```

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393/393 [==============================] - 125s 319ms/step - loss: 0.0763 -
accuracy: 0.9747 - val_loss: 0.0541 - val_accuracy: 0.9790
```

Testing Accuracy

```
20/20 [==============================] - 6s 245ms/step - loss: 0.8156 - accuracy:
0.8013
Loss = 0.8156483769416809
Test Accuracy = 0.8012820482254028
```
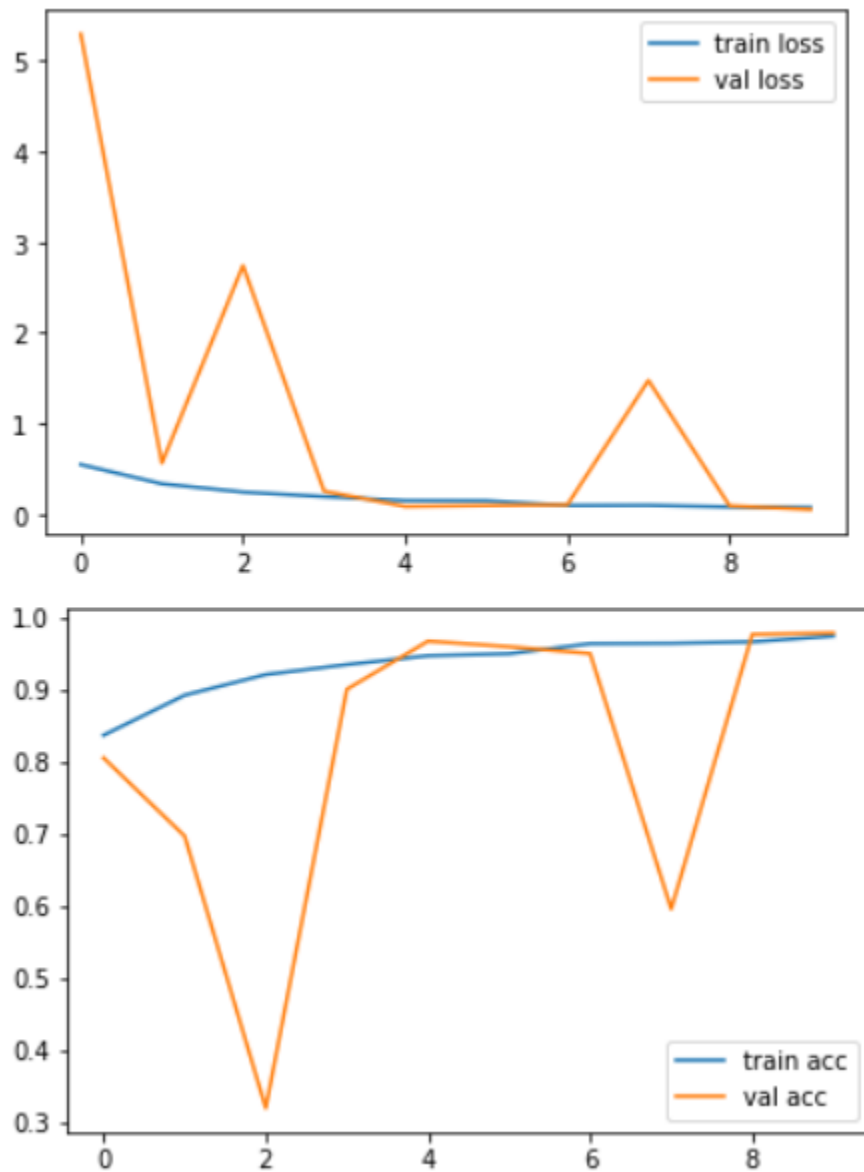
Training loss vs Validation accuracy & Training accuracy vs Validation accuracy

