Model Development Phase Template

Date	15 March 2024
Team ID	SWTID1720418653
Project Title	Crystal Clear Vision: Revolutionizing Cataract Prediction through Transfer Learning Mastery
Maximum Marks	10 Marks

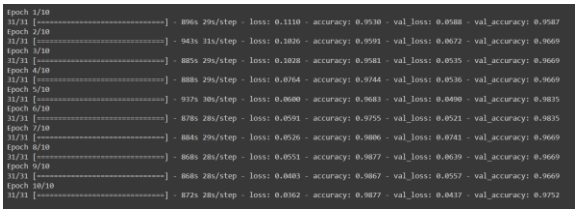
Initial Model Training Code, Model Validation and Evaluation Report

The initial model training code will be showcased in the future through a screenshot. The model validation and evaluation report will include a summary and training and validation performance metrics for multiple models, presented through respective screenshots.

Initial Model Training Code (5 marks):

Paste the screenshot of the model training code

Model Validation and Evaluation Report (5 marks):

Model	Summary	Training and Validation Performance Metrics
VGG16		

```
Model: "model_1"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 input_2 (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

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

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

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

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

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

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

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

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

 flatten_1 (Flatten)         (None, 25088)

 dense_2 (Dense)             (None, 1024)

 dropout (Dropout)           (None, 1024)

 dense_3 (Dense)             (None, 1)

=================================================================
Total params: 40406849 (154.14 MB)
Trainable params: 25692161 (98.01 MB)
Non-trainable params: 14714688 (56.13 MB)
_________________________________________________________________
```

VGG19

```
Model: "model"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 input_2 (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_conv4 (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_conv2 (Conv2D)       (None, 28, 28, 512)       2359808

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

 block4_conv4 (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_conv4 (Conv2D)       (None, 14, 14, 512)       2359808

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

 flatten_1 (Flatten)         (None, 25088)             0

 dense_2 (Dense)             (None, 1024)              25691136

 dropout_1 (Dropout)         (None, 1024)              0

 dense_3 (Dense)             (None, 1)                 1025

=================================================================
Total params: 45716545 (174.39 MB)
Trainable params: 25692161 (98.01 MB)
Non-trainable params: 20024384 (76.39 MB)
_________________________________________________________________
```

```
Epoch 1/10
31/31 [==============================] - 1121s 36s/step - loss: 0.1984 - accuracy: 0.9182 - val_loss: 0.1509 - val_accuracy: 0.9421
Epoch 2/10
31/31 [==============================] - 1156s 37s/step - loss: 0.1738 - accuracy: 0.9284 - val_loss: 0.1289 - val_accuracy: 0.9421
Epoch 3/10
31/31 [==============================] - 1123s 36s/step - loss: 0.1390 - accuracy: 0.9458 - val_loss: 0.1244 - val_accuracy: 0.9504
Epoch 4/10
31/31 [==============================] - 1108s 36s/step - loss: 0.1356 - accuracy: 0.9581 - val_loss: 0.1005 - val_accuracy: 0.9587
Epoch 5/10
31/31 [==============================] - 1138s 37s/step - loss: 0.0979 - accuracy: 0.9663 - val_loss: 0.0857 - val_accuracy: 0.9752
Epoch 6/10
31/31 [==============================] - 1093s 35s/step - loss: 0.0912 - accuracy: 0.9652 - val_loss: 0.0782 - val_accuracy: 0.9669
Epoch 7/10
31/31 [==============================] - 1117s 36s/step - loss: 0.0764 - accuracy: 0.9744 - val_loss: 0.0784 - val_accuracy: 0.9752
Epoch 8/10
31/31 [==============================] - 1080s 35s/step - loss: 0.0872 - accuracy: 0.9734 - val_loss: 0.1566 - val_accuracy: 0.9504
Epoch 9/10
31/31 [==============================] - 1086s 35s/step - loss: 0.0780 - accuracy: 0.9744 - val_loss: 0.0959 - val_accuracy: 0.9752
Epoch 10/10
31/31 [==============================] - 1087s 35s/step - loss: 0.0563 - accuracy: 0.9796 - val_loss: 0.0820 - val_accuracy: 0.9835
```

