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In [16]: # ATTENTION: Please do not alter any of the provided code in the exercise. Only
          # add your own code where indicated
          # ATTENTION: Please do not add or remove any cells in the exercise. The grader
          # will check specific cells based on the cell position.
          # ATTENTION: Please use the provided epoch values when training.

          # Import all the necessary files!
          import os
          import tensorflow as tf
          from tensorflow.keras import layers
          from tensorflow.keras import Model
          from os import getcwd
```

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In [17]: path_inception = f"{getcwd()}/../tmp2/inception_v3_weights_tf_dim_ordering_tf_
         kernels_notop.h5"

# Import the inception model
from tensorflow.keras.applications.inception_v3 import InceptionV3

# Create an instance of the inception model from the local pre-trained weights
local_weights_file = path_inception

pre_trained_model = InceptionV3(input_shape = (150, 150, 3),
                                include_top = False,
                                weights = None)

pre_trained_model.load_weights(local_weights_file)

# Make all the layers in the pre-trained model non-trainable
for layer in pre_trained_model.layers:
    layer.trainable = False

# Print the model summary
pre_trained_model.summary()

# Expected Output is extremely large, but should end with:

#batch_normalization_v1_281 (Batch Normalization)   576      conv2d_281
#
#
#activation_273 (Activation)   0      batch_normalization_v1_273[0][0]
#
#
#mixed9_1 (Concatenate)   0      activation_2
#75[0][0]
#      activation_2
#76[0][0]
#
#
#concatenate_5 (Concatenate)   0      activation_2
#79[0][0]
#      activation_2
#80[0][0]
#
#
#activation_281 (Activation)   0      batch_normalization_v1_281[0][0]
#
#
#mixed10 (Concatenate)   0      activation_2
#73[0][0]
#      mixed9_1[0]
#      concatenate_
#5[0][0]
#      activation_2
#81[0][0]