Model Architecture

```
Model: "model"

_____
 Layer (type)                Output Shape          Param #      Connected to
===============================================================================
 input_1 (InputLayer)        [(None, 224, 224, 3   0            []
                             )]

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

Layer (type)	Output Shape	Param #	Connected to
conv1_conv (Conv2D)	(None, 112, 112, 64)	9472	['conv1_pad[0][0]']
conv1_bn (BatchNormalization)	(None, 112, 112, 64)	256	['conv1_conv[0][0]']
conv1_relu (Activation)	(None, 112, 112, 64)	0	['conv1_bn[0][0]']
pool1_pad (ZeroPadding2D)	(None, 114, 114, 64)	0	['conv1_relu[0][0]']
pool1_pool (MaxPooling2D)	(None, 56, 56, 64)	0	['pool1_pad[0][0]']
conv2_block1_1_conv (Conv2D)	(None, 56, 56, 64)	4160	['pool1_pool[0][0]']
conv2_block1_1_bn (BatchNormalization)	(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 (BatchNormalization)	(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 (BatchNormalization)	(None, 56, 56, 256)	1024	['conv2_block1_0_conv[0][0]']
conv2_block1_3_bn (BatchNormalization)	(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 (BatchNormalization)	(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 (BatchNormalization)	(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 (BatchNormalization)	(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 (BatchNormal	(None, 56, 56, 64)	256	['conv2_block3_1_conv[0][0]']

ization)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

conv3_block2_3_bn (BatchNormal   (None, 28, 28, 512)   2048     ['conv3_block2_3_conv[0][0]']
ization)
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conv3_block2_add (Add)          (None, 28, 28, 512)  0          ['conv3_block1_out[0][0]',
                                                                 'conv3_block2_3_bn[0][0]']

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

conv4_block1_0_conv (Conv2D)    (None, 14, 14, 1024  525312     ['conv3_block4_out[0][0]']
                                )
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conv4_block1_3_conv (Conv2D)     (None, 14, 14, 1024   263168     ['conv4_block1_2_relu[0][0]']
                                 )

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

ization)

conv4_block4_1_relu (Activatio n)	(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 (BatchNormal ization)	(None, 14, 14, 256)	1024	['conv4_block4_2_conv[0][0]']
conv4_block4_2_relu (Activatio n)	(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 (BatchNormal ization)	(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 (BatchNormal ization)	(None, 14, 14, 256)	1024	['conv4_block5_1_conv[0][0]']
conv4_block5_1_relu (Activatio n)	(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 (BatchNormal ization)	(None, 14, 14, 256)	1024	['conv4_block5_2_conv[0][0]']
conv4_block5_2_relu (Activatio n)	(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 (BatchNormal ization)	(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 (BatchNormal ization)	(None, 14, 14, 256)	1024	['conv4_block6_1_conv[0][0]']
conv4_block6_1_relu (Activatio n)	(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 (BatchNormal ization)	(None, 14, 14, 256)	1024	['conv4_block6_2_conv[0][0]']
conv4_block6_2_relu (Activatio n)	(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 (BatchNormal ization)	(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 (BatchNormal ization)	(None, 7, 7, 512)	2048	['conv5_block1_1_conv[0][0]']
conv5_block1_1_relu (Activatio n)	(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 (BatchNormal ization)	(None, 7, 7, 512)	2048	['conv5_block1_2_conv[0][0]']
conv5_block1_2_relu (Activatio n)	(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 (BatchNormal ization)	(None, 7, 7, 2048)	8192	['conv5_block1_0_conv[0][0]']
conv5_block1_3_bn (BatchNormal ization)	(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 (BatchNormal ization)	(None, 7, 7, 512)	2048	['conv5_block2_1_conv[0][0]']
conv5_block2_1_relu (Activatio n)	(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 (BatchNormal ization)	(None, 7, 7, 512)	2048	['conv5_block2_2_conv[0][0]']
conv5_block2_2_relu (Activatio n)	(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 (BatchNormal ization)	(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 (BatchNormal ization)	(None, 7, 7, 512)	2048	['conv5_block3_1_conv[0][0]']
conv5_block3_1_relu (Activatio n)	(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 (BatchNormal ization)	(None, 7, 7, 512)	2048	['conv5_block3_2_conv[0][0]']

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

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

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

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

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

global_average_pooling2d (Glob  (None, 2048)        0          ['conv5_block3_out[0][0]']
alAveragePooling2D)

dropout (Dropout)               (None, 2048)        0          ['global_average_pooling2d[0][0]'
                                                                ]

dense (Dense)                   (None, 2)           4098       ['dropout[0][0]']

==================================================================================================
Total params: 23,591,810
Trainable params: 23,538,690
Non-trainable params: 53,120
_____
```

VGG16

<u>Parameter</u>

Epochs = 10   Batch size = 12 Validation split = 0.1(training dataset)   Actual Training data=0.9(training dataset