ResNet

```
Model: "model_1"
__________________________________________________________________________________________________
 Layer (type)                Output Shape              Param #   Connected to
==================================================================================================
 input_3 (InputLayer)        [(None, None, None, 3)]   0         []

 conv1_pad (ZeroPadding2D)   (None, None, None, 3)     0         ['input_3[0][0]']

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

 conv1_bn (BatchNormalizati  (None, None, None, 64)    256       ['conv1_conv[0][0]']
 on)

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

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

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

 conv2_block1_1_conv (Conv2  (None, None, None, 64)    4160      ['pool1_pool[0][0]']
 D)

 conv2_block1_1_bn (BatchNo  (None, None, None, 64)    256       ['conv2_block1_1_conv[0][0]']
 rmalization)
conv2_block1_1_relu (Activ  (None, None, None, 64)    0         ['conv2_block1_1_bn[0][0]']
ation)

conv2_block1_2_conv (Conv2  (None, None, None, 64)    36928     ['conv2_block1_1_relu[0][0]']
D)

conv2_block1_2_bn (BatchNo  (None, None, None, 64)    256       ['conv2_block1_2_conv[0][0]']
rmalization)

conv2_block1_2_relu (Activ  (None, None, None, 64)    0         ['conv2_block1_2_bn[0][0]']
ation)

conv2_block1_0_conv (Conv2  (None, None, None, 256)   16640     ['pool1_pool[0][0]']
D)

conv2_block1_3_conv (Conv2  (None, None, None, 256)   16640     ['conv2_block1_2_relu[0][0]']
D)

conv2_block1_0_bn (BatchNo  (None, None, None, 256)   1024      ['conv2_block1_0_conv[0][0]']
rmalization)

conv2_block1_3_bn (BatchNo  (None, None, None, 256)   1024      ['conv2_block1_3_conv[0][0]']
rmalization)

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

conv2_block1_out (Activati  (None, None, None, 256)   0         ['conv2_block1_add[0][0]']
on)
```

```
Epoch 1/10
31/31 [==============================] - 79s 1s/step - loss: 0.0000e+00 - accuracy: 0.5031 - val_loss: 0.0000e+00 - val_accuracy: 0.4959
Epoch 2/10
31/31 [==============================] - 38s 1s/step - loss: 0.0000e+00 - accuracy: 0.5031 - val_loss: 0.0000e+00 - val_accuracy: 0.4959
Epoch 3/10
31/31 [==============================] - 38s 1s/step - loss: 0.0000e+00 - accuracy: 0.5031 - val_loss: 0.0000e+00 - val_accuracy: 0.4959
Epoch 4/10
31/31 [==============================] - 39s 1s/step - loss: 0.0000e+00 - accuracy: 0.5031 - val_loss: 0.0000e+00 - val_accuracy: 0.4959
Epoch 5/10
31/31 [==============================] - 39s 1s/step - loss: 0.0000e+00 - accuracy: 0.5031 - val_loss: 0.0000e+00 - val_accuracy: 0.4959
Epoch 6/10
31/31 [==============================] - 40s 1s/step - loss: 0.0000e+00 - accuracy: 0.5031 - val_loss: 0.0000e+00 - val_accuracy: 0.4959
Epoch 7/10
31/31 [==============================] - 38s 1s/step - loss: 0.0000e+00 - accuracy: 0.5031 - val_loss: 0.0000e+00 - val_accuracy: 0.4959
Epoch 8/10
31/31 [==============================] - 38s 1s/step - loss: 0.0000e+00 - accuracy: 0.5031 - val_loss: 0.0000e+00 - val_accuracy: 0.4959
Epoch 9/10
31/31 [==============================] - 40s 1s/step - loss: 0.0000e+00 - accuracy: 0.5031 - val_loss: 0.0000e+00 - val_accuracy: 0.4959
Epoch 10/10
31/31 [==============================] - 39s 1s/step - loss: 0.0000e+00 - accuracy: 0.5031 - val_loss: 0.0000e+00 - val_accuracy: 0.4959
<keras.src.callbacks.History at 0x797bf622bac0>
```

<table>
<tr>
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<td>
<pre>
conv2_block2_2_conv (Conv2 (None, None, None, 64)   36928   ['conv2_block2_1_relu[0][0]'
D)

conv2_block2_2_bn (BatchNo (None, None, None, 64)   256   ['conv2_block2_2_conv[0][0]'
rmalization)

conv2_block2_2_relu (Activ (None, None, None, 64)   0   ['conv2_block2_2_bn[0][0]']
ation)

conv2_block2_3_conv (Conv2 (None, None, None, 256)   16640   ['conv2_block2_2_relu[0][0]'
D)

conv2_block2_3_bn (BatchNo (None, None, None, 256)   1024   ['conv2_block2_3_conv[0][0]'
rmalization)