```

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#=====
=====
#Total params: 21,802,784
#Trainable params: 0
#Non-trainable params: 21,802,784
```

Model: "inception_v3"

Layer (type)	Output Shape	Param #	Connected to
input_2 (InputLayer)	[(None, 150, 150, 3) 0]		
conv2d_94 (Conv2D)	(None, 74, 74, 32)	864	input_2[0]
batch_normalization_94 (Batch Normalization)	(None, 74, 74, 32)	96	conv2d_94[0]
activation_94 (Activation)	(None, 74, 74, 32)	0	batch_normalization_94[0][0]
conv2d_95 (Conv2D)	(None, 72, 72, 32)	9216	activation_94[0][0]
batch_normalization_95 (Batch Normalization)	(None, 72, 72, 32)	96	conv2d_95[0]
activation_95 (Activation)	(None, 72, 72, 32)	0	batch_normalization_95[0][0]
conv2d_96 (Conv2D)	(None, 72, 72, 64)	18432	activation_95[0][0]
batch_normalization_96 (Batch Normalization)	(None, 72, 72, 64)	192	conv2d_96[0]
activation_96 (Activation)	(None, 72, 72, 64)	0	batch_normalization_96[0][0]
max_pooling2d_4 (MaxPooling2D)	(None, 35, 35, 64)	0	activation_96[0][0]
conv2d_97 (Conv2D)	(None, 35, 35, 80)	5120	max_pooling2d_4[0][0]
batch_normalization_97 (Batch Normalization)	(None, 35, 35, 80)	240	conv2d_97[0]

activation_97 (Activation)	(None, 35, 35, 80)	0	batch_normalization_97[0][0]
conv2d_98 (Conv2D)	(None, 33, 33, 192)	138240	activation_97[0][0]
batch_normalization_98 (Batch Normalization)	(None, 33, 33, 192)	576	conv2d_98[0][0]
activation_98 (Activation)	(None, 33, 33, 192)	0	batch_normalization_98[0][0]
max_pooling2d_5 (MaxPooling2D)	(None, 16, 16, 192)	0	activation_98[0][0]
conv2d_102 (Conv2D)	(None, 16, 16, 64)	12288	max_pooling2d_5[0][0]
batch_normalization_102 (Batch Normalization)	(None, 16, 16, 64)	192	conv2d_102[0][0]
activation_102 (Activation)	(None, 16, 16, 64)	0	batch_normalization_102[0][0]
conv2d_100 (Conv2D)	(None, 16, 16, 48)	9216	max_pooling2d_5[0][0]
conv2d_103 (Conv2D)	(None, 16, 16, 96)	55296	activation_102[0][0]
batch_normalization_100 (Batch Normalization)	(None, 16, 16, 48)	144	conv2d_100[0][0]
batch_normalization_103 (Batch Normalization)	(None, 16, 16, 96)	288	conv2d_103[0][0]
activation_100 (Activation)	(None, 16, 16, 48)	0	batch_normalization_100[0][0]
activation_103 (Activation)	(None, 16, 16, 96)	0	batch_normalization_103[0][0]
average_pooling2d_9 (AveragePooling2D)	(None, 16, 16, 192)	0	max_pooling2d_5[0][0]

d_5[0][0]

conv2d_99 (Conv2D) d_5[0][0]	(None, 16, 16, 64)	12288	max_pooling2
conv2d_101 (Conv2D) 00[0][0]	(None, 16, 16, 64)	76800	activation_1
conv2d_104 (Conv2D) 03[0][0]	(None, 16, 16, 96)	82944	activation_1
conv2d_105 (Conv2D) ing2d_9[0][0]	(None, 16, 16, 32)	6144	average_pool
batch_normalization_99 (BatchNo [0])	(None, 16, 16, 64)	192	conv2d_99[0]
batch_normalization_101 (BatchN [0][0])	(None, 16, 16, 64)	192	conv2d_101
batch_normalization_104 (BatchN [0][0])	(None, 16, 16, 96)	288	conv2d_104
batch_normalization_105 (BatchN [0][0])	(None, 16, 16, 32)	96	conv2d_105
activation_99 (Activation) ization_99[0][0]	(None, 16, 16, 64)	0	batch_normal
activation_101 (Activation) ization_101[0][0]	(None, 16, 16, 64)	0	batch_normal
activation_104 (Activation) ization_104[0][0]	(None, 16, 16, 96)	0	batch_normal
activation_105 (Activation) ization_105[0][0]	(None, 16, 16, 32)	0	batch_normal
mixed0 (Concatenate) 9[0][0]	(None, 16, 16, 256)	0	activation_9
01[0][0]			activation_1
04[0][0]			activation_1

			activation_1
05[0][0]			
conv2d_109 (Conv2D)	(None, 16, 16, 64)	16384	mixed0[0][0]
batch_normalization_109 (Batch Normalization)	(None, 16, 16, 64)	192	conv2d_109[0][0]
activation_109 (Activation)	(None, 16, 16, 64)	0	batch_normalization_109[0][0]
conv2d_107 (Conv2D)	(None, 16, 16, 48)	12288	mixed0[0][0]
conv2d_110 (Conv2D)	(None, 16, 16, 96)	55296	activation_109[0][0]
batch_normalization_107 (Batch Normalization)	(None, 16, 16, 48)	144	conv2d_107[0][0]
batch_normalization_110 (Batch Normalization)	(None, 16, 16, 96)	288	conv2d_110[0][0]
activation_107 (Activation)	(None, 16, 16, 48)	0	batch_normalization_107[0][0]
activation_110 (Activation)	(None, 16, 16, 96)	0	batch_normalization_110[0][0]
average_pooling2d_10 (Average Pooling)	(None, 16, 16, 256)	0	mixed0[0][0]
conv2d_106 (Conv2D)	(None, 16, 16, 64)	16384	mixed0[0][0]
conv2d_108 (Conv2D)	(None, 16, 16, 64)	76800	activation_107[0][0]
conv2d_111 (Conv2D)	(None, 16, 16, 96)	82944	activation_110[0][0]
conv2d_112 (Conv2D)	(None, 16, 16, 64)	16384	average_pooling2d_10[0][0]
batch_normalization_106 (Batch Normalization)	(None, 16, 16, 64)	192	conv2d_106

[0][0]

batch_normalization_108 (Batch Normalization)	(None, 16, 16, 64)	192	conv2d_108
batch_normalization_111 (Batch Normalization)	(None, 16, 16, 96)	288	conv2d_111
batch_normalization_112 (Batch Normalization)	(None, 16, 16, 64)	192	conv2d_112
activation_106 (Activation)	(None, 16, 16, 64)	0	batch_normalization_106[0][0]
activation_108 (Activation)	(None, 16, 16, 64)	0	batch_normalization_108[0][0]
activation_111 (Activation)	(None, 16, 16, 96)	0	batch_normalization_111[0][0]
activation_112 (Activation)	(None, 16, 16, 64)	0	batch_normalization_112[0][0]
mixed1 (Concatenate)	(None, 16, 16, 288)	0	activation_106[0][0]
			activation_108[0][0]
			activation_111[0][0]
			activation_112[0][0]
conv2d_116 (Conv2D)	(None, 16, 16, 64)	18432	mixed1[0][0]
batch_normalization_116 (Batch Normalization)	(None, 16, 16, 64)	192	conv2d_116
activation_116 (Activation)	(None, 16, 16, 64)	0	batch_normalization_116[0][0]
conv2d_114 (Conv2D)	(None, 16, 16, 48)	13824	mixed1[0][0]
conv2d_117 (Conv2D)	(None, 16, 16, 96)	55296	activation_116[0][0]

<u>batch_normalization_114</u> (BatchN (None, 16, 16, 48) [0][0])	144	conv2d_114
<u>batch_normalization_117</u> (BatchN (None, 16, 16, 96) [0][0])	288	conv2d_117
<u>activation_114</u> (Activation) (None, 16, 16, 48) [0][0])	0	batch_normal
<u>activation_117</u> (Activation) (None, 16, 16, 96) [0][0])	0	batch_normal
<u>average_pooling2d_11</u> (AveragePo (None, 16, 16, 288) [0][0])	0	mixed1[0][0]
<u>conv2d_113</u> (Conv2D) (None, 16, 16, 64)	18432	mixed1[0][0]
<u>conv2d_115</u> (Conv2D) (None, 16, 16, 64) [0][0])	76800	activation_1
<u>conv2d_118</u> (Conv2D) (None, 16, 16, 96) [0][0])	82944	activation_1
<u>conv2d_119</u> (Conv2D) (None, 16, 16, 64) [0][0])	18432	average_pool
<u>batch_normalization_113</u> (BatchN (None, 16, 16, 64) [0][0])	192	conv2d_113
<u>batch_normalization_115</u> (BatchN (None, 16, 16, 64) [0][0])	192	conv2d_115
<u>batch_normalization_118</u> (BatchN (None, 16, 16, 96) [0][0])	288	conv2d_118
<u>batch_normalization_119</u> (BatchN (None, 16, 16, 64) [0][0])	192	conv2d_119
<u>activation_113</u> (Activation) (None, 16, 16, 64) [0][0])	0	batch_normal
<u>activation_115</u> (Activation) (None, 16, 16, 64)	0	batch_normal

ization_115[0][0]

activation_118 (Activation) ization_118[0][0]	(None, 16, 16, 96)	0	batch_normal
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activation_119 (Activation) ization_119[0][0]	(None, 16, 16, 64)	0	batch_normal
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mixed2 (Concatenate) 13[0][0]	(None, 16, 16, 288)	0	activation_1
15[0][0]			activation_1
18[0][0]			activation_1
19[0][0]			activation_1

conv2d_121 (Conv2D)	(None, 16, 16, 64)	18432	mixed2[0][0]
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batch_normalization_121 (BatchN [0][0])	(None, 16, 16, 64)	192	conv2d_121
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activation_121 (Activation) ization_121[0][0]	(None, 16, 16, 64)	0	batch_normal
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conv2d_122 (Conv2D) 21[0][0]	(None, 16, 16, 96)	55296	activation_1
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batch_normalization_122 (BatchN [0][0])	(None, 16, 16, 96)	288	conv2d_122
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activation_122 (Activation) ization_122[0][0]	(None, 16, 16, 96)	0	batch_normal
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conv2d_120 (Conv2D)	(None, 7, 7, 384)	995328	mixed2[0][0]
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conv2d_123 (Conv2D) 22[0][0]	(None, 7, 7, 96)	82944	activation_1
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batch_normalization_120 (BatchN [0][0])	(None, 7, 7, 384)	1152	conv2d_120
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batch_normalization_123 (BatchN [0][0])	(None, 7, 7, 96)	288	conv2d_123