Learning Rate = 5e-5

<u>Training Accuracy Validation Accuracy</u>

```
Epoch 1/10
393/393 [==============================] - ETA: 0s - loss: 0.1219 - accuracy:
0.9556
Epoch 00001: val_accuracy improved from -inf to 0.97328, saving model to
vgg16_finetune.h15
INFO:tensorflow:Assets written to: vgg16_finetune.h15/assets
393/393 [==============================] - 111s 195ms/step - loss: 0.1219 -
accuracy: 0.9556 - val_loss: 0.0632 - val_accuracy: 0.9733 - lr: 5.0000e-05
Epoch 2/10
393/393 [==============================] - ETA: 0s - loss: 0.0490 - accuracy:
0.9834
Epoch 00002: val_accuracy did not improve from 0.97328
393/393 [==============================] - 62s 159ms/step - loss: 0.0490 -
accuracy: 0.9834 - val_loss: 0.0765 - val_accuracy: 0.9695 - lr: 5.0000e-05
Epoch 3/10
393/393 [==============================] - ETA: 0s - loss: 0.0393 - accuracy:
0.9860
Epoch 00003: val_accuracy improved from 0.97328 to 0.97901, saving model to
vgg16_finetune.h15
INFO:tensorflow:Assets written to: vgg16_finetune.h15/assets
393/393 [==============================] - 70s 179ms/step - loss: 0.0393 -
accuracy: 0.9860 - val_loss: 0.0721 - val_accuracy: 0.9790 - lr: 5.0000e-05
Epoch 4/10
393/393 [==============================] - ETA: 0s - loss: 0.0180 - accuracy:
0.9930
Epoch 00004: val_accuracy did not improve from 0.97901
```

```
393/393 [==============================] - 62s 159ms/step - loss: 0.0180 -
accuracy: 0.9930 - val_loss: 0.0547 - val_accuracy: 0.9771 - lr: 5.0000e-05
Epoch 5/10
393/393 [==============================] - ETA: 0s - loss: 0.0126 - accuracy:
0.9953
Epoch 00005: val_accuracy did not improve from 0.97901
393/393 [==============================] - 62s 159ms/step - loss: 0.0126 -
accuracy: 0.9953 - val_loss: 0.0720 - val_accuracy: 0.9790 - lr: 5.0000e-05
Epoch 6/10
393/393 [==============================] - ETA: 0s - loss: 0.0136 - accuracy:
0.9953
Epoch 00006: val_accuracy did not improve from 0.97901
393/393 [==============================] - 62s 159ms/step - loss: 0.0136 -
accuracy: 0.9953 - val_loss: 0.1604 - val_accuracy: 0.9637 - lr: 5.0000e-05
Epoch 7/10
393/393 [==============================] - ETA: 0s - loss: 0.0086 - accuracy:
0.9970
Epoch 00007: val_accuracy improved from 0.97901 to 0.98092, saving model to
vgg16_finetune.h15
INFO:tensorflow:Assets written to: vgg16_finetune.h15/assets
393/393 [==============================] - 71s 180ms/step - loss: 0.0086 -
accuracy: 0.9970 - val_loss: 0.0701 - val_accuracy: 0.9809 - lr: 5.0000e-05
Epoch 8/10
393/393 [==============================] - ETA: 0s - loss: 0.0157 - accuracy:
0.9953
Epoch 00008: val_accuracy did not improve from 0.98092
393/393 [==============================] - 62s 158ms/step - loss: 0.0157 -
accuracy: 0.9953 - val_loss: 0.0443 - val_accuracy: 0.9809 - lr: 5.0000e-05
Epoch 9/10
393/393 [==============================] - ETA: 0s - loss: 0.0169 - accuracy:
0.9955
Epoch 00009: val_accuracy did not improve from 0.98092
393/393 [==============================] - 62s 159ms/step - loss: 0.0169 -
accuracy: 0.9955 - val_loss: 0.0553 - val_accuracy: 0.9809 - lr: 5.0000e-05
Epoch 10/10
393/393 [==============================] - ETA: 0s - loss: 0.0159 - accuracy:
0.9958
Epoch 00010: val_accuracy did not improve from 0.98092
393/393 [==============================] - 62s 159ms/step - loss: 0.0159 -
accuracy: 0.9958 - val_loss: 0.0537 - val_accuracy: 0.9752 - lr: 5.0000e-05
```

```
20/20 [==============================] - 19s 487ms/step - loss: 0.7982 - accuracy:
0.8510
Loss = 0.7981559634208679
Test Accuracy = 0.8509615659713745
```
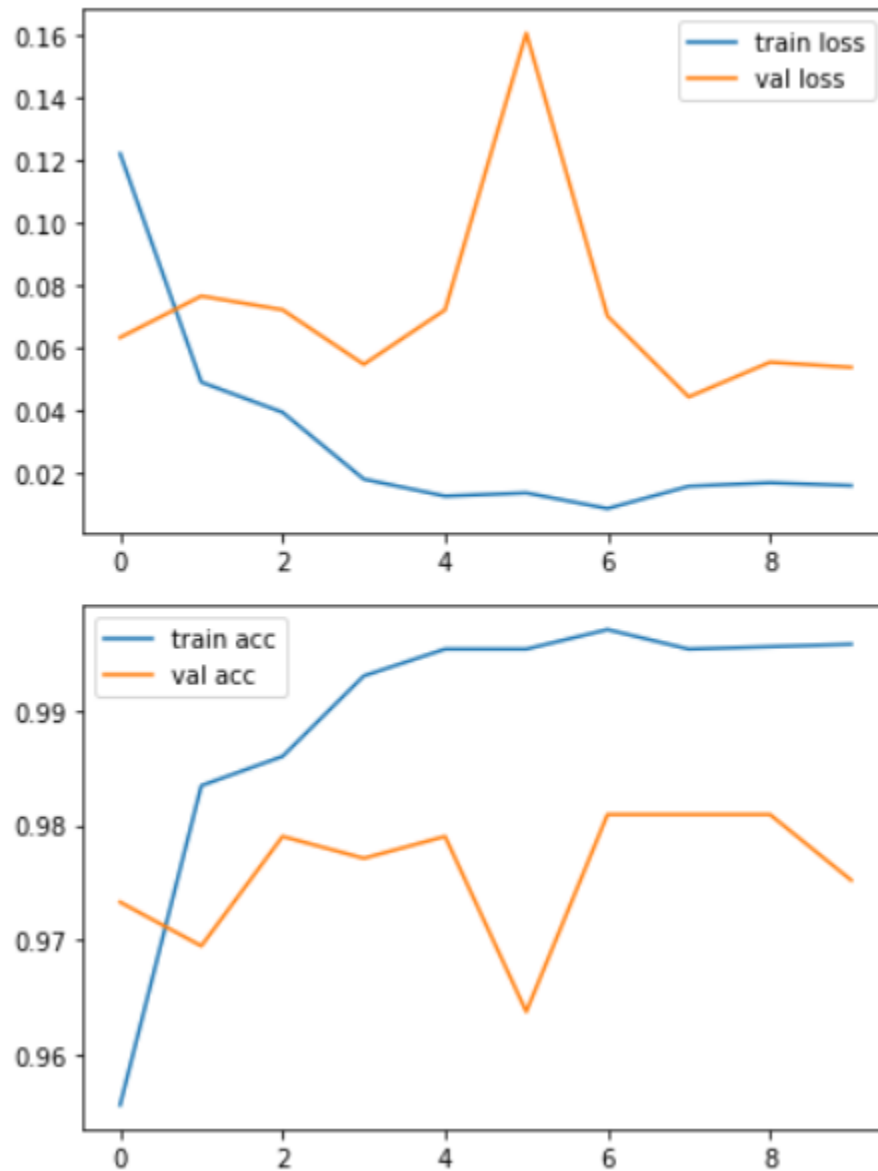
Training loss vs Validation accuracy & Training accuracy vs Validation accuracy