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

conv2_block2_out (Activati (None, None, None, 256)   0   ['conv2_block2_add[0][0]']
on)

conv2_block3_1_conv (Conv2 (None, None, None, 64)   16448   ['conv2_block2_out[0][0]']
D)

conv2_block3_1_bn (BatchNo (None, None, None, 64)   256   ['conv2_block3_1_conv[0][0]'
rmalization)

conv2_block3_1_relu (Activ (None, None, None, 64)   0   ['conv2_block3_1_bn[0][0]']
ation)
</pre>
...
<pre>
conv5_block3_3_bn (BatchNo (None, None, None, 2048)   8192   ['conv5_block3_3_conv[0][0]']
rmalization)

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

conv5_block3_out (Activati (None, None, None, 2048)   0   ['conv5_block3_add[0][0]']
on)

global_average_pooling2d_1 (None, 2048)   0   ['conv5_block3_out[0][0]']
 (GlobalAveragePooling2D)

dense_2 (Dense)   (None, 1024)   2098176   ['global_average_pooling2d_1[0
                                                                    ][0]']

dense_3 (Dense)   (None, 1)   1025   ['dense_2[0][0]']

==
Total params: 25686913 (97.99 MB)
Trainable params: 2099201 (8.01 MB)
Non-trainable params: 23587712 (89.98 MB)
</pre>
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<tr>
<td>XceptionNet</td>
<td>
<pre>
Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/xcep
83683744/83683744 [==============================] - 1s 0us/step
Model: "model"
</pre>

Layer (type)	Output Shape	Param #	Connected to
input_1 (InputLayer)	[(None, 224, 224, 3)]	0	[]
block1_conv1 (Conv2D)	(None, 111, 111, 32)	864	['input_1[0][0]']
block1_conv1_bn (BatchNorm alization)	(None, 111, 111, 32)	128	['block1_conv1[0][0]']
block1_conv1_act (Activati on)	(None, 111, 111, 32)	0	['block1_conv1_bn[0][0]']
block1_conv2 (Conv2D)	(None, 109, 109, 64)	18432	['block1_conv1_act[0][0]']
block1_conv2_bn (BatchNorm alization)	(None, 109, 109, 64)	256	['block1_conv2[0][0]']
block1_conv2_act (Activati on)	(None, 109, 109, 64)	0	['block1_conv2_bn[0][0]']
block2_sepconv1 (Separable Conv2D)	(None, 109, 109, 128)	8768	['block1_conv2_act[0][0]']
block2_sepconv1_bn (BatchN ormalization)	(None, 109, 109, 128)	512	['block2_sepconv1[0][0]']