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activation_120 (Activation) ization_120[0][0]	(None, 7, 7, 384)	0	batch_normal
activation_123 (Activation) ization_123[0][0]	(None, 7, 7, 96)	0	batch_normal
max_pooling2d_6 (MaxPooling2D)	(None, 7, 7, 288)	0	mixed2[0][0]
mixed3 (Concatenate) 20[0][0] 23[0][0] d_6[0][0]	(None, 7, 7, 768)	0	activation_1 activation_1 max_pooling2
conv2d_128 (Conv2D)	(None, 7, 7, 128)	98304	mixed3[0][0]
batch_normalization_128 (BatchN [0][0])	(None, 7, 7, 128)	384	conv2d_128
activation_128 (Activation) ization_128[0][0]	(None, 7, 7, 128)	0	batch_normal
conv2d_129 (Conv2D) 28[0][0]	(None, 7, 7, 128)	114688	activation_1
batch_normalization_129 (BatchN [0][0])	(None, 7, 7, 128)	384	conv2d_129
activation_129 (Activation) ization_129[0][0]	(None, 7, 7, 128)	0	batch_normal
conv2d_125 (Conv2D)	(None, 7, 7, 128)	98304	mixed3[0][0]
conv2d_130 (Conv2D) 29[0][0]	(None, 7, 7, 128)	114688	activation_1
batch_normalization_125 (BatchN [0][0])	(None, 7, 7, 128)	384	conv2d_125
batch_normalization_130 (BatchN [0][0])	(None, 7, 7, 128)	384	conv2d_130

activation_125 (Activation) ization_125[0][0]	(None, 7, 7, 128)	0	batch_normal
activation_130 (Activation) ization_130[0][0]	(None, 7, 7, 128)	0	batch_normal
conv2d_126 (Conv2D) 25[0][0]	(None, 7, 7, 128)	114688	activation_1
conv2d_131 (Conv2D) 30[0][0]	(None, 7, 7, 128)	114688	activation_1
batch_normalization_126 (BatchN [0][0])	(None, 7, 7, 128)	384	conv2d_126
batch_normalization_131 (BatchN [0][0])	(None, 7, 7, 128)	384	conv2d_131
activation_126 (Activation) ization_126[0][0]	(None, 7, 7, 128)	0	batch_normal
activation_131 (Activation) ization_131[0][0]	(None, 7, 7, 128)	0	batch_normal
average_pooling2d_12 (AveragePo [0][0])	(None, 7, 7, 768)	0	mixed3[0][0]
conv2d_124 (Conv2D)	(None, 7, 7, 192)	147456	mixed3[0][0]
conv2d_127 (Conv2D) 26[0][0]	(None, 7, 7, 192)	172032	activation_1
conv2d_132 (Conv2D) 31[0][0]	(None, 7, 7, 192)	172032	activation_1
conv2d_133 (Conv2D) ing2d_12[0][0]	(None, 7, 7, 192)	147456	average_pool
batch_normalization_124 (BatchN [0][0])	(None, 7, 7, 192)	576	conv2d_124
batch_normalization_127 (BatchN [0][0])	(None, 7, 7, 192)	576	conv2d_127

[0][0]

batch_normalization_132 (BatchN [0][0])	(None, 7, 7, 192)	576	conv2d_132
batch_normalization_133 (BatchN [0][0])	(None, 7, 7, 192)	576	conv2d_133
activation_124 (Activation) ization_124[0][0]	(None, 7, 7, 192)	0	batch_normal
activation_127 (Activation) ization_127[0][0]	(None, 7, 7, 192)	0	batch_normal
activation_132 (Activation) ization_132[0][0]	(None, 7, 7, 192)	0	batch_normal
activation_133 (Activation) ization_133[0][0]	(None, 7, 7, 192)	0	batch_normal
mixed4 (Concatenate) 24[0][0] 27[0][0] 32[0][0] 33[0][0]	(None, 7, 7, 768)	0	activation_1 activation_1 activation_1 activation_1
conv2d_138 (Conv2D)	(None, 7, 7, 160)	122880	mixed4[0][0]
batch_normalization_138 (BatchN [0][0])	(None, 7, 7, 160)	480	conv2d_138
activation_138 (Activation) ization_138[0][0]	(None, 7, 7, 160)	0	batch_normal
conv2d_139 (Conv2D) 38[0][0]	(None, 7, 7, 160)	179200	activation_1
batch_normalization_139 (BatchN [0][0])	(None, 7, 7, 160)	480	conv2d_139
activation_139 (Activation)	(None, 7, 7, 160)	0	batch_normal

ization_139[0][0]

conv2d_135 (Conv2D)	(None, 7, 7, 160)	122880	mixed4[0][0]
conv2d_140 (Conv2D) 39[0][0]	(None, 7, 7, 160)	179200	activation_1
batch_normalization_135 (BatchN [0][0]	(None, 7, 7, 160)	480	conv2d_135
batch_normalization_140 (BatchN [0][0]	(None, 7, 7, 160)	480	conv2d_140
activation_135 (Activation) ization_135[0][0]	(None, 7, 7, 160)	0	batch_normal
activation_140 (Activation) ization_140[0][0]	(None, 7, 7, 160)	0	batch_normal
conv2d_136 (Conv2D) 35[0][0]	(None, 7, 7, 160)	179200	activation_1
conv2d_141 (Conv2D) 40[0][0]	(None, 7, 7, 160)	179200	activation_1
batch_normalization_136 (BatchN [0][0]	(None, 7, 7, 160)	480	conv2d_136
batch_normalization_141 (BatchN [0][0]	(None, 7, 7, 160)	480	conv2d_141
activation_136 (Activation) ization_136[0][0]	(None, 7, 7, 160)	0	batch_normal
activation_141 (Activation) ization_141[0][0]	(None, 7, 7, 160)	0	batch_normal
average_pooling2d_13 (AveragePo	(None, 7, 7, 768)	0	mixed4[0][0]
conv2d_134 (Conv2D)	(None, 7, 7, 192)	147456	mixed4[0][0]
conv2d_137 (Conv2D)	(None, 7, 7, 192)	215040	activation_1

36[0][0]

conv2d_142 (Conv2D) 41[0][0]	(None, 7, 7, 192)	215040	activation_1
conv2d_143 (Conv2D) ing2d_13[0][0]	(None, 7, 7, 192)	147456	average_pool
batch_normalization_134 (BatchN [0][0]	(None, 7, 7, 192)	576	conv2d_134
batch_normalization_137 (BatchN [0][0]	(None, 7, 7, 192)	576	conv2d_137
batch_normalization_142 (BatchN [0][0]	(None, 7, 7, 192)	576	conv2d_142
batch_normalization_143 (BatchN [0][0]	(None, 7, 7, 192)	576	conv2d_143
activation_134 (Activation) ization_134[0][0]	(None, 7, 7, 192)	0	batch_normal
activation_137 (Activation) ization_137[0][0]	(None, 7, 7, 192)	0	batch_normal
activation_142 (Activation) ization_142[0][0]	(None, 7, 7, 192)	0	batch_normal
activation_143 (Activation) ization_143[0][0]	(None, 7, 7, 192)	0	batch_normal
mixed5 (Concatenate) 34[0][0] 37[0][0] 42[0][0] 43[0][0]	(None, 7, 7, 768)	0	activation_1 activation_1 activation_1 activation_1
conv2d_148 (Conv2D)	(None, 7, 7, 160)	122880	mixed5[0][0]
batch_normalization_148 (BatchN	(None, 7, 7, 160)	480	conv2d_148

[0][0]

activation_148 (Activation) ization_148[0][0]	(None, 7, 7, 160)	0	batch_normal
conv2d_149 (Conv2D) 48[0][0]	(None, 7, 7, 160)	179200	activation_1
batch_normalization_149 (BatchN [0][0]	(None, 7, 7, 160)	480	conv2d_149
activation_149 (Activation) ization_149[0][0]	(None, 7, 7, 160)	0	batch_normal
conv2d_145 (Conv2D)	(None, 7, 7, 160)	122880	mixed5[0][0]
conv2d_150 (Conv2D) 49[0][0]	(None, 7, 7, 160)	179200	activation_1
batch_normalization_145 (BatchN [0][0]	(None, 7, 7, 160)	480	conv2d_145
batch_normalization_150 (BatchN [0][0]	(None, 7, 7, 160)	480	conv2d_150
activation_145 (Activation) ization_145[0][0]	(None, 7, 7, 160)	0	batch_normal
activation_150 (Activation) ization_150[0][0]	(None, 7, 7, 160)	0	batch_normal
conv2d_146 (Conv2D) 45[0][0]	(None, 7, 7, 160)	179200	activation_1
conv2d_151 (Conv2D) 50[0][0]	(None, 7, 7, 160)	179200	activation_1
batch_normalization_146 (BatchN [0][0]	(None, 7, 7, 160)	480	conv2d_146
batch_normalization_151 (BatchN [0][0]	(None, 7, 7, 160)	480	conv2d_151

activation_146 (Activation) ization_146[0][0]	(None, 7, 7, 160)	0	batch_normal
activation_151 (Activation) ization_151[0][0]	(None, 7, 7, 160)	0	batch_normal
average_pooling2d_14 (AveragePo	(None, 7, 7, 768)	0	mixed5[0][0]
conv2d_144 (Conv2D)	(None, 7, 7, 192)	147456	mixed5[0][0]
conv2d_147 (Conv2D) 46[0][0]	(None, 7, 7, 192)	215040	activation_1
conv2d_152 (Conv2D) 51[0][0]	(None, 7, 7, 192)	215040	activation_1
conv2d_153 (Conv2D) ing2d_14[0][0]	(None, 7, 7, 192)	147456	average_pool
batch_normalization_144 (BatchN [0][0]	(None, 7, 7, 192)	576	conv2d_144
batch_normalization_147 (BatchN [0][0]	(None, 7, 7, 192)	576	conv2d_147
batch_normalization_152 (BatchN [0][0]	(None, 7, 7, 192)	576	conv2d_152
batch_normalization_153 (BatchN [0][0]	(None, 7, 7, 192)	576	conv2d_153
activation_144 (Activation) ization_144[0][0]	(None, 7, 7, 192)	0	batch_normal
activation_147 (Activation) ization_147[0][0]	(None, 7, 7, 192)	0	batch_normal
activation_152 (Activation) ization_152[0][0]	(None, 7, 7, 192)	0	batch_normal
activation_153 (Activation) ization_153[0][0]	(None, 7, 7, 192)	0	batch_normal

<u>mixed6 (Concatenate)</u> 44[0][0]	(None, 7, 7, 768)	0	activation_1
47[0][0]			activation_1
52[0][0]			activation_1
53[0][0]			activation_1
<u>conv2d_158 (Conv2D)</u>	(None, 7, 7, 192)	147456	mixed6[0][0]
<u>batch_normalization_158 (BatchN</u> [0][0]	(None, 7, 7, 192)	576	conv2d_158
<u>activation_158 (Activation)</u> ization_158[0][0]	(None, 7, 7, 192)	0	batch_normal
<u>conv2d_159 (Conv2D)</u> 58[0][0]	(None, 7, 7, 192)	258048	activation_1
<u>batch_normalization_159 (BatchN</u> [0][0]	(None, 7, 7, 192)	576	conv2d_159
<u>activation_159 (Activation)</u> ization_159[0][0]	(None, 7, 7, 192)	0	batch_normal
<u>conv2d_155 (Conv2D)</u>	(None, 7, 7, 192)	147456	mixed6[0][0]
<u>conv2d_160 (Conv2D)</u> 59[0][0]	(None, 7, 7, 192)	258048	activation_1
<u>batch_normalization_155 (BatchN</u> [0][0]	(None, 7, 7, 192)	576	conv2d_155
