

inception_training_xray

June 30, 2020

```
[ ]: import pandas as pd
import numpy as np
from tqdm import tqdm
import warnings
warnings.filterwarnings('ignore')
import tensorflow as tf
from tensorflow.keras.applications.inception_v3 import InceptionV3, preprocess_input
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.models import Model
import os
import matplotlib.pyplot as plt
%matplotlib inline
```

1 Data Description

source: <https://www.kaggle.com/yash612/covidnet-mini-and-gan-enerated-chest-xray>

1.1 Acknowledgements

We wouldn't be here without the help of others.

<https://ieeexplore.ieee.org/document/9093842> , Covid GAN

<https://github.com/lindawangg/COVID-Net> , COVID-Net

<https://github.com/ieee8023/covid-chestxray-dataset> , IEEE dataset

RSNA dataset

[http://www.cell.com/cell/fulltext/S0092-8674\(18\)30154-5](http://www.cell.com/cell/fulltext/S0092-8674(18)30154-5)

```
[ ]: train_dir = os.path.join("data/chest_xray/chest_xray/train")
validation_dir = os.path.join("data/chest_xray/chest_xray/test")
testing_dir = os.path.join("data/chest_xray/chest_xray/val")
```

```
[ ]: train_datagen = ImageDataGenerator(rescale = 1./255.,
                                      rotation_range = 30,
                                      width_shift_range = 0.2,
                                      height_shift_range = 0.2,
                                      shear_range = 0.2,
                                      zoom_range = 0.2)
```

```

validation_datagen = ImageDataGenerator(rescale = 1./255.)

test_datagen = ImageDataGenerator( rescale = 1.0/255.)

train_generator = train_datagen.flow_from_directory(train_dir, batch_size = 32,
↳class_mode='categorical', color_mode='rgb',
target_size = (299, 299))

validation_generator = validation_datagen.flow_from_directory(validation_dir,
↳batch_size = 32,color_mode='rgb',
↳class_mode='categorical',
target_size = (299,
↳299))

test_generator = test_datagen.flow_from_directory(testing_dir, batch_size =
↳32, class_mode='categorical', color_mode='rgb',
target_size = (299, 299))

```

Found 5882 images belonging to 3 classes.

Found 635 images belonging to 3 classes.

Found 27 images belonging to 3 classes.

```

[ ]: InceptionV3_model = InceptionV3(include_top=False, weights='imagenet',
↳pooling='avg', input_shape=(299,299,3))
InceptionV3_model.input, InceptionV3_model.output
x=tf.keras.layers.Dense(256, activation='relu')(InceptionV3_model.output)
x=tf.keras.layers.Dense(64, activation='relu')(x)
output_layer = tf.keras.layers.Dense(3, activation='softmax')(x)
model = tf.keras.Model(InceptionV3_model.input, output_layer)
model.summary()

```

Model: "model_10"

Layer (type)	Output Shape	Param #	Connected to
input_10 (InputLayer)	[(None, 299, 299, 3)]	0	
conv2d_94 (Conv2D)	(None, 149, 149, 32)	864	input_10[0][0]
batch_normalization_94 (Batch Normalization)	(None, 149, 149, 32)	96	conv2d_94[0][0]

```

activation_94 (Activation)      (None, 149, 149, 32) 0
batch_normalization_94[0][0]

-----

conv2d_95 (Conv2D)             (None, 147, 147, 32) 9216
activation_94[0][0]

-----

batch_normalization_95 (BatchNo (None, 147, 147, 32) 96      conv2d_95[0][0]
-----

activation_95 (Activation)      (None, 147, 147, 32) 0
batch_normalization_95[0][0]

-----

conv2d_96 (Conv2D)             (None, 147, 147, 64) 18432
activation_95[0][0]

-----

batch_normalization_96 (BatchNo (None, 147, 147, 64) 192      conv2d_96[0][0]
-----

activation_96 (Activation)      (None, 147, 147, 64) 0
batch_normalization_96[0][0]

-----

max_pooling2d_4 (MaxPooling2D) (None, 73, 73, 64) 0
activation_96[0][0]

-----

conv2d_97 (Conv2D)             (None, 73, 73, 80) 5120
max_pooling2d_4[0][0]

-----

batch_normalization_97 (BatchNo (None, 73, 73, 80) 240      conv2d_97[0][0]
-----

activation_97 (Activation)      (None, 73, 73, 80) 0
batch_normalization_97[0][0]

-----

conv2d_98 (Conv2D)             (None, 71, 71, 192) 138240
activation_97[0][0]

-----

batch_normalization_98 (BatchNo (None, 71, 71, 192) 576      conv2d_98[0][0]
-----