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<td>
<pre>
Epoch 1/10
30/30 [==============================] - 51s 1s/step - loss: 0.2613 - accuracy: 0.9059 - val_loss: 0.2293 - val_accuracy: 0.9271
Epoch 2/10
30/30 [==============================] - 37s 1s/step - loss: 0.2010 - accuracy: 0.9313 - val_loss: 0.1698 - val_accuracy: 0.9688
Epoch 3/10
30/30 [==============================] - 35s 1s/step - loss: 0.1365 - accuracy: 0.9609 - val_loss: 0.0504 - val_accuracy: 0.9792
Epoch 4/10
30/30 [==============================] - 38s 1s/step - loss: 0.1508 - accuracy: 0.9397 - val_loss: 0.1055 - val_accuracy: 0.9792
Epoch 5/10
30/30 [==============================] - 36s 1s/step - loss: 0.1449 - accuracy: 0.9408 - val_loss: 0.1263 - val_accuracy: 0.9688
Epoch 6/10
30/30 [==============================] - 37s 1s/step - loss: 0.1118 - accuracy: 0.9524 - val_loss: 0.1172 - val_accuracy: 0.9792
Epoch 7/10
30/30 [==============================] - 35s 1s/step - loss: 0.0979 - accuracy: 0.9598 - val_loss: 0.0880 - val_accuracy: 0.9688
Epoch 8/10
30/30 [==============================] - 35s 1s/step - loss: 0.0920 - accuracy: 0.9641 - val_loss: 0.0949 - val_accuracy: 0.9792
Epoch 9/10
30/30 [==============================] - 36s 1s/step - loss: 0.0752 - accuracy: 0.9746 - val_loss: 0.0561 - val_accuracy: 0.9896
Epoch 10/10
30/30 [==============================] - 36s 1s/step - loss: 0.0697 - accuracy: 0.9799 - val_loss: 0.0772 - val_accuracy: 0.9792
</pre>
</td>
</tr>
</table>

```
block2_sepconv1_bn (BatchN  (None, 109, 109, 128)       512       ['block2_sepconv1[0][0]']
ormalization)

block2_sepconv2_act (Activ  (None, 109, 109, 128)       0         ['block2_sepconv1_bn[0][0]']
ation)

block2_sepconv2 (Separable  (None, 109, 109, 128)       17536     ['block2_sepconv2_act[0][0]']
Conv2D)

block2_sepconv2_bn (BatchN  (None, 109, 109, 128)       512       ['block2_sepconv2[0][0]']
ormalization)

conv2d (Conv2D)             (None, 55, 55, 128)         8192      ['block1_conv2_act[0][0]']

block2_pool (MaxPooling2D)  (None, 55, 55, 128)         0         ['block2_sepconv2_bn[0][0]']

batch_normalization (Batch  (None, 55, 55, 128)         512       ['conv2d[0][0]']
Normalization)

add (Add)                   (None, 55, 55, 128)         0         ['block2_pool[0][0]',
                                                                   'batch_normalization[0][0]']

block3_sepconv1_act (Activ  (None, 55, 55, 128)         0         ['add[0][0]']
ation)

block3_sepconv1 (Separable  (None, 55, 55, 256)         33920     ['block3_sepconv1_act[0][0]']
Conv2D)

block3_sepconv1_bn (BatchN  (None, 55, 55, 256)         1024      ['block3_sepconv1[0][0]']
ormalization)
```

```
block3_sepconv2 (Separable  (None, 55, 55, 256)         67840     ['block3_sepconv2_act[0][0]']
Conv2D)

block3_sepconv2_bn (BatchN  (None, 55, 55, 256)         1024      ['block3_sepconv2[0][0]']
ormalization)

conv2d_1 (Conv2D)           (None, 28, 28, 256)         32768     ['add[0][0]']

block3_pool (MaxPooling2D)  (None, 28, 28, 256)         0         ['block3_sepconv2_bn[0][0]']

batch_normalization_1 (Bat  (None, 28, 28, 256)         1024      ['conv2d_1[0][0]']
chNormalization)

add_1 (Add)                 (None, 28, 28, 256)         0         ['block3_pool[0][0]',
                                                                   'batch_normalization_1[0][0]'
                                                                   ]

block4_sepconv1_act (Activ  (None, 28, 28, 256)         0         ['add_1[0][0]']
ation)

block4_sepconv1 (Separable  (None, 28, 28, 728)         188672    ['block4_sepconv1_act[0][0]']
Conv2D)

block4_sepconv1_bn (BatchN  (None, 28, 28, 728)         2912      ['block4_sepconv1[0][0]']
ormalization)

block4_sepconv2_act (Activ  (None, 28, 28, 728)         0         ['block4_sepconv1_bn[0][0]']
ation)

block5_sepconv1_act (Activ  (None, 14, 14, 728)         0         ['add_2[0][0]']
ation)

block5_sepconv1 (Separable  (None, 14, 14, 728)         536536    ['block5_sepconv1_act[0][0]']
Conv2D)

block5_sepconv1_bn (BatchN  (None, 14, 14, 728)         2912      ['block5_sepconv1[0][0]']
ormalization)

block5_sepconv2_act (Activ  (None, 14, 14, 728)         0         ['block5_sepconv1_bn[0][0]']
ation)

block5_sepconv2 (Separable  (None, 14, 14, 728)         536536    ['block5_sepconv2_act[0][0]']
Conv2D)

block5_sepconv2_bn (BatchN  (None, 14, 14, 728)         2912      ['block5_sepconv2[0][0]']
ormalization)

block5_sepconv3_act (Activ  (None, 14, 14, 728)         0         ['block5_sepconv2_bn[0][0]']
ation)

block5_sepconv3 (Separable  (None, 14, 14, 728)         536536    ['block5_sepconv3_act[0][0]']
Conv2D)

block5_sepconv3_bn (BatchN  (None, 14, 14, 728)         2912      ['block5_sepconv3[0][0]']
ormalization)

add_3 (Add)                 (None, 14, 14, 728)         0         ['block5_sepconv3_bn[0][0]',
                                                                   'add_2[0][0]']
```