<u>batch_normalization_160 (BatchN</u> [0][0]	(None, 7, 7, 192)	576	conv2d_160
<u>activation_155 (Activation)</u> ization_155[0][0]	(None, 7, 7, 192)	0	batch_normal
<u>activation_160 (Activation)</u> ization_160[0][0]	(None, 7, 7, 192)	0	batch_normal

conv2d_156 (Conv2D) 55[0][0]	(None, 7, 7, 192)	258048	activation_1
conv2d_161 (Conv2D) 60[0][0]	(None, 7, 7, 192)	258048	activation_1
batch_normalization_156 (BatchN [0][0])	(None, 7, 7, 192)	576	conv2d_156
batch_normalization_161 (BatchN [0][0])	(None, 7, 7, 192)	576	conv2d_161
activation_156 (Activation) ization_156[0][0]	(None, 7, 7, 192)	0	batch_normal
activation_161 (Activation) ization_161[0][0]	(None, 7, 7, 192)	0	batch_normal
average_pooling2d_15 (AveragePo [0][0])	(None, 7, 7, 768)	0	mixed6[0][0]
conv2d_154 (Conv2D)	(None, 7, 7, 192)	147456	mixed6[0][0]
conv2d_157 (Conv2D) 56[0][0]	(None, 7, 7, 192)	258048	activation_1
conv2d_162 (Conv2D) 61[0][0]	(None, 7, 7, 192)	258048	activation_1
conv2d_163 (Conv2D) ing2d_15[0][0]	(None, 7, 7, 192)	147456	average_pool
batch_normalization_154 (BatchN [0][0])	(None, 7, 7, 192)	576	conv2d_154
batch_normalization_157 (BatchN [0][0])	(None, 7, 7, 192)	576	conv2d_157
batch_normalization_162 (BatchN [0][0])	(None, 7, 7, 192)	576	conv2d_162
batch_normalization_163 (BatchN [0][0])	(None, 7, 7, 192)	576	conv2d_163

activation_154 (Activation) ization_154[0][0]	(None, 7, 7, 192)	0	batch_normal
activation_157 (Activation) ization_157[0][0]	(None, 7, 7, 192)	0	batch_normal
activation_162 (Activation) ization_162[0][0]	(None, 7, 7, 192)	0	batch_normal
activation_163 (Activation) ization_163[0][0]	(None, 7, 7, 192)	0	batch_normal
mixed7 (Concatenate) 54[0][0] 57[0][0] 62[0][0] 63[0][0]	(None, 7, 7, 768)	0	activation_1 activation_1 activation_1 activation_1
conv2d_166 (Conv2D)	(None, 7, 7, 192)	147456	mixed7[0][0]
batch_normalization_166 (BatchN [0][0]	(None, 7, 7, 192)	576	conv2d_166
activation_166 (Activation) ization_166[0][0]	(None, 7, 7, 192)	0	batch_normal
conv2d_167 (Conv2D) 66[0][0]	(None, 7, 7, 192)	258048	activation_1
batch_normalization_167 (BatchN [0][0]	(None, 7, 7, 192)	576	conv2d_167
activation_167 (Activation) ization_167[0][0]	(None, 7, 7, 192)	0	batch_normal
conv2d_164 (Conv2D)	(None, 7, 7, 192)	147456	mixed7[0][0]
conv2d_168 (Conv2D) 67[0][0]	(None, 7, 7, 192)	258048	activation_1


batch_normalization_164 (BatchN	(None, 7, 7, 192)	576	conv2d_164
[0][0]			
batch_normalization_168 (BatchN	(None, 7, 7, 192)	576	conv2d_168
[0][0]			
activation_164 (Activation)	(None, 7, 7, 192)	0	batch_normal
ization_164[0][0]			
activation_168 (Activation)	(None, 7, 7, 192)	0	batch_normal
ization_168[0][0]			
conv2d_165 (Conv2D)	(None, 3, 3, 320)	552960	activation_1
64[0][0]			
conv2d_169 (Conv2D)	(None, 3, 3, 192)	331776	activation_1
68[0][0]			
batch_normalization_165 (BatchN	(None, 3, 3, 320)	960	conv2d_165
[0][0]			
batch_normalization_169 (BatchN	(None, 3, 3, 192)	576	conv2d_169
[0][0]			
activation_165 (Activation)	(None, 3, 3, 320)	0	batch_normal
ization_165[0][0]			
activation_169 (Activation)	(None, 3, 3, 192)	0	batch_normal
ization_169[0][0]			
max_pooling2d_7 (MaxPooling2D)	(None, 3, 3, 768)	0	mixed7[0][0]
mixed8 (Concatenate)	(None, 3, 3, 1280)	0	activation_1
65[0][0]			
			activation_1
69[0][0]			
			max_pooling2
d_7[0][0]			
conv2d_174 (Conv2D)	(None, 3, 3, 448)	573440	mixed8[0][0]
batch_normalization_174 (BatchN	(None, 3, 3, 448)	1344	conv2d_174
[0][0]			

activation_174 (Activation) ization_174[0][0]	(None, 3, 3, 448)	0	batch_normal
conv2d_171 (Conv2D)	(None, 3, 3, 384)	491520	mixed8[0][0]
conv2d_175 (Conv2D) 74[0][0]	(None, 3, 3, 384)	1548288	activation_1
batch_normalization_171 (BatchN [0][0]	(None, 3, 3, 384)	1152	conv2d_171
batch_normalization_175 (BatchN [0][0]	(None, 3, 3, 384)	1152	conv2d_175
activation_171 (Activation) ization_171[0][0]	(None, 3, 3, 384)	0	batch_normal
activation_175 (Activation) ization_175[0][0]	(None, 3, 3, 384)	0	batch_normal
conv2d_172 (Conv2D) 71[0][0]	(None, 3, 3, 384)	442368	activation_1
conv2d_173 (Conv2D) 71[0][0]	(None, 3, 3, 384)	442368	activation_1
conv2d_176 (Conv2D) 75[0][0]	(None, 3, 3, 384)	442368	activation_1
conv2d_177 (Conv2D) 75[0][0]	(None, 3, 3, 384)	442368	activation_1
average_pooling2d_16 (AveragePo (None, 3, 3, 1280)	(None, 3, 3, 1280)	0	mixed8[0][0]
conv2d_170 (Conv2D)	(None, 3, 3, 320)	409600	mixed8[0][0]
batch_normalization_172 (BatchN [0][0]	(None, 3, 3, 384)	1152	conv2d_172
batch_normalization_173 (BatchN [0][0]	(None, 3, 3, 384)	1152	conv2d_173

batch_normalization_176 (Batch Normalization)	(None, 3, 3, 384)	1152	conv2d_176
batch_normalization_177 (Batch Normalization)	(None, 3, 3, 384)	1152	conv2d_177
conv2d_178 (Conv2D)	(None, 3, 3, 192)	245760	average_pooling2d_16
batch_normalization_170 (Batch Normalization)	(None, 3, 3, 320)	960	conv2d_170
activation_172 (Activation)	(None, 3, 3, 384)	0	batch_normalization_172
activation_173 (Activation)	(None, 3, 3, 384)	0	batch_normalization_173
activation_176 (Activation)	(None, 3, 3, 384)	0	batch_normalization_176
activation_177 (Activation)	(None, 3, 3, 384)	0	batch_normalization_177
batch_normalization_178 (Batch Normalization)	(None, 3, 3, 192)	576	conv2d_178
activation_170 (Activation)	(None, 3, 3, 320)	0	batch_normalization_170
mixed9_0 (Concatenate)	(None, 3, 3, 768)	0	activation_172
concatenate_2 (Concatenate)	(None, 3, 3, 768)	0	activation_173
activation_178 (Activation)	(None, 3, 3, 192)	0	batch_normalization_178

<u>mixed9 (Concatenate)</u> 70[0][0]	(None, 3, 3, 2048)	0	activation_1
[0]			mixed9_0[0]
2[0][0]			concatenate_
78[0][0]			activation_1
<u>conv2d_183 (Conv2D)</u>	(None, 3, 3, 448)	917504	mixed9[0][0]
<u>batch_normalization_183 (BatchN</u> [0][0]	(None, 3, 3, 448)	1344	conv2d_183
<u>activation_183 (Activation)</u> ization_183[0][0]	(None, 3, 3, 448)	0	batch_normal
<u>conv2d_180 (Conv2D)</u>	(None, 3, 3, 384)	786432	mixed9[0][0]
<u>conv2d_184 (Conv2D)</u> 83[0][0]	(None, 3, 3, 384)	1548288	activation_1
<u>batch_normalization_180 (BatchN</u> [0][0]	(None, 3, 3, 384)	1152	conv2d_180
<u>batch_normalization_184 (BatchN</u> [0][0]	(None, 3, 3, 384)	1152	conv2d_184
<u>activation_180 (Activation)</u> ization_180[0][0]	(None, 3, 3, 384)	0	batch_normal
<u>activation_184 (Activation)</u> ization_184[0][0]	(None, 3, 3, 384)	0	batch_normal
<u>conv2d_181 (Conv2D)</u> 80[0][0]	(None, 3, 3, 384)	442368	activation_1
<u>conv2d_182 (Conv2D)</u> 80[0][0]	(None, 3, 3, 384)	442368	activation_1
<u>conv2d_185 (Conv2D)</u> 84[0][0]	(None, 3, 3, 384)	442368	activation_1

conv2d_186 (Conv2D)	(None, 3, 3, 384)	442368	activation_184[0][0]
average_pooling2d_17	(AveragePool, 3, 3, 2048)	0	mixed9[0][0]
conv2d_179 (Conv2D)	(None, 3, 3, 320)	655360	mixed9[0][0]
batch_normalization_181 (Batch Normalization)	(None, 3, 3, 384)	1152	conv2d_181[0][0]
batch_normalization_182 (Batch Normalization)	(None, 3, 3, 384)	1152	conv2d_182[0][0]
batch_normalization_185 (Batch Normalization)	(None, 3, 3, 384)	1152	conv2d_185[0][0]
batch_normalization_186 (Batch Normalization)	(None, 3, 3, 384)	1152	conv2d_186[0][0]
conv2d_187 (Conv2D)	(None, 3, 3, 192)	393216	average_pooling2d_17[0][0]
batch_normalization_179 (Batch Normalization)	(None, 3, 3, 320)	960	conv2d_179[0][0]
activation_181 (Activation)	(None, 3, 3, 384)	0	batch_normalization_181[0][0]
activation_182 (Activation)	(None, 3, 3, 384)	0	batch_normalization_182[0][0]
activation_185 (Activation)	(None, 3, 3, 384)	0	batch_normalization_185[0][0]
activation_186 (Activation)	(None, 3, 3, 384)	0	batch_normalization_186[0][0]
batch_normalization_187 (Batch Normalization)	(None, 3, 3, 192)	576	conv2d_187[0][0]
activation_179 (Activation)	(None, 3, 3, 320)	0	batch_normalization_179[0][0]

<u>mixed9_1 (Concatenate)</u> 81[0][0]	(None, 3, 3, 768)	0	activation_1
82[0][0]			activation_1
<u>concatenate_3 (Concatenate)</u> 85[0][0]	(None, 3, 3, 768)	0	activation_1
86[0][0]			activation_1
<u>activation_187 (Activation)</u> ization_187[0][0]	(None, 3, 3, 192)	0	batch_normal
<u>mixed10 (Concatenate)</u> 79[0][0]	(None, 3, 3, 2048)	0	activation_1
[0]			mixed9_1[0]
3[0][0]			concatenate_
87[0][0]			activation_1
=====			
=====			
Total params: 21,802,784			
Trainable params: 0			
Non-trainable params: 21,802,784			
<hr/>			
			