Model Architecture
```
Model: "model"
```

Layer (type)	Output Shape	Param #
input_1 (InputLayer)	[(None, 224, 224, 3)]	0
block1_conv1 (Conv2D)	(None, 224, 224, 64)	1792
block1_conv2 (Conv2D)	(None, 224, 224, 64)	36928

```
block1_pool (MaxPooling2D)   (None, 112, 112, 64)     0

block2_conv1 (Conv2D)        (None, 112, 112, 128)    73856

block2_conv2 (Conv2D)        (None, 112, 112, 128)    147584

block2_pool (MaxPooling2D)   (None, 56, 56, 128)      0

block3_conv1 (Conv2D)        (None, 56, 56, 256)      295168

block3_conv2 (Conv2D)        (None, 56, 56, 256)      590080

block3_conv3 (Conv2D)        (None, 56, 56, 256)      590080

block3_pool (MaxPooling2D)   (None, 28, 28, 256)      0

block4_conv1 (Conv2D)        (None, 28, 28, 512)      1180160

block4_conv2 (Conv2D)        (None, 28, 28, 512)      2359808

block4_conv3 (Conv2D)        (None, 28, 28, 512)      2359808

block4_pool (MaxPooling2D)   (None, 14, 14, 512)      0

block5_conv1 (Conv2D)        (None, 14, 14, 512)      2359808

block5_conv2 (Conv2D)        (None, 14, 14, 512)      2359808

block5_conv3 (Conv2D)        (None, 14, 14, 512)      2359808

block5_pool (MaxPooling2D)   (None, 7, 7, 512)        0

flatten (Flatten)            (None, 25088)            0

dense (Dense)                (None, 512)              12845568

dropout (Dropout)            (None, 512)              0

dense_1 (Dense)              (None, 256)              131328

dense_2 (Dense)              (None, 2)                514

=================================================================
Total params: 27,692,098
Trainable params: 20,056,834
Non-trainable params: 7,635,264
```

315_Birds_Species

ResNet50 and VGG16 are being trained on this dataset. Due to lack of parallel computing power models are not trained yet. I will push updated report pdf file after training on github. And comparison between models.

Trained Model H5 Files

Click https://drive.google.com/drive/folders/1r0l1Y6gRV5e-5qHYWaCF7_uqkdbHRlsB?usp=sharing