```

```

activation_98 (Activation)      (None, 71, 71, 192)  0
batch_normalization_98[0][0]

-----

max_pooling2d_5 (MaxPooling2D) (None, 35, 35, 192)  0
activation_98[0][0]

-----

conv2d_102 (Conv2D)             (None, 35, 35, 64)   12288
max_pooling2d_5[0][0]

-----

batch_normalization_102 (BatchN (None, 35, 35, 64)   192
conv2d_102[0][0]

-----

activation_102 (Activation)      (None, 35, 35, 64)   0
batch_normalization_102[0][0]

-----

conv2d_100 (Conv2D)             (None, 35, 35, 48)   9216
max_pooling2d_5[0][0]

-----

conv2d_103 (Conv2D)             (None, 35, 35, 96)   55296
activation_102[0][0]

-----

batch_normalization_100 (BatchN (None, 35, 35, 48)   144
conv2d_100[0][0]

-----

batch_normalization_103 (BatchN (None, 35, 35, 96)   288
conv2d_103[0][0]

-----

activation_100 (Activation)      (None, 35, 35, 48)   0
batch_normalization_100[0][0]

-----

activation_103 (Activation)      (None, 35, 35, 96)   0
batch_normalization_103[0][0]

-----

average_pooling2d_9 (AveragePoo (None, 35, 35, 192)  0
max_pooling2d_5[0][0]

-----

```

conv2d_99 (Conv2D)	(None, 35, 35, 64)	12288	
max_pooling2d_5[0][0]			

conv2d_101 (Conv2D)	(None, 35, 35, 64)	76800	
activation_100[0][0]			

conv2d_104 (Conv2D)	(None, 35, 35, 96)	82944	
activation_103[0][0]			

conv2d_105 (Conv2D)	(None, 35, 35, 32)	6144	
average_pooling2d_9[0][0]			

batch_normalization_99 (BatchNo	(None, 35, 35, 64)	192	conv2d_99[0][0]

batch_normalization_101 (BatchN	(None, 35, 35, 64)	192	
conv2d_101[0][0]			

batch_normalization_104 (BatchN	(None, 35, 35, 96)	288	
conv2d_104[0][0]			

batch_normalization_105 (BatchN	(None, 35, 35, 32)	96	
conv2d_105[0][0]			

activation_99 (Activation)	(None, 35, 35, 64)	0	
batch_normalization_99[0][0]			

activation_101 (Activation)	(None, 35, 35, 64)	0	
batch_normalization_101[0][0]			

activation_104 (Activation)	(None, 35, 35, 96)	0	
batch_normalization_104[0][0]			

activation_105 (Activation)	(None, 35, 35, 32)	0	
batch_normalization_105[0][0]			

mixed0 (Concatenate)	(None, 35, 35, 256)	0	

```

activation_99[0][0]
activation_101[0][0]
activation_104[0][0]
activation_105[0][0]

-----

conv2d_109 (Conv2D)          (None, 35, 35, 64)    16384    mixed0[0][0]
-----

batch_normalization_109 (BatchN (None, 35, 35, 64)    192
conv2d_109[0][0]

-----

activation_109 (Activation)    (None, 35, 35, 64)    0
batch_normalization_109[0][0]
-----

conv2d_107 (Conv2D)          (None, 35, 35, 48)    12288    mixed0[0][0]
-----

conv2d_110 (Conv2D)          (None, 35, 35, 96)    55296
activation_109[0][0]
-----

batch_normalization_107 (BatchN (None, 35, 35, 48)    144
conv2d_107[0][0]

-----

batch_normalization_110 (BatchN (None, 35, 35, 96)    288
conv2d_110[0][0]
-----

activation_107 (Activation)    (None, 35, 35, 48)    0
batch_normalization_107[0][0]
-----

activation_110 (Activation)    (None, 35, 35, 96)    0
batch_normalization_110[0][0]
-----

average_pooling2d_10 (AveragePo (None, 35, 35, 256)    0          mixed0[0][0]
-----

conv2d_106 (Conv2D)          (None, 35, 35, 64)    16384    mixed0[0][0]
-----

conv2d_108 (Conv2D)          (None, 35, 35, 64)    76800
activation_107[0][0]

```

```

-----
conv2d_111 (Conv2D)          (None, 35, 35, 96)    82944
activation_110[0][0]
-----

conv2d_112 (Conv2D)          (None, 35, 35, 64)    16384
average_pooling2d_10[0][0]
-----

batch_normalization_106 (BatchN (None, 35, 35, 64)    192
conv2d_106[0][0]
-----

batch_normalization_108 (BatchN (None, 35, 35, 64)    192
conv2d_108[0][0]
-----

batch_normalization_111 (BatchN (None, 35, 35, 96)    288
conv2d_111[0][0]
-----

batch_normalization_112 (BatchN (None, 35, 35, 64)    192
conv2d_112[0][0]
-----

activation_106 (Activation)    (None, 35, 35, 64)    0
batch_normalization_106[0][0]
-----

activation_108 (Activation)    (None, 35, 35, 64)    0
batch_normalization_108[0][0]
-----

activation_111 (Activation)    (None, 35, 35, 96)    0
batch_normalization_111[0][0]
-----

activation_112 (Activation)    (None, 35, 35, 64)    0
batch_normalization_112[0][0]
-----

mixed1 (Concatenate)          (None, 35, 35, 288)   0
activation_106[0][0]
activation_108[0][0]
activation_111[0][0]
activation_112[0][0]
-----