```
In [18]: last_layer = pre_trained_model.get_layer('mixed7')
print('last layer output shape: ', last_layer.output_shape)
last_output = last_layer.output
```

```
# Expected Output:
# ('last layer output shape: ', (None, 7, 7, 768))
```

```
last layer output shape: (None, 7, 7, 768)
```

```
In [19]: # Define a Callback class that stops training once accuracy reaches 97.0%
class myCallback(tf.keras.callbacks.Callback):
    def on_epoch_end(self, epoch, logs={}):
        if(logs.get('accuracy')>0.97):
            print("\nReached 97.0% accuracy so cancelling training!")
            self.model.stop_training = True
```

```
In [20]: from tensorflow.keras.optimizers import RMSprop

# Flatten the output layer to 1 dimension
x = layers.Flatten()(last_output)
# Add a fully connected layer with 1,024 hidden units and ReLU activation
x = layers.Dense(1024, activation='relu')(x)
# Add a dropout rate of 0.2
x = layers.Dropout(0.2)(x)
# Add a final sigmoid layer for classification
x = layers.Dense(1, activation='sigmoid')(x)

model = Model(pre_trained_model.input, x)

model.compile(optimizer = RMSprop(lr=0.0001),
              loss = 'binary_crossentropy',
              metrics = ['accuracy'])

model.summary()