	block6_sepconv1_act (Activation) (None, 14, 14, 728) 0 ['add_3[0][0]'] block6_sepconv1 (SeparableConv2D) (None, 14, 14, 728) 536536 ['block6_sepconv1_act[0][0]'] block6_sepconv1_bn (BatchNormalization) (None, 14, 14, 728) 2912 ['block6_sepconv1[0][0]'] block6_sepconv2_act (Activation) (None, 14, 14, 728) 0 ['block6_sepconv1_bn[0][0]'] block6_sepconv2 (SeparableConv2D) (None, 14, 14, 728) 536536 ['block6_sepconv2_act[0][0]'] block6_sepconv2_bn (BatchNormalization) (None, 14, 14, 728) 2912 ['block6_sepconv2[0][0]'] block6_sepconv3_act (Activation) (None, 14, 14, 728) 0 ['block6_sepconv2_bn[0][0]'] block6_sepconv3 (SeparableConv2D) (None, 14, 14, 728) 536536 ['block6_sepconv3_act[0][0]'] block6_sepconv3_bn (BatchNormalization) (None, 14, 14, 728) 2912 ['block6_sepconv3[0][0]'] add_4 (Add) (None, 14, 14, 728) 0 ['block6_sepconv3_bn[0][0]', 'add_3[0][0]'] …so on layers block14_sepconv1 (SeparableConv2D) (None, 7, 7, 1536) 1582080 ['add_11[0][0]'] block14_sepconv1_bn (BatchNormalization) (None, 7, 7, 1536) 6144 ['block14_sepconv1[0][0]'] block14_sepconv1_act (Activation) (None, 7, 7, 1536) 0 ['block14_sepconv1_bn[0][0]'] block14_sepconv2 (SeparableConv2D) (None, 7, 7, 2048) 3159552 ['block14_sepconv1_act[0][0]'] block14_sepconv2_bn (BatchNormalization) (None, 7, 7, 2048) 8192 ['block14_sepconv2[0][0]'] block14_sepconv2_act (Activation) (None, 7, 7, 2048) 0 ['block14_sepconv2_bn[0][0]'] flatten (Flatten) (None, 100352) 0 ['block14_sepconv2_act[0][0]'] dense (Dense) (None, 1024) 102761472 ['flatten[0][0]'] dropout (Dropout) (None, 1024) 0 ['dense[0][0]'] dense_1 (Dense) (None, 1) 1025 ['dropout[0][0]'] ========== Total params: 123623977 (471.59 MB) Trainable params: 102762497 (392.01 MB) Non-trainable params: 20861480 (79.58 MB)	
InceptionNet	Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/inception_v3/inception_v3_weights_tf_dim_ordering_tf_kernels_notop.h5 87910968/87910968 [==========] - 0s 0us/step Model: "model_1" Layer (type) Output Shape Param # Connected to input_2 (InputLayer) [(None, 224, 224, 3)] 0 [] conv2d_4 (Conv2D) (None, 111, 111, 32) 864 ['input_2[0][0]'] batch_normalization_4 (BatchNormalization) (None, 111, 111, 32) 96 ['conv2d_4[0][0]'] activation (Activation) (None, 111, 111, 32) 0 ['batch_normalization_4[0][0]'] conv2d_5 (Conv2D) (None, 109, 109, 32) 9216 ['activation[0][0]'] batch_normalization_5 (BatchNormalization) (None, 109, 109, 32) 96 ['conv2d_5[0][0]'] activation_1 (Activation) (None, 109, 109, 32) 0 ['batch_normalization_5[0][0]'] conv2d_6 (Conv2D) (None, 109, 109, 64) 18432 ['activation_1[0][0]'] batch_normalization_6 (BatchNormalization) (None, 109, 109, 64) 192 ['conv2d_6[0][0]']	Epoch 1/10 31/31 [==========] - 48s 1s/step - loss: 0.1638 - accuracy: 0.9356 - val_loss: 0.1368 - val_accuracy: 0.9421 Epoch 2/10 31/31 [==========] - 34s 1s/step - loss: 0.1512 - accuracy: 0.9417 - val_loss: 0.1303 - val_accuracy: 0.9587 Epoch 3/10 31/31 [==========] - 34s 1s/step - loss: 0.1121 - accuracy: 0.9581 - val_loss: 0.1439 - val_accuracy: 0.9587 Epoch 4/10 31/31 [==========] - 34s 1s/step - loss: 0.1164 - accuracy: 0.9530 - val_loss: 0.1467 - val_accuracy: 0.9587 Epoch 5/10 31/31 [==========] - 35s 1s/step - loss: 0.1215 - accuracy: 0.9509 - val_loss: 0.1434 - val_accuracy: 0.9587 Epoch 6/10 31/31 [==========] - 36s 1s/step - loss: 0.0816 - accuracy: 0.9724 - val_loss: 0.1359 - val_accuracy: 0.9669 Epoch 7/10 31/31 [==========] - 35s 1s/step - loss: 0.0889 - accuracy: 0.9693 - val_loss: 0.1248 - val_accuracy: 0.9669 Epoch 8/10 31/31 [==========] - 36s 1s/step - loss: 0.0831 - accuracy: 0.9693 - val_loss: 0.1136 - val_accuracy: 0.9587 Epoch 9/10 31/31 [==========] - 40s 1s/step - loss: 0.0770 - accuracy: 0.9714 - val_loss: 0.1167 - val_accuracy: 0.9587 Epoch 10/10 31/31 [==========] - 36s 1s/step - loss: 0.0689 - accuracy: 0.9785 - val_loss: 0.1271 - val_accuracy: 0.9669