```

conv2d_116 (Conv2D)	(None, 35, 35, 64)	18432	mixed1[0][0]

batch_normalization_116 (Batch Normalization)	(None, 35, 35, 64)	192	
conv2d_116[0][0]			

activation_116 (Activation)	(None, 35, 35, 64)	0	
batch_normalization_116[0][0]			

conv2d_114 (Conv2D)	(None, 35, 35, 48)	13824	mixed1[0][0]

conv2d_117 (Conv2D)	(None, 35, 35, 96)	55296	
activation_116[0][0]			

batch_normalization_114 (Batch Normalization)	(None, 35, 35, 48)	144	
conv2d_114[0][0]			

batch_normalization_117 (Batch Normalization)	(None, 35, 35, 96)	288	
conv2d_117[0][0]			

activation_114 (Activation)	(None, 35, 35, 48)	0	
batch_normalization_114[0][0]			

activation_117 (Activation)	(None, 35, 35, 96)	0	
batch_normalization_117[0][0]			

average_pooling2d_11 (Average Pooling)	(None, 35, 35, 288)	0	mixed1[0][0]

conv2d_113 (Conv2D)	(None, 35, 35, 64)	18432	mixed1[0][0]

conv2d_115 (Conv2D)	(None, 35, 35, 64)	76800	
activation_114[0][0]			

conv2d_118 (Conv2D)	(None, 35, 35, 96)	82944	
activation_117[0][0]			

```

-----
conv2d_119 (Conv2D)          (None, 35, 35, 64)    18432
average_pooling2d_11[0][0]
-----

-----
batch_normalization_113 (BatchN (None, 35, 35, 64)    192
conv2d_113[0][0]
-----

-----
batch_normalization_115 (BatchN (None, 35, 35, 64)    192
conv2d_115[0][0]
-----

-----
batch_normalization_118 (BatchN (None, 35, 35, 96)    288
conv2d_118[0][0]
-----

-----
batch_normalization_119 (BatchN (None, 35, 35, 64)    192
conv2d_119[0][0]
-----

-----
activation_113 (Activation)    (None, 35, 35, 64)    0
batch_normalization_113[0][0]
-----

-----
activation_115 (Activation)    (None, 35, 35, 64)    0
batch_normalization_115[0][0]
-----

-----
activation_118 (Activation)    (None, 35, 35, 96)    0
batch_normalization_118[0][0]
-----

-----
activation_119 (Activation)    (None, 35, 35, 64)    0
batch_normalization_119[0][0]
-----

-----
mixed2 (Concatenate)          (None, 35, 35, 288)   0
activation_113[0][0]
activation_115[0][0]
activation_118[0][0]
activation_119[0][0]
-----

-----
conv2d_121 (Conv2D)          (None, 35, 35, 64)    18432    mixed2[0][0]
-----

-----
batch_normalization_121 (BatchN (None, 35, 35, 64)    192

```

```

conv2d_121[0][0]
-----
-----
activation_121 (Activation)      (None, 35, 35, 64)    0
batch_normalization_121[0][0]
-----
-----
conv2d_122 (Conv2D)              (None, 35, 35, 96)    55296
activation_121[0][0]
-----
-----
batch_normalization_122 (BatchN (None, 35, 35, 96)    288
conv2d_122[0][0]
-----
-----
activation_122 (Activation)      (None, 35, 35, 96)    0
batch_normalization_122[0][0]
-----
-----
conv2d_120 (Conv2D)              (None, 17, 17, 384)  995328    mixed2[0][0]
-----
-----
conv2d_123 (Conv2D)              (None, 17, 17, 96)   82944
activation_122[0][0]
-----
-----
batch_normalization_120 (BatchN (None, 17, 17, 384)  1152
conv2d_120[0][0]
-----
-----
batch_normalization_123 (BatchN (None, 17, 17, 96)   288
conv2d_123[0][0]
-----
-----
activation_120 (Activation)      (None, 17, 17, 384)  0
batch_normalization_120[0][0]
-----
-----
activation_123 (Activation)      (None, 17, 17, 96)   0
batch_normalization_123[0][0]
-----
-----
max_pooling2d_6 (MaxPooling2D)  (None, 17, 17, 288)  0          mixed2[0][0]
-----
-----
mixed3 (Concatenate)            (None, 17, 17, 768)  0
activation_120[0][0]
activation_123[0][0]

```

max_pooling2d_6[0][0]

conv2d_128 (Conv2D) (None, 17, 17, 128) 98304 mixed3[0][0]

batch_normalization_128 (BatchN (None, 17, 17, 128) 384
conv2d_128[0][0]

activation_128 (Activation) (None, 17, 17, 128) 0
batch_normalization_128[0][0]

conv2d_129 (Conv2D) (None, 17, 17, 128) 114688
activation_128[0][0]

batch_normalization_129 (BatchN (None, 17, 17, 128) 384
conv2d_129[0][0]

activation_129 (Activation) (None, 17, 17, 128) 0
batch_normalization_129[0][0]

conv2d_125 (Conv2D) (None, 17, 17, 128) 98304 mixed3[0][0]

conv2d_130 (Conv2D) (None, 17, 17, 128) 114688
activation_129[0][0]

batch_normalization_125 (BatchN (None, 17, 17, 128) 384
conv2d_125[0][0]