# Expected output will be large. Last few lines should be:
```

# mixed7 (Concatenate)	(None, 7, 7, 768)	0	activation_248[0][0]
#			activation_251[0][0]
#			activation_256[0][0]
#			activation_257[0][0]
#			
# flatten_4 (Flatten)	(None, 37632)	0	mixed7[0]
#			
# dense_8 (Dense)	(None, 1024)	38536192	flatten_4[0][0]
#			
# dropout_4 (Dropout)	(None, 1024)	0	dense_8[0]
#			
# dense_9 (Dense)	(None, 1)	1025	dropout_4[0][0]
#			
#			
#			
# Total params:	47,512,481		
# Trainable params:	38,537,217		
# Non-trainable params:	8,975,264		

Model: "model_1"

Layer (type)	Output Shape	Param #	Connected to
=====			
input_2 (InputLayer)	[(None, 150, 150, 3) 0		
=====			
conv2d_94 (Conv2D)	(None, 74, 74, 32)	864	input_2[0]
=====			
batch_normalization_94 (BatchNo	(None, 74, 74, 32)	96	conv2d_94[0]
[0]			
=====			
activation_94 (Activation)	(None, 74, 74, 32)	0	batch_normal
ization_94[0][0]			
=====			
conv2d_95 (Conv2D)	(None, 72, 72, 32)	9216	activation_9
4[0][0]			
=====			
batch_normalization_95 (BatchNo	(None, 72, 72, 32)	96	conv2d_95[0]
[0]			
=====			
activation_95 (Activation)	(None, 72, 72, 32)	0	batch_normal
ization_95[0][0]			
=====			
conv2d_96 (Conv2D)	(None, 72, 72, 64)	18432	activation_9
5[0][0]			
=====			
batch_normalization_96 (BatchNo	(None, 72, 72, 64)	192	conv2d_96[0]
[0]			
=====			
activation_96 (Activation)	(None, 72, 72, 64)	0	batch_normal
ization_96[0][0]			
=====			
max_pooling2d_4 (MaxPooling2D)	(None, 35, 35, 64)	0	activation_9
6[0][0]			
=====			
conv2d_97 (Conv2D)	(None, 35, 35, 80)	5120	max_pooling2
d_4[0][0]			
=====			
batch_normalization_97 (BatchNo	(None, 35, 35, 80)	240	conv2d_97[0]
[0]			
=====			

activation_97 (Activation)	(None, 35, 35, 80)	0	batch_normalization_97[0][0]
conv2d_98 (Conv2D)	(None, 33, 33, 192)	138240	activation_97[0][0]
batch_normalization_98 (Batch Normalization)	(None, 33, 33, 192)	576	conv2d_98[0][0]
activation_98 (Activation)	(None, 33, 33, 192)	0	batch_normalization_98[0][0]
max_pooling2d_5 (MaxPooling2D)	(None, 16, 16, 192)	0	activation_98[0][0]
conv2d_102 (Conv2D)	(None, 16, 16, 64)	12288	max_pooling2d_5[0][0]
batch_normalization_102 (Batch Normalization)	(None, 16, 16, 64)	192	conv2d_102[0][0]
activation_102 (Activation)	(None, 16, 16, 64)	0	batch_normalization_102[0][0]
conv2d_100 (Conv2D)	(None, 16, 16, 48)	9216	max_pooling2d_5[0][0]
conv2d_103 (Conv2D)	(None, 16, 16, 96)	55296	activation_102[0][0]
batch_normalization_100 (Batch Normalization)	(None, 16, 16, 48)	144	conv2d_100[0][0]
batch_normalization_103 (Batch Normalization)	(None, 16, 16, 96)	288	conv2d_103[0][0]
activation_100 (Activation)	(None, 16, 16, 48)	0	batch_normalization_100[0][0]
activation_103 (Activation)	(None, 16, 16, 96)	0	batch_normalization_103[0][0]
average_pooling2d_9 (AveragePooling2D)	(None, 16, 16, 192)	0	max_pooling2d_5[0][0]

d_5[0][0]

conv2d_99 (Conv2D) d_5[0][0]	(None, 16, 16, 64)	12288	max_pooling2
conv2d_101 (Conv2D) 00[0][0]	(None, 16, 16, 64)	76800	activation_1
conv2d_104 (Conv2D) 03[0][0]	(None, 16, 16, 96)	82944	activation_1
conv2d_105 (Conv2D) ing2d_9[0][0]	(None, 16, 16, 32)	6144	average_pool
batch_normalization_99 (BatchNo [0])	(None, 16, 16, 64)	192	conv2d_99[0]
batch_normalization_101 (BatchN [0][0])	(None, 16, 16, 64)	192	conv2d_101
batch_normalization_104 (BatchN [0][0])	(None, 16, 16, 96)	288	conv2d_104
batch_normalization_105 (BatchN [0][0])	(None, 16, 16, 32)	96	conv2d_105
activation_99 (Activation) ization_99[0][0]	(None, 16, 16, 64)	0	batch_normal
activation_101 (Activation) ization_101[0][0]	(None, 16, 16, 64)	0	batch_normal
activation_104 (Activation) ization_104[0][0]	(None, 16, 16, 96)	0	batch_normal
activation_105 (Activation) ization_105[0][0]	(None, 16, 16, 32)	0	batch_normal
mixed0 (Concatenate) 9[0][0]	(None, 16, 16, 256)	0	activation_9
01[0][0]			activation_1
04[0][0]			activation_1

activation_1

05[0][0]

conv2d_109 (Conv2D)	(None, 16, 16, 64)	16384	mixed0[0][0]
batch_normalization_109 (Batch Normalization)	(None, 16, 16, 64)	192	conv2d_109[0][0]
activation_109 (Activation)	(None, 16, 16, 64)	0	batch_normalization_109[0][0]
conv2d_107 (Conv2D)	(None, 16, 16, 48)	12288	mixed0[0][0]
conv2d_110 (Conv2D)	(None, 16, 16, 96)	55296	activation_109[0][0]
batch_normalization_107 (Batch Normalization)	(None, 16, 16, 48)	144	conv2d_107[0][0]
batch_normalization_110 (Batch Normalization)	(None, 16, 16, 96)	288	conv2d_110[0][0]
activation_107 (Activation)	(None, 16, 16, 48)	0	batch_normalization_107[0][0]
activation_110 (Activation)	(None, 16, 16, 96)	0	batch_normalization_110[0][0]
average_pooling2d_10 (Average Pooling)	(None, 16, 16, 256)	0	mixed0[0][0]
conv2d_106 (Conv2D)	(None, 16, 16, 64)	16384	mixed0[0][0]
conv2d_108 (Conv2D)	(None, 16, 16, 64)	76800	activation_107[0][0]
conv2d_111 (Conv2D)	(None, 16, 16, 96)	82944	activation_110[0][0]
conv2d_112 (Conv2D)	(None, 16, 16, 64)	16384	average_pooling2d_10[0][0]
batch_normalization_106 (Batch Normalization)	(None, 16, 16, 64)	192	conv2d_106

[0][0]

batch_normalization_108 (BatchN	(None, 16, 16, 64)	192	conv2d_108
[0][0]			
batch_normalization_111 (BatchN	(None, 16, 16, 96)	288	conv2d_111
[0][0]			
batch_normalization_112 (BatchN	(None, 16, 16, 64)	192	conv2d_112
[0][0]			
activation_106 (Activation)	(None, 16, 16, 64)	0	batch_normal
ization_106[0][0]			
activation_108 (Activation)	(None, 16, 16, 64)	0	batch_normal
ization_108[0][0]			
activation_111 (Activation)	(None, 16, 16, 96)	0	batch_normal
ization_111[0][0]			
activation_112 (Activation)	(None, 16, 16, 64)	0	batch_normal
ization_112[0][0]			
mixed1 (Concatenate)	(None, 16, 16, 288)	0	activation_1
06[0][0]			
			activation_1
08[0][0]			
			activation_1
11[0][0]			
			activation_1
12[0][0]			
conv2d_116 (Conv2D)	(None, 16, 16, 64)	18432	mixed1[0][0]
batch_normalization_116 (BatchN	(None, 16, 16, 64)	192	conv2d_116
[0][0]			
activation_116 (Activation)	(None, 16, 16, 64)	0	batch_normal
ization_116[0][0]			
conv2d_114 (Conv2D)	(None, 16, 16, 48)	13824	mixed1[0][0]
conv2d_117 (Conv2D)	(None, 16, 16, 96)	55296	activation_1
16[0][0]			

batch_normalization_114 (BatchN (None, 16, 16, 48) [0][0])	144	conv2d_114
batch_normalization_117 (BatchN (None, 16, 16, 96) [0][0])	288	conv2d_117
activation_114 (Activation) (None, 16, 16, 48) [0][0])	0	batch_normal
activation_117 (Activation) (None, 16, 16, 96) [0][0])	0	batch_normal
average_pooling2d_11 (AveragePo (None, 16, 16, 288) [0][0])	0	mixed1[0][0]
conv2d_113 (Conv2D) (None, 16, 16, 64)	18432	mixed1[0][0]
conv2d_115 (Conv2D) (None, 16, 16, 64) [0][0])	76800	activation_1
conv2d_118 (Conv2D) (None, 16, 16, 96) [0][0])	82944	activation_1
conv2d_119 (Conv2D) (None, 16, 16, 64) [0][0])	18432	average_pool
batch_normalization_113 (BatchN (None, 16, 16, 64) [0][0])	192	conv2d_113
batch_normalization_115 (BatchN (None, 16, 16, 64) [0][0])	192	conv2d_115
batch_normalization_118 (BatchN (None, 16, 16, 96) [0][0])	288	conv2d_118
batch_normalization_119 (BatchN (None, 16, 16, 64) [0][0])	192	conv2d_119
activation_113 (Activation) (None, 16, 16, 64) [0][0])	0	batch_normal
activation_115 (Activation) (None, 16, 16, 64)	0	batch_normal

ization_115[0][0]

activation_118 (Activation) ization_118[0][0]	(None, 16, 16, 96)	0	batch_normal
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activation_119 (Activation) ization_119[0][0]	(None, 16, 16, 64)	0	batch_normal
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mixed2 (Concatenate) 13[0][0]	(None, 16, 16, 288)	0	activation_1
15[0][0]			activation_1
18[0][0]			activation_1
19[0][0]			activation_1

conv2d_121 (Conv2D)	(None, 16, 16, 64)	18432	mixed2[0][0]
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batch_normalization_121 (BatchN [0][0])	(None, 16, 16, 64)	192	conv2d_121
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activation_121 (Activation) ization_121[0][0]	(None, 16, 16, 64)	0	batch_normal
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conv2d_122 (Conv2D) 21[0][0]	(None, 16, 16, 96)	55296	activation_1
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batch_normalization_122 (BatchN [0][0])	(None, 16, 16, 96)	288	conv2d_122
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activation_122 (Activation) ization_122[0][0]	(None, 16, 16, 96)	0	batch_normal
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conv2d_120 (Conv2D)	(None, 7, 7, 384)	995328	mixed2[0][0]
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conv2d_123 (Conv2D) 22[0][0]	(None, 7, 7, 96)	82944	activation_1
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batch_normalization_120 (BatchN [0][0])	(None, 7, 7, 384)	1152	conv2d_120
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batch_normalization_123 (BatchN [0][0])	(None, 7, 7, 96)	288	conv2d_123
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activation_120 (Activation) ization_120[0][0]	(None, 7, 7, 384)	0	batch_normal
activation_123 (Activation) ization_123[0][0]	(None, 7, 7, 96)	0	batch_normal
max_pooling2d_6 (MaxPooling2D)	(None, 7, 7, 288)	0	mixed2[0][0]
mixed3 (Concatenate) 20[0][0] 23[0][0] d_6[0][0]	(None, 7, 7, 768)	0	activation_1 activation_1 max_pooling2
conv2d_128 (Conv2D)	(None, 7, 7, 128)	98304	mixed3[0][0]
batch_normalization_128 (BatchN [0][0])	(None, 7, 7, 128)	384	conv2d_128
activation_128 (Activation) ization_128[0][0]	(None, 7, 7, 128)	0	batch_normal
conv2d_129 (Conv2D) 28[0][0]	(None, 7, 7, 128)	114688	activation_1
batch_normalization_129 (BatchN [0][0])	(None, 7, 7, 128)	384	conv2d_129
activation_129 (Activation) ization_129[0][0]	(None, 7, 7, 128)	0	batch_normal