conv2d_6 (Conv2D)	(None, 109, 109, 64)	18432	['activation_1[0][0]']	
batch_normalization_6 (BatchNormalization)	(None, 109, 109, 64)	192	['conv2d_6[0][0]']	
activation_2 (Activation)	(None, 109, 109, 64)	0	['batch_normalization_6[0][0]']	
max_pooling2d (MaxPooling2D)	(None, 54, 54, 64)	0	['activation_2[0][0]']	
conv2d_7 (Conv2D)	(None, 54, 54, 80)	5120	['max_pooling2d[0][0]']	
batch_normalization_7 (BatchNormalization)	(None, 54, 54, 80)	240	['conv2d_7[0][0]']	
activation_3 (Activation)	(None, 54, 54, 80)	0	['batch_normalization_7[0][0]']	
conv2d_8 (Conv2D)	(None, 52, 52, 192)	138240	['activation_3[0][0]']	
batch_normalization_8 (BatchNormalization)	(None, 52, 52, 192)	576	['conv2d_8[0][0]']	
activation_4 (Activation)	(None, 52, 52, 192)	0	['batch_normalization_8[0][0]']	
max_pooling2d_1 (MaxPooling2D)	(None, 25, 25, 192)	0	['activation_4[0][0]']	
conv2d_12 (Conv2D)	(None, 25, 25, 64)	12288	['max_pooling2d_1[0][0]']	
batch_normalization_12 (BatchNormalization)	(None, 25, 25, 64)	192	['conv2d_12[0][0]']	
activation_8 (Activation)	(None, 25, 25, 64)	0	['batch_normalization_12[0][0]']	
conv2d_10 (Conv2D)	(None, 25, 25, 48)	9216	['max_pooling2d_1[0][0]']	
conv2d_13 (Conv2D)	(None, 25, 25, 96)	55296	['activation_8[0][0]']	
batch_normalization_10 (BatchNormalization)	(None, 25, 25, 48)	144	['conv2d_10[0][0]']	
batch_normalization_13 (BatchNormalization)	(None, 25, 25, 96)	288	['conv2d_13[0][0]']	
activation_6 (Activation)	(None, 25, 25, 48)	0	['batch_normalization_10[0][0]']	
activation_9 (Activation)	(None, 25, 25, 96)	0	['batch_normalization_13[0][0]']	
average_pooling2d (AveragePooling2D)	(None, 25, 25, 192)	0	['max_pooling2d_1[0][0]']	
conv2d_9 (Conv2D)	(None, 25, 25, 64)	12288	['max_pooling2d_1[0][0]']	