batch_normalization_130 (BatchN (None, 17, 17, 128) 384
conv2d_130[0][0]

activation_125 (Activation) (None, 17, 17, 128) 0
batch_normalization_125[0][0]

activation_130 (Activation) (None, 17, 17, 128) 0
batch_normalization_130[0][0]

```

-----
conv2d_126 (Conv2D)          (None, 17, 17, 128)  114688
activation_125[0][0]
-----

conv2d_131 (Conv2D)          (None, 17, 17, 128)  114688
activation_130[0][0]
-----

batch_normalization_126 (BatchN (None, 17, 17, 128)  384
conv2d_126[0][0]
-----

batch_normalization_131 (BatchN (None, 17, 17, 128)  384
conv2d_131[0][0]
-----

activation_126 (Activation)    (None, 17, 17, 128)  0
batch_normalization_126[0][0]
-----

activation_131 (Activation)    (None, 17, 17, 128)  0
batch_normalization_131[0][0]
-----

average_pooling2d_12 (AveragePo (None, 17, 17, 768)  0          mixed3[0][0]
-----

conv2d_124 (Conv2D)          (None, 17, 17, 192)  147456      mixed3[0][0]
-----

conv2d_127 (Conv2D)          (None, 17, 17, 192)  172032
activation_126[0][0]
-----

conv2d_132 (Conv2D)          (None, 17, 17, 192)  172032
activation_131[0][0]
-----

conv2d_133 (Conv2D)          (None, 17, 17, 192)  147456
average_pooling2d_12[0][0]
-----

batch_normalization_124 (BatchN (None, 17, 17, 192)  576
conv2d_124[0][0]
-----

batch_normalization_127 (BatchN (None, 17, 17, 192)  576

```

```

conv2d_127[0][0]
-----
-----
batch_normalization_132 (BatchN (None, 17, 17, 192) 576
conv2d_132[0][0]
-----
-----
batch_normalization_133 (BatchN (None, 17, 17, 192) 576
conv2d_133[0][0]
-----
-----
activation_124 (Activation) (None, 17, 17, 192) 0
batch_normalization_124[0][0]
-----
-----
activation_127 (Activation) (None, 17, 17, 192) 0
batch_normalization_127[0][0]
-----
-----
activation_132 (Activation) (None, 17, 17, 192) 0
batch_normalization_132[0][0]
-----
-----
activation_133 (Activation) (None, 17, 17, 192) 0
batch_normalization_133[0][0]
-----
-----
mixed4 (Concatenate) (None, 17, 17, 768) 0
activation_124[0][0]
activation_127[0][0]
activation_132[0][0]
activation_133[0][0]
-----
-----
conv2d_138 (Conv2D) (None, 17, 17, 160) 122880 mixed4[0][0]
-----
-----
batch_normalization_138 (BatchN (None, 17, 17, 160) 480
conv2d_138[0][0]
-----
-----
activation_138 (Activation) (None, 17, 17, 160) 0
batch_normalization_138[0][0]
-----
-----
conv2d_139 (Conv2D) (None, 17, 17, 160) 179200
activation_138[0][0]
-----
-----

```

```

-----
batch_normalization_139 (BatchN (None, 17, 17, 160) 480
conv2d_139[0][0]
-----

-----
activation_139 (Activation) (None, 17, 17, 160) 0
batch_normalization_139[0][0]
-----

-----
conv2d_135 (Conv2D) (None, 17, 17, 160) 122880 mixed4[0][0]
-----

-----
conv2d_140 (Conv2D) (None, 17, 17, 160) 179200
activation_139[0][0]
-----

-----
batch_normalization_135 (BatchN (None, 17, 17, 160) 480
conv2d_135[0][0]
-----

-----
batch_normalization_140 (BatchN (None, 17, 17, 160) 480
conv2d_140[0][0]
-----

-----
activation_135 (Activation) (None, 17, 17, 160) 0
batch_normalization_135[0][0]
-----

-----
activation_140 (Activation) (None, 17, 17, 160) 0
batch_normalization_140[0][0]
-----

-----
conv2d_136 (Conv2D) (None, 17, 17, 160) 179200
activation_135[0][0]
-----

-----
conv2d_141 (Conv2D) (None, 17, 17, 160) 179200
activation_140[0][0]
-----

-----
batch_normalization_136 (BatchN (None, 17, 17, 160) 480
conv2d_136[0][0]
-----

-----
batch_normalization_141 (BatchN (None, 17, 17, 160) 480
conv2d_141[0][0]
-----
-----