conv2d_125 (Conv2D)	(None, 7, 7, 128)	98304	mixed3[0][0]
conv2d_130 (Conv2D) 29[0][0]	(None, 7, 7, 128)	114688	activation_1
batch_normalization_125 (BatchN [0][0])	(None, 7, 7, 128)	384	conv2d_125
batch_normalization_130 (BatchN [0][0])	(None, 7, 7, 128)	384	conv2d_130

activation_125 (Activation) ization_125[0][0]	(None, 7, 7, 128)	0	batch_normal
activation_130 (Activation) ization_130[0][0]	(None, 7, 7, 128)	0	batch_normal
conv2d_126 (Conv2D) 25[0][0]	(None, 7, 7, 128)	114688	activation_1
conv2d_131 (Conv2D) 30[0][0]	(None, 7, 7, 128)	114688	activation_1
batch_normalization_126 (BatchN [0][0])	(None, 7, 7, 128)	384	conv2d_126
batch_normalization_131 (BatchN [0][0])	(None, 7, 7, 128)	384	conv2d_131
activation_126 (Activation) ization_126[0][0]	(None, 7, 7, 128)	0	batch_normal
activation_131 (Activation) ization_131[0][0]	(None, 7, 7, 128)	0	batch_normal
average_pooling2d_12 (AveragePo [0][0])	(None, 7, 7, 768)	0	mixed3[0][0]
conv2d_124 (Conv2D)	(None, 7, 7, 192)	147456	mixed3[0][0]
conv2d_127 (Conv2D) 26[0][0]	(None, 7, 7, 192)	172032	activation_1
conv2d_132 (Conv2D) 31[0][0]	(None, 7, 7, 192)	172032	activation_1
conv2d_133 (Conv2D) ing2d_12[0][0]	(None, 7, 7, 192)	147456	average_pool
batch_normalization_124 (BatchN [0][0])	(None, 7, 7, 192)	576	conv2d_124
batch_normalization_127 (BatchN [0][0])	(None, 7, 7, 192)	576	conv2d_127

[0][0]

batch_normalization_132 (BatchN [0][0])	(None, 7, 7, 192)	576	conv2d_132
batch_normalization_133 (BatchN [0][0])	(None, 7, 7, 192)	576	conv2d_133
activation_124 (Activation) ization_124[0][0]	(None, 7, 7, 192)	0	batch_normal
activation_127 (Activation) ization_127[0][0]	(None, 7, 7, 192)	0	batch_normal
activation_132 (Activation) ization_132[0][0]	(None, 7, 7, 192)	0	batch_normal
activation_133 (Activation) ization_133[0][0]	(None, 7, 7, 192)	0	batch_normal
mixed4 (Concatenate) 24[0][0] 27[0][0] 32[0][0] 33[0][0]	(None, 7, 7, 768)	0	activation_1 activation_1 activation_1 activation_1
conv2d_138 (Conv2D)	(None, 7, 7, 160)	122880	mixed4[0][0]
batch_normalization_138 (BatchN [0][0])	(None, 7, 7, 160)	480	conv2d_138
activation_138 (Activation) ization_138[0][0]	(None, 7, 7, 160)	0	batch_normal
conv2d_139 (Conv2D) 38[0][0]	(None, 7, 7, 160)	179200	activation_1
batch_normalization_139 (BatchN [0][0])	(None, 7, 7, 160)	480	conv2d_139
activation_139 (Activation)	(None, 7, 7, 160)	0	batch_normal

ization_139[0][0]

conv2d_135 (Conv2D)	(None, 7, 7, 160)	122880	mixed4[0][0]
conv2d_140 (Conv2D) 39[0][0]	(None, 7, 7, 160)	179200	activation_1
batch_normalization_135 (BatchN [0][0])	(None, 7, 7, 160)	480	conv2d_135
batch_normalization_140 (BatchN [0][0])	(None, 7, 7, 160)	480	conv2d_140
activation_135 (Activation) ization_135[0][0]	(None, 7, 7, 160)	0	batch_normal
activation_140 (Activation) ization_140[0][0]	(None, 7, 7, 160)	0	batch_normal
conv2d_136 (Conv2D) 35[0][0]	(None, 7, 7, 160)	179200	activation_1
conv2d_141 (Conv2D) 40[0][0]	(None, 7, 7, 160)	179200	activation_1
batch_normalization_136 (BatchN [0][0])	(None, 7, 7, 160)	480	conv2d_136
batch_normalization_141 (BatchN [0][0])	(None, 7, 7, 160)	480	conv2d_141
activation_136 (Activation) ization_136[0][0]	(None, 7, 7, 160)	0	batch_normal
activation_141 (Activation) ization_141[0][0]	(None, 7, 7, 160)	0	batch_normal
average_pooling2d_13 (AveragePo	(None, 7, 7, 768)	0	mixed4[0][0]
conv2d_134 (Conv2D)	(None, 7, 7, 192)	147456	mixed4[0][0]
conv2d_137 (Conv2D)	(None, 7, 7, 192)	215040	activation_1

36[0][0]

conv2d_142 (Conv2D) 41[0][0]	(None, 7, 7, 192)	215040	activation_1
conv2d_143 (Conv2D) ing2d_13[0][0]	(None, 7, 7, 192)	147456	average_pool
batch_normalization_134 (BatchN [0][0]	(None, 7, 7, 192)	576	conv2d_134
batch_normalization_137 (BatchN [0][0]	(None, 7, 7, 192)	576	conv2d_137
batch_normalization_142 (BatchN [0][0]	(None, 7, 7, 192)	576	conv2d_142
batch_normalization_143 (BatchN [0][0]	(None, 7, 7, 192)	576	conv2d_143
activation_134 (Activation) ization_134[0][0]	(None, 7, 7, 192)	0	batch_normal
activation_137 (Activation) ization_137[0][0]	(None, 7, 7, 192)	0	batch_normal
activation_142 (Activation) ization_142[0][0]	(None, 7, 7, 192)	0	batch_normal
activation_143 (Activation) ization_143[0][0]	(None, 7, 7, 192)	0	batch_normal
mixed5 (Concatenate) 34[0][0] 37[0][0] 42[0][0] 43[0][0]	(None, 7, 7, 768)	0	activation_1 activation_1 activation_1 activation_1
conv2d_148 (Conv2D)	(None, 7, 7, 160)	122880	mixed5[0][0]
batch_normalization_148 (BatchN	(None, 7, 7, 160)	480	conv2d_148

[0][0]

activation_148 (Activation) ization_148[0][0]	(None, 7, 7, 160)	0	batch_normal
conv2d_149 (Conv2D) 48[0][0]	(None, 7, 7, 160)	179200	activation_1
batch_normalization_149 (BatchN [0][0]	(None, 7, 7, 160)	480	conv2d_149
activation_149 (Activation) ization_149[0][0]	(None, 7, 7, 160)	0	batch_normal
conv2d_145 (Conv2D)	(None, 7, 7, 160)	122880	mixed5[0][0]
conv2d_150 (Conv2D) 49[0][0]	(None, 7, 7, 160)	179200	activation_1
batch_normalization_145 (BatchN [0][0]	(None, 7, 7, 160)	480	conv2d_145
batch_normalization_150 (BatchN [0][0]	(None, 7, 7, 160)	480	conv2d_150
activation_145 (Activation) ization_145[0][0]	(None, 7, 7, 160)	0	batch_normal
activation_150 (Activation) ization_150[0][0]	(None, 7, 7, 160)	0	batch_normal
conv2d_146 (Conv2D) 45[0][0]	(None, 7, 7, 160)	179200	activation_1
conv2d_151 (Conv2D) 50[0][0]	(None, 7, 7, 160)	179200	activation_1
batch_normalization_146 (BatchN [0][0]	(None, 7, 7, 160)	480	conv2d_146
batch_normalization_151 (BatchN [0][0]	(None, 7, 7, 160)	480	conv2d_151

activation_146 (Activation) ization_146[0][0]	(None, 7, 7, 160)	0	batch_normal
activation_151 (Activation) ization_151[0][0]	(None, 7, 7, 160)	0	batch_normal
average_pooling2d_14 (AveragePo	(None, 7, 7, 768)	0	mixed5[0][0]
conv2d_144 (Conv2D)	(None, 7, 7, 192)	147456	mixed5[0][0]
conv2d_147 (Conv2D) 46[0][0]	(None, 7, 7, 192)	215040	activation_1
conv2d_152 (Conv2D) 51[0][0]	(None, 7, 7, 192)	215040	activation_1
conv2d_153 (Conv2D) ing2d_14[0][0]	(None, 7, 7, 192)	147456	average_pool
batch_normalization_144 (BatchN [0][0]	(None, 7, 7, 192)	576	conv2d_144
batch_normalization_147 (BatchN [0][0]	(None, 7, 7, 192)	576	conv2d_147
batch_normalization_152 (BatchN [0][0]	(None, 7, 7, 192)	576	conv2d_152
batch_normalization_153 (BatchN [0][0]	(None, 7, 7, 192)	576	conv2d_153
activation_144 (Activation) ization_144[0][0]	(None, 7, 7, 192)	0	batch_normal
activation_147 (Activation) ization_147[0][0]	(None, 7, 7, 192)	0	batch_normal
activation_152 (Activation) ization_152[0][0]	(None, 7, 7, 192)	0	batch_normal
activation_153 (Activation) ization_153[0][0]	(None, 7, 7, 192)	0	batch_normal

<u>mixed6 (Concatenate)</u> 44[0][0]	(None, 7, 7, 768)	0	activation_1
47[0][0]			activation_1
52[0][0]			activation_1
53[0][0]			activation_1
<u>conv2d_158 (Conv2D)</u>	(None, 7, 7, 192)	147456	mixed6[0][0]
<u>batch_normalization_158 (BatchN</u> [0][0]	(None, 7, 7, 192)	576	conv2d_158
<u>activation_158 (Activation)</u> ization_158[0][0]	(None, 7, 7, 192)	0	batch_normal
<u>conv2d_159 (Conv2D)</u> 58[0][0]	(None, 7, 7, 192)	258048	activation_1
<u>batch_normalization_159 (BatchN</u> [0][0]	(None, 7, 7, 192)	576	conv2d_159
<u>activation_159 (Activation)</u> ization_159[0][0]	(None, 7, 7, 192)	0	batch_normal
<u>conv2d_155 (Conv2D)</u>	(None, 7, 7, 192)	147456	mixed6[0][0]
<u>conv2d_160 (Conv2D)</u> 59[0][0]	(None, 7, 7, 192)	258048	activation_1
<u>batch_normalization_155 (BatchN</u> [0][0]	(None, 7, 7, 192)	576	conv2d_155
<u>batch_normalization_160 (BatchN</u> [0][0]	(None, 7, 7, 192)	576	conv2d_160
<u>activation_155 (Activation)</u> ization_155[0][0]	(None, 7, 7, 192)	0	batch_normal
<u>activation_160 (Activation)</u> ization_160[0][0]	(None, 7, 7, 192)	0	batch_normal

conv2d_156 (Conv2D) 55[0][0]	(None, 7, 7, 192)	258048	activation_1
conv2d_161 (Conv2D) 60[0][0]	(None, 7, 7, 192)	258048	activation_1
batch_normalization_156 (BatchN [0][0])	(None, 7, 7, 192)	576	conv2d_156
batch_normalization_161 (BatchN [0][0])	(None, 7, 7, 192)	576	conv2d_161
activation_156 (Activation) ization_156[0][0]	(None, 7, 7, 192)	0	batch_normal
activation_161 (Activation) ization_161[0][0]	(None, 7, 7, 192)	0	batch_normal
average_pooling2d_15 (AveragePo [0][0])	(None, 7, 7, 768)	0	mixed6[0][0]
conv2d_154 (Conv2D)	(None, 7, 7, 192)	147456	mixed6[0][0]
conv2d_157 (Conv2D) 56[0][0]	(None, 7, 7, 192)	258048	activation_1
conv2d_162 (Conv2D) 61[0][0]	(None, 7, 7, 192)	258048	activation_1
conv2d_163 (Conv2D) ing2d_15[0][0]	(None, 7, 7, 192)	147456	average_pool
batch_normalization_154 (BatchN [0][0])	(None, 7, 7, 192)	576	conv2d_154
batch_normalization_157 (BatchN [0][0])	(None, 7, 7, 192)	576	conv2d_157
batch_normalization_162 (BatchN [0][0])	(None, 7, 7, 192)	576	conv2d_162
batch_normalization_163 (BatchN [0][0])	(None, 7, 7, 192)	576	conv2d_163

activation_154 (Activation) ization_154[0][0]	(None, 7, 7, 192)	0	batch_normal
activation_157 (Activation) ization_157[0][0]	(None, 7, 7, 192)	0	batch_normal
activation_162 (Activation) ization_162[0][0]	(None, 7, 7, 192)	0	batch_normal
activation_163 (Activation) ization_163[0][0]	(None, 7, 7, 192)	0	batch_normal
mixed7 (Concatenate) 54[0][0] 57[0][0] 62[0][0] 63[0][0]	(None, 7, 7, 768)	0	activation_1 activation_1 activation_1 activation_1
flatten_1 (Flatten)	(None, 37632)	0	mixed7[0][0]
dense_2 (Dense) [0]	(None, 1024)	38536192	flatten_1[0]
dropout_1 (Dropout) [0]	(None, 1024)	0	dense_2[0]
dense_3 (Dense) [0]	(None, 1)	1025	dropout_1[0]
=====			
Total params: 47,512,481			
Trainable params: 38,537,217			
Non-trainable params: 8,975,264			
<div> <div></div> <div></div> </div>			