..so on layers

mixed9_1 (Concatenate)	(None, 5, 5, 768)	0	['activation_87[0][0]', 'activation_88[0][0]']	
concatenate_1 (Concatenate)	(None, 5, 5, 768)	0	['activation_91[0][0]', 'activation_92[0][0]']	
activation_93 (Activation)	(None, 5, 5, 192)	0	['batch_normalization_97[0][0]']	
mixed10 (Concatenate)	(None, 5, 5, 2048)	0	['activation_85[0][0]', 'mixed9_1[0][0]', 'concatenate_1[0][0]', 'activation_93[0][0]']	
flatten_1 (Flatten)	(None, 51200)	0	['mixed10[0][0]']	
dense_2 (Dense)	(None, 1024)	52429824	['flatten_1[0][0]']	
dropout_1 (Dropout)	(None, 1024)	0	['dense_2[0][0]']	
dense_3 (Dense)	(None, 1)	1025	['dropout_1[0][0]']	

Total params: 74233633 (283.18 MB)
Trainable params: 52430849 (200.01 MB)
Non-trainable params: 21802784 (83.17 MB)

MobileNet

```
Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/mobilenet_v2/mobil
9406464/9406464 [==============================] - 0s 0us/step
Model: "model"
```

Layer (type)	Output Shape	Param #	Connected to
input_1 (InputLayer)	[(None, 224, 224, 3)]	0	[]
Conv1 (Conv2D)	(None, 112, 112, 32)	864	['input_1[0][0]']
bn_Conv1 (BatchNormalization)	(None, 112, 112, 32)	128	['Conv1[0][0]']
Conv1_relu (ReLU)	(None, 112, 112, 32)	0	['bn_Conv1[0][0]']
expanded_conv_depthwise (DepthwiseConv2D)	(None, 112, 112, 32)	288	['Conv1_relu[0][0]']
expanded_conv_depthwise_BN (BatchNormalization)	(None, 112, 112, 32)	128	['expanded_conv_depthwise[0][0]']
expanded_conv_depthwise_relu (ReLU)	(None, 112, 112, 32)	0	['expanded_conv_depthwise_BN[0][0]']
expanded_conv_project (Conv2D)	(None, 112, 112, 16)	512	['expanded_conv_depthwise_relu[0][0]']
expanded_conv_project_BN (BatchNormalization)	(None, 112, 112, 16)	64	['expanded_conv_project[0][0]']
block_1_expand (Conv2D)	(None, 112, 112, 96)	1536	['expanded_conv_project_BN[0][0]']
block_1_expand_BN (BatchNormalization)	(None, 112, 112, 96)	384	['block_1_expand[0][0]']
block_1_expand_relu (ReLU)	(None, 112, 112, 96)	0	['block_1_expand_BN[0][0]']
block_1_pad (ZeroPadding2D)	(None, 113, 113, 96)	0	['block_1_expand_relu[0][0]']
block_1_depthwise (DepthwiseConv2D)	(None, 56, 56, 96)	864	['block_1_pad[0][0]']
block_1_depthwise_BN (BatchNormalization)	(None, 56, 56, 96)	384	['block_1_depthwise[0][0]']
block_1_depthwise_relu (ReLU)	(None, 56, 56, 96)	0	['block_1_depthwise_BN[0][0]']
block_1_project (Conv2D)	(None, 56, 56, 24)	2304	['block_1_depthwise_relu[0][0]']
block_1_project_BN (BatchNormalization)	(None, 56, 56, 24)	96	['block_1_project[0][0]']
block_2_expand (Conv2D)	(None, 56, 56, 144)	3456	['block_1_project_BN[0][0]']
block_2_expand_BN (BatchNormalization)	(None, 56, 56, 144)	576	['block_2_expand[0][0]']
block_2_expand_relu (ReLU)	(None, 56, 56, 144)	0	['block_2_expand_BN[0][0]']
block_2_depthwise (DepthwiseConv2D)	(None, 56, 56, 144)	1296	['block_2_expand_relu[0][0]']
block_2_depthwise_BN (BatchNormalization)	(None, 56, 56, 144)	576	['block_2_depthwise[0][0]']
block_2_depthwise_relu (ReLU)	(None, 56, 56, 144)	0	['block_2_depthwise_BN[0][0]']
block_2_project (Conv2D)	(None, 56, 56, 24)	3456	['block_2_depthwise_relu[0][0]']
block_2_project_BN (BatchNormalization)	(None, 56, 56, 24)	96	['block_2_project[0][0]']
block_2_add (Add)	(None, 56, 56, 24)	0	['block_1_project_BN[0][0]', 'block_2_project_BN[0][0]']
block_3_expand (Conv2D)	(None, 56, 56, 144)	3456	['block_2_add[0][0]']
block_3_expand_BN (BatchNormalization)	(None, 56, 56, 144)	576	['block_3_expand[0][0]']
block_3_expand_relu (ReLU)	(None, 56, 56, 144)	0	['block_3_expand_BN[0][0]']
block_3_pad (ZeroPadding2D)	(None, 57, 57, 144)	0	['block_3_expand_relu[0][0]']
block_3_depthwise (DepthwiseConv2D)	(None, 28, 28, 144)	1296	['block_3_pad[0][0]']
block_3_depthwise_BN (BatchNormalization)	(None, 28, 28, 144)	576	['block_3_depthwise[0][0]']