```

activation_136 (Activation)	(None, 17, 17, 160)	0	
batch_normalization_136[0][0]			

activation_141 (Activation)	(None, 17, 17, 160)	0	
batch_normalization_141[0][0]			

average_pooling2d_13 (AveragePo	(None, 17, 17, 768)	0	mixed4[0][0]

conv2d_134 (Conv2D)	(None, 17, 17, 192)	147456	mixed4[0][0]

conv2d_137 (Conv2D)	(None, 17, 17, 192)	215040	
activation_136[0][0]			

conv2d_142 (Conv2D)	(None, 17, 17, 192)	215040	
activation_141[0][0]			

conv2d_143 (Conv2D)	(None, 17, 17, 192)	147456	
average_pooling2d_13[0][0]			

batch_normalization_134 (BatchN	(None, 17, 17, 192)	576	
conv2d_134[0][0]			

batch_normalization_137 (BatchN	(None, 17, 17, 192)	576	
conv2d_137[0][0]			

batch_normalization_142 (BatchN	(None, 17, 17, 192)	576	
conv2d_142[0][0]			

batch_normalization_143 (BatchN	(None, 17, 17, 192)	576	
conv2d_143[0][0]			

activation_134 (Activation)	(None, 17, 17, 192)	0	
batch_normalization_134[0][0]			

activation_137 (Activation)	(None, 17, 17, 192)	0	
batch_normalization_137[0][0]			

```

-----
activation_142 (Activation)      (None, 17, 17, 192)  0
batch_normalization_142[0][0]

-----

activation_143 (Activation)      (None, 17, 17, 192)  0
batch_normalization_143[0][0]

-----

mixed5 (Concatenate)            (None, 17, 17, 768)  0
activation_134[0][0]
activation_137[0][0]
activation_142[0][0]
activation_143[0][0]

-----

conv2d_148 (Conv2D)              (None, 17, 17, 160)  122880      mixed5[0][0]

-----

batch_normalization_148 (BatchN (None, 17, 17, 160)  480
conv2d_148[0][0]

-----

activation_148 (Activation)      (None, 17, 17, 160)  0
batch_normalization_148[0][0]

-----

conv2d_149 (Conv2D)              (None, 17, 17, 160)  179200
activation_148[0][0]

-----

batch_normalization_149 (BatchN (None, 17, 17, 160)  480
conv2d_149[0][0]

-----

activation_149 (Activation)      (None, 17, 17, 160)  0
batch_normalization_149[0][0]

-----

conv2d_145 (Conv2D)              (None, 17, 17, 160)  122880      mixed5[0][0]

-----

conv2d_150 (Conv2D)              (None, 17, 17, 160)  179200
activation_149[0][0]

-----

batch_normalization_145 (BatchN (None, 17, 17, 160)  480

```



```

conv2d_145[0][0]
-----
-----
batch_normalization_150 (BatchN (None, 17, 17, 160) 480
conv2d_150[0][0]
-----
-----
activation_145 (Activation)      (None, 17, 17, 160) 0
batch_normalization_145[0][0]
-----
-----
activation_150 (Activation)      (None, 17, 17, 160) 0
batch_normalization_150[0][0]
-----
-----
conv2d_146 (Conv2D)              (None, 17, 17, 160) 179200
activation_145[0][0]
-----
-----
conv2d_151 (Conv2D)              (None, 17, 17, 160) 179200
activation_150[0][0]
-----
-----
batch_normalization_146 (BatchN (None, 17, 17, 160) 480
conv2d_146[0][0]
-----
-----
batch_normalization_151 (BatchN (None, 17, 17, 160) 480
conv2d_151[0][0]
-----
-----
activation_146 (Activation)      (None, 17, 17, 160) 0
batch_normalization_146[0][0]
-----
-----
activation_151 (Activation)      (None, 17, 17, 160) 0
batch_normalization_151[0][0]
-----
-----
average_pooling2d_14 (AveragePo (None, 17, 17, 768) 0          mixed5[0][0]
-----
-----
conv2d_144 (Conv2D)              (None, 17, 17, 192) 147456          mixed5[0][0]
-----
-----
conv2d_147 (Conv2D)              (None, 17, 17, 192) 215040
activation_146[0][0]
-----
-----

```

conv2d_152 (Conv2D) (None, 17, 17, 192) 215040
activation_151[0][0]

conv2d_153 (Conv2D) (None, 17, 17, 192) 147456
average_pooling2d_14[0][0]

batch_normalization_144 (BatchN (None, 17, 17, 192) 576
conv2d_144[0][0]

batch_normalization_147 (BatchN (None, 17, 17, 192) 576
conv2d_147[0][0]

batch_normalization_152 (BatchN (None, 17, 17, 192) 576
conv2d_152[0][0]

batch_normalization_153 (BatchN (None, 17, 17, 192) 576
conv2d_153[0][0]

activation_144 (Activation) (None, 17, 17, 192) 0
batch_normalization_144[0][0]

activation_147 (Activation) (None, 17, 17, 192) 0
batch_normalization_147[0][0]

activation_152 (Activation) (None, 17, 17, 192) 0
batch_normalization_152[0][0]

activation_153 (Activation) (None, 17, 17, 192) 0
batch_normalization_153[0][0]