```
In [21]: # Get the Horse or Human dataset
path_horse_or_human = f"{getcwd()}/../tmp2/horse-or-human.zip"
# Get the Horse or Human Validation dataset
path_validation_horse_or_human = f"{getcwd()}/../tmp2/validation-horse-or-human.zip"
from tensorflow.keras.preprocessing.image import ImageDataGenerator

import os
import zipfile
import shutil

shutil.rmtree('/tmp')
local_zip = path_horse_or_human
zip_ref = zipfile.ZipFile(local_zip, 'r')
zip_ref.extractall('/tmp/training')
zip_ref.close()

local_zip = path_validation_horse_or_human
zip_ref = zipfile.ZipFile(local_zip, 'r')
zip_ref.extractall('/tmp/validation')
zip_ref.close()
```

```
In [22]: # Define our example directories and files
train_dir = '/tmp/training'
validation_dir = '/tmp/validation'

train_horses_dir = os.path.join(train_dir, 'horses')
train_humans_dir = os.path.join(train_dir, 'humans')
validation_horses_dir = os.path.join(validation_dir, 'horses')
validation_humans_dir = os.path.join(validation_dir, 'humans')

train_horses_fnames = os.listdir(train_horses_dir)
train_humans_fnames = os.listdir(train_humans_dir)
validation_horses_fnames = os.listdir(validation_horses_dir)
validation_humans_fnames = os.listdir(validation_humans_dir)

print(len(train_horses_fnames))
print(len(train_humans_fnames))
print(len(validation_horses_fnames))
print(len(validation_humans_fnames))

# Expected Output:
# 500
# 527
# 128
# 128
```

```
500
527
128
128
```

```
In [23]: # Add our data-augmentation parameters to ImageDataGenerator
train_datagen = ImageDataGenerator(rescale = 1./255.,
                                   rotation_range = 40,
                                   width_shift_range = 0.2,
                                   height_shift_range = 0.2,
                                   shear_range = 0.2,
                                   zoom_range = 0.2,
                                   horizontal_flip = True)

# Note that the validation data should not be augmented!
test_datagen = ImageDataGenerator( rescale = 1.0/255. )

# Flow training images in batches of 20 using train_datagen generator
train_generator = train_datagen.flow_from_directory(train_dir,
                                                    batch_size = 20,
                                                    class_mode = 'binary',
                                                    target_size = (150, 150))

# Flow validation images in batches of 20 using test_datagen generator
validation_generator = test_datagen.flow_from_directory( validation_dir,
                                                         batch_size = 20,
                                                         class_mode = 'binary',
                                                         target_size = (150,
                                                         150))

# Expected Output:
# Found 1027 images belonging to 2 classes.
# Found 256 images belonging to 2 classes.
```

```
Found 1027 images belonging to 2 classes.
Found 256 images belonging to 2 classes.
```

In [24]: *# Run this and see how many epochs it should take before the callback
fires, and stops training at 97% accuracy*

```
callbacks = myCallback()
history = model.fit_generator(train_generator,
                             validation_data = validation_generator,
                             steps_per_epoch = 50,
                             epochs = 3,
                             validation_steps = 12,
                             verbose = 1,
                             callbacks=[callbacks])
```

Epoch 1/3

50/50 [=====] - 49s 982ms/step - loss: 0.2969 - accuracy: 0.8825 - val_loss: 0.0049 - val_accuracy: 1.0000

Epoch 2/3

50/50 [=====] - 49s 980ms/step - loss: 0.0863 - accuracy: 0.9676 - val_loss: 0.0017 - val_accuracy: 1.0000

Epoch 3/3

49/50 [=====>.] - ETA: 0s - loss: 0.0732 - accuracy: 0.9741

Reached 97.0% accuracy so cancelling training!

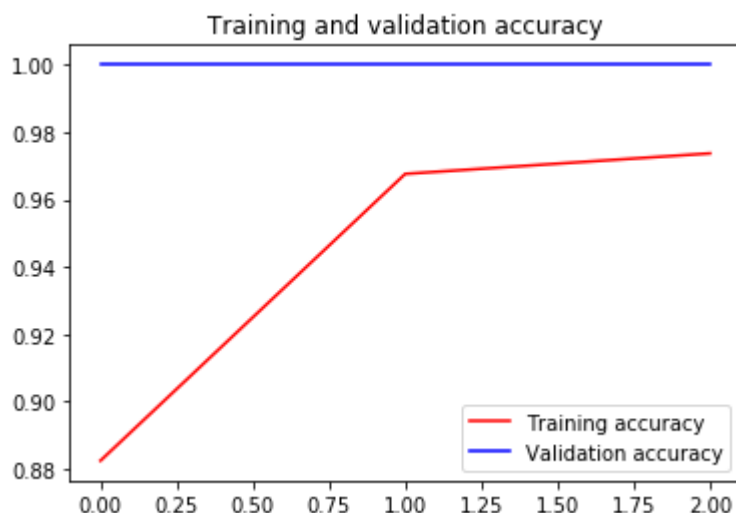
50/50 [=====] - 50s 994ms/step - loss: 0.0727 - accuracy: 0.9737 - val_loss: 7.0780e-04 - val_accuracy: 1.0000

```
In [25]: %matplotlib inline
import matplotlib.pyplot as plt
acc = history.history['accuracy']
val_acc = history.history['val_accuracy']
loss = history.history['loss']
val_loss = history.history['val_loss']

epochs = range(len(acc))

plt.plot(epochs, acc, 'r', label='Training accuracy')
plt.plot(epochs, val_acc, 'b', label='Validation accuracy')
plt.title('Training and validation accuracy')
plt.legend(loc=0)
plt.figure()

plt.show()
```



<Figure size 432x288 with 0 Axes>

Submission Instructions

```
In [ ]: # Now click the 'Submit Assignment' button above.
```

When you're done or would like to take a break, please run the two cells below to save your work and close the Notebook. This will free up resources for your fellow learners.

```
In [ ]: %%javascript
<!-- Save the notebook -->
IPython.notebook.save_checkpoint();
```



```
In [ ]: %%javascript
        IPython.notebook.session.delete();
        window.onbeforeunload = null
        setTimeout(function() { window.close(); }, 1000);
```