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block_16_project_BN (BatchNormalization)	(None, 7, 7, 320)	1280	['block_16_project[0][0]']
Conv_1 (Conv2D)	(None, 7, 7, 1280)	409600	['block_16_project_BN[0][0]']
Conv_1_bn (BatchNormalization)	(None, 7, 7, 1280)	5120	['Conv_1[0][0]']
out_relu (ReLU)	(None, 7, 7, 1280)	0	['Conv_1_bn[0][0]']
flatten (Flatten)	(None, 62720)	0	['out_relu[0][0]']
dense (Dense)	(None, 128)	8028288	['flatten[0][0]']
dropout (Dropout)	(None, 128)	0	['dense[0][0]']
dense_1 (Dense)	(None, 1)	129	['dropout[0][0]']

```
Total params: 10286401 (39.24 MB)
Trainable params: 8028417 (30.63 MB)
Non-trainable params: 2257984 (8.61 MB)
```

```
Epoch 1/15
30/30 [==============================] - 408s 13s/step - loss: 0.5267 - accuracy: 0.8097 - val_loss: 0.1454 - val_accuracy: 0.947
Epoch 2/15
30/30 [==============================] - 89s 3s/step - loss: 0.2533 - accuracy: 0.9123 - val_loss: 0.0981 - val_accuracy: 0.9688
Epoch 3/15
30/30 [==============================] - 78s 3s/step - loss: 0.1954 - accuracy: 0.9228 - val_loss: 0.1251 - val_accuracy: 0.9479
Epoch 4/15
30/30 [==============================] - 78s 3s/step - loss: 0.1545 - accuracy: 0.9450 - val_loss: 0.1292 - val_accuracy: 0.9271
Epoch 5/15
30/30 [==============================] - 81s 3s/step - loss: 0.1496 - accuracy: 0.9503 - val_loss: 0.1729 - val_accuracy: 0.9479
Epoch 6/15
30/30 [==============================] - 75s 3s/step - loss: 0.1447 - accuracy: 0.9471 - val_loss: 0.0928 - val_accuracy: 0.9688
Epoch 7/15
30/30 [==============================] - 79s 3s/step - loss: 0.1426 - accuracy: 0.9419 - val_loss: 0.1682 - val_accuracy: 0.9479
Epoch 8/15
30/30 [==============================] - 78s 3s/step - loss: 0.1253 - accuracy: 0.9514 - val_loss: 0.1474 - val_accuracy: 0.9479
Epoch 9/15
30/30 [==============================] - 81s 3s/step - loss: 0.0822 - accuracy: 0.9662 - val_loss: 0.1378 - val_accuracy: 0.9583
Epoch 10/15
30/30 [==============================] - 87s 3s/step - loss: 0.0672 - accuracy: 0.9757 - val_loss: 0.1498 - val_accuracy: 0.9583
Epoch 11/15
30/30 [==============================] - 76s 3s/step - loss: 0.0712 - accuracy: 0.9704 - val_loss: 0.1345 - val_accuracy: 0.9479
Epoch 12/15
30/30 [==============================] - 78s 3s/step - loss: 0.0871 - accuracy: 0.9683 - val_loss: 0.1812 - val_accuracy: 0.9583
Epoch 13/15
30/30 [==============================] - 74s 2s/step - loss: 0.0888 - accuracy: 0.9662 - val_loss: 0.1361 - val_accuracy: 0.9583
Epoch 14/15
30/30 [==============================] - 76s 2s/step - loss: 0.0604 - accuracy: 0.9746 - val_loss: 0.1611 - val_accuracy: 0.9583
Epoch 15/15
30/30 [==============================] - 74s 2s/step - loss: 0.0638 - accuracy: 0.9736 - val_loss: 0.1545 - val_accuracy: 0.9583
```