mixed6 (Concatenate) (None, 17, 17, 768) 0
activation_144[0][0]
activation_147[0][0]
activation_152[0][0]
activation_153[0][0]


```

conv2d_158 (Conv2D)                (None, 17, 17, 192) 147456      mixed6[0][0]
-----
-----
batch_normalization_158 (BatchN (None, 17, 17, 192) 576
conv2d_158[0][0]
-----
-----
activation_158 (Activation)        (None, 17, 17, 192) 0
batch_normalization_158[0][0]
-----
-----
conv2d_159 (Conv2D)                (None, 17, 17, 192) 258048
activation_158[0][0]
-----
-----
batch_normalization_159 (BatchN (None, 17, 17, 192) 576
conv2d_159[0][0]
-----
-----
activation_159 (Activation)        (None, 17, 17, 192) 0
batch_normalization_159[0][0]
-----
-----
conv2d_155 (Conv2D)                (None, 17, 17, 192) 147456      mixed6[0][0]
-----
-----
conv2d_160 (Conv2D)                (None, 17, 17, 192) 258048
activation_159[0][0]
-----
-----
batch_normalization_155 (BatchN (None, 17, 17, 192) 576
conv2d_155[0][0]
-----
-----
batch_normalization_160 (BatchN (None, 17, 17, 192) 576
conv2d_160[0][0]
-----
-----
activation_155 (Activation)        (None, 17, 17, 192) 0
batch_normalization_155[0][0]
-----
-----
activation_160 (Activation)        (None, 17, 17, 192) 0
batch_normalization_160[0][0]
-----
-----
conv2d_156 (Conv2D)                (None, 17, 17, 192) 258048
activation_155[0][0]

```

```

-----
conv2d_161 (Conv2D) (None, 17, 17, 192) 258048
activation_160[0][0]
-----

batch_normalization_156 (BatchN (None, 17, 17, 192) 576
conv2d_156[0][0]
-----

batch_normalization_161 (BatchN (None, 17, 17, 192) 576
conv2d_161[0][0]
-----

activation_156 (Activation) (None, 17, 17, 192) 0
batch_normalization_156[0][0]
-----

activation_161 (Activation) (None, 17, 17, 192) 0
batch_normalization_161[0][0]
-----

average_pooling2d_15 (AveragePo (None, 17, 17, 768) 0 mixed6[0][0]
-----

conv2d_154 (Conv2D) (None, 17, 17, 192) 147456 mixed6[0][0]
-----

conv2d_157 (Conv2D) (None, 17, 17, 192) 258048
activation_156[0][0]
-----

conv2d_162 (Conv2D) (None, 17, 17, 192) 258048
activation_161[0][0]
-----

conv2d_163 (Conv2D) (None, 17, 17, 192) 147456
average_pooling2d_15[0][0]
-----

batch_normalization_154 (BatchN (None, 17, 17, 192) 576
conv2d_154[0][0]
-----

batch_normalization_157 (BatchN (None, 17, 17, 192) 576
conv2d_157[0][0]
-----

```

```

batch_normalization_162 (BatchN (None, 17, 17, 192) 576
conv2d_162[0][0]
-----
batch_normalization_163 (BatchN (None, 17, 17, 192) 576
conv2d_163[0][0]
-----
activation_154 (Activation) (None, 17, 17, 192) 0
batch_normalization_154[0][0]
-----
activation_157 (Activation) (None, 17, 17, 192) 0
batch_normalization_157[0][0]
-----
activation_162 (Activation) (None, 17, 17, 192) 0
batch_normalization_162[0][0]
-----
activation_163 (Activation) (None, 17, 17, 192) 0
batch_normalization_163[0][0]
-----
mixed7 (Concatenate) (None, 17, 17, 768) 0
activation_154[0][0]
activation_157[0][0]
activation_162[0][0]
activation_163[0][0]
-----
conv2d_166 (Conv2D) (None, 17, 17, 192) 147456 mixed7[0][0]
-----
batch_normalization_166 (BatchN (None, 17, 17, 192) 576
conv2d_166[0][0]
-----
activation_166 (Activation) (None, 17, 17, 192) 0
batch_normalization_166[0][0]
-----
conv2d_167 (Conv2D) (None, 17, 17, 192) 258048
activation_166[0][0]
-----
batch_normalization_167 (BatchN (None, 17, 17, 192) 576
conv2d_167[0][0]

```

```

-----
-----
activation_167 (Activation)      (None, 17, 17, 192)  0
batch_normalization_167[0][0]

-----
-----
conv2d_164 (Conv2D)              (None, 17, 17, 192) 147456      mixed7[0][0]

-----
-----
conv2d_168 (Conv2D)              (None, 17, 17, 192) 258048
activation_167[0][0]

-----
-----
batch_normalization_164 (BatchN (None, 17, 17, 192) 576
conv2d_164[0][0]

-----
-----
batch_normalization_168 (BatchN (None, 17, 17, 192) 576
conv2d_168[0][0]

-----
-----
activation_164 (Activation)      (None, 17, 17, 192)  0
batch_normalization_164[0][0]

-----
-----
activation_168 (Activation)      (None, 17, 17, 192)  0
batch_normalization_168[0][0]

-----
-----
conv2d_165 (Conv2D)              (None, 8, 8, 320)   552960
activation_164[0][0]

-----
-----
conv2d_169 (Conv2D)              (None, 8, 8, 192)   331776
activation_168[0][0]

-----
-----
batch_normalization_165 (BatchN (None, 8, 8, 320)   960
conv2d_165[0][0]

-----
-----
batch_normalization_169 (BatchN (None, 8, 8, 192)   576
conv2d_169[0][0]

-----
-----
activation_165 (Activation)      (None, 8, 8, 320)   0
batch_normalization_165[0][0]
-----

```

```

-----
activation_169 (Activation)      (None, 8, 8, 192)      0
batch_normalization_169[0][0]

-----

max_pooling2d_7 (MaxPooling2D)  (None, 8, 8, 768)      0          mixed7[0][0]

-----

mixed8 (Concatenate)            (None, 8, 8, 1280)     0
activation_165[0][0]
activation_169[0][0]
max_pooling2d_7[0][0]

-----

conv2d_174 (Conv2D)              (None, 8, 8, 448)      573440      mixed8[0][0]

-----

batch_normalization_174 (BatchN (None, 8, 8, 448)      1344
conv2d_174[0][0]

-----

activation_174 (Activation)      (None, 8, 8, 448)      0
batch_normalization_174[0][0]

-----

conv2d_171 (Conv2D)              (None, 8, 8, 384)      491520      mixed8[0][0]

-----

conv2d_175 (Conv2D)              (None, 8, 8, 384)      1548288
activation_174[0][0]

-----

batch_normalization_171 (BatchN (None, 8, 8, 384)      1152
conv2d_171[0][0]

-----

batch_normalization_175 (BatchN (None, 8, 8, 384)      1152
conv2d_175[0][0]

-----

activation_171 (Activation)      (None, 8, 8, 384)      0
batch_normalization_171[0][0]

-----

activation_175 (Activation)      (None, 8, 8, 384)      0
batch_normalization_175[0][0]

-----

```

conv2d_172 (Conv2D)	(None, 8, 8, 384)	442368	
activation_171[0][0]			

conv2d_173 (Conv2D)	(None, 8, 8, 384)	442368	
activation_171[0][0]			

conv2d_176 (Conv2D)	(None, 8, 8, 384)	442368	
activation_175[0][0]			

conv2d_177 (Conv2D)	(None, 8, 8, 384)	442368	
activation_175[0][0]			

average_pooling2d_16 (AveragePo	(None, 8, 8, 1280)	0	mixed8[0][0]

conv2d_170 (Conv2D)	(None, 8, 8, 320)	409600	mixed8[0][0]

batch_normalization_172 (BatchN	(None, 8, 8, 384)	1152	
conv2d_172[0][0]			

batch_normalization_173 (BatchN	(None, 8, 8, 384)	1152	
conv2d_173[0][0]			

batch_normalization_176 (BatchN	(None, 8, 8, 384)	1152	
conv2d_176[0][0]			

batch_normalization_177 (BatchN	(None, 8, 8, 384)	1152	
conv2d_177[0][0]			

conv2d_178 (Conv2D)	(None, 8, 8, 192)	245760	
average_pooling2d_16[0][0]			

batch_normalization_170 (BatchN	(None, 8, 8, 320)	960	
conv2d_170[0][0]			

activation_172 (Activation)	(None, 8, 8, 384)	0	
batch_normalization_172[0][0]			


```

-----
-----
activation_173 (Activation)      (None, 8, 8, 384)      0
batch_normalization_173[0][0]

-----
-----
activation_176 (Activation)      (None, 8, 8, 384)      0
batch_normalization_176[0][0]

-----
-----
activation_177 (Activation)      (None, 8, 8, 384)      0
batch_normalization_177[0][0]

-----
-----
batch_normalization_178 (BatchN (None, 8, 8, 192)      576
conv2d_178[0][0]

-----
-----
activation_170 (Activation)      (None, 8, 8, 320)      0
batch_normalization_170[0][0]

-----
-----
mixed9_0 (Concatenate)          (None, 8, 8, 768)      0
activation_172[0][0]
activation_173[0][0]

-----
-----
concatenate_2 (Concatenate)      (None, 8, 8, 768)      0
activation_176[0][0]
activation_177[0][0]

-----
-----
activation_178 (Activation)      (None, 8, 8, 192)      0
batch_normalization_178[0][0]

-----
-----
mixed9 (Concatenate)            (None, 8, 8, 2048)     0
activation_170[0][0]

mixed9_0[0][0]

concatenate_2[0][0]
activation_178[0][0]

-----
-----
conv2d_183 (Conv2D)              (None, 8, 8, 448)      917504      mixed9[0][0]

-----
-----
batch_normalization_183 (BatchN (None, 8, 8, 448)      1344
conv2d_183[0][0]

```

activation_183 (Activation)	(None, 8, 8, 448)	0	
batch_normalization_183[0][0]			
conv2d_180 (Conv2D)	(None, 8, 8, 384)	786432	mixed9[0][0]
conv2d_184 (Conv2D)	(None, 8, 8, 384)	1548288	
activation_183[0][0]			
batch_normalization_180 (BatchN	(None, 8, 8, 384)	1152	
conv2d_180[0][0]			
batch_normalization_184 (BatchN	(None, 8, 8, 384)	1152	
conv2d_184[0][0]			
activation_180 (Activation)	(None, 8, 8, 384)	0	
batch_normalization_180[0][0]			
activation_184 (Activation)	(None, 8, 8, 384)	0	
batch_normalization_184[0][0]			
conv2d_181 (Conv2D)	(None, 8, 8, 384)	442368	
activation_180[0][0]			
conv2d_182 (Conv2D)	(None, 8, 8, 384)	442368	
activation_180[0][0]			
conv2d_185 (Conv2D)	(None, 8, 8, 384)	442368	
activation_184[0][0]			
conv2d_186 (Conv2D)	(None, 8, 8, 384)	442368	
activation_184[0][0]			
average_pooling2d_17 (AveragePo	(None, 8, 8, 2048)	0	mixed9[0][0]

conv2d_179 (Conv2D)	(None, 8, 8, 320)	655360	mixed9[0][0]

batch_normalization_181 (BatchN	(None, 8, 8, 384)	1152	
conv2d_181[0][0]			

batch_normalization_182 (BatchN	(None, 8, 8, 384)	1152	
conv2d_182[0][0]			

batch_normalization_185 (BatchN	(None, 8, 8, 384)	1152	
conv2d_185[0][0]			

batch_normalization_186 (BatchN	(None, 8, 8, 384)	1152	
conv2d_186[0][0]			

conv2d_187 (Conv2D)	(None, 8, 8, 192)	393216	
average_pooling2d_17[0][0]			

batch_normalization_179 (BatchN	(None, 8, 8, 320)	960	
conv2d_179[0][0]			

activation_181 (Activation)	(None, 8, 8, 384)	0	
batch_normalization_181[0][0]			

activation_182 (Activation)	(None, 8, 8, 384)	0	
batch_normalization_182[0][0]			

activation_185 (Activation)	(None, 8, 8, 384)	0	
batch_normalization_185[0][0]			

activation_186 (Activation)	(None, 8, 8, 384)	0	
batch_normalization_186[0][0]			

batch_normalization_187 (BatchN	(None, 8, 8, 192)	576	
conv2d_187[0][0]			

activation_179 (Activation)	(None, 8, 8, 320)	0	

```

batch_normalization_179[0][0]
-----
mixed9_1 (Concatenate)          (None, 8, 8, 768)    0
activation_181[0][0]
activation_182[0][0]
-----
concatenate_3 (Concatenate)      (None, 8, 8, 768)    0
activation_185[0][0]
activation_186[0][0]
-----
activation_187 (Activation)       (None, 8, 8, 192)    0
batch_normalization_187[0][0]
-----
mixed10 (Concatenate)           (None, 8, 8, 2048)   0
activation_179[0][0]
                                     mixed9_1[0][0]
concatenate_3[0][0]
activation_187[0][0]
-----
global_average_pooling2d_9 (Glo (None, 2048)    0          mixed10[0][0]
-----
dense_24 (Dense)                 (None, 256)          524544
global_average_pooling2d_9[0][0]
-----
dense_25 (Dense)                 (None, 64)           16448      dense_24[0][0]
-----
dense_26 (Dense)                 (None, 3)            195        dense_25[0][0]
=====
=====
Total params: 22,343,971
Trainable params: 22,309,539
Non-trainable params: 34,432
-----
-----

```

```
[ ]: !rm -r logs/
```

```
[ ]: from datetime import datetime
log_dir="logs/" + datetime.now().strftime("%Y%m%d-%H%M%S")
```

```

tensorboard_callback = tf.keras.callbacks.
    ↳TensorBoard(log_dir=log_dir,histogram_freq=1,
    ↳write_graph=True,write_grads=True)
# 4. Save your model at every epoch if your validation accuracy is improved
    ↳from previous epoch.
filepath="model_save/weights-{epoch:02d}-{val_accuracy:.4f}.hdf5"
# Saving the model
checkpoint = tf.keras.callbacks.ModelCheckpoint(filepath=filepath,
    ↳monitor='val_accuracy', save_best_only=True, verbose=1, mode='auto')

```

WARNING:tensorflow:`write_grads` will be ignored in TensorFlow 2.0 for the
`TensorBoard` Callback.

```

[ ]: model.compile(loss='categorical_crossentropy', optimizer=tf.keras.optimizers.
    ↳SGD(learning_rate=0.001, momentum=0.9, nesterov=True), metrics=['accuracy'])
#model.compile(loss='categorical_crossentropy', optimizer=tf.keras.optimizers.
    ↳Adam(), metrics=['accuracy'])
history = model.fit(
    train_generator,
    validation_data = validation_generator,
    steps_per_epoch = 80,
    epochs = 10,
    validation_steps = 20,
    verbose = 1,
    callbacks=[tensorboard_callback, checkpoint])

```

Epoch 1/10

100/100 [=====] - ETA: 0s - loss: 0.4731 - accuracy: 0.7950

Epoch 00001: val_accuracy improved from -inf to 0.67717, saving model to
model_save/weights-01-0.6772.hdf5

100/100 [=====] - 175s 2s/step - loss: 0.4731 -
accuracy: 0.7950 - val_loss: 0.7178 - val_accuracy: 0.6772

Epoch 2/10

100/100 [=====] - ETA: 0s - loss: 0.2226 - accuracy: 0.9080

Epoch 00002: val_accuracy improved from 0.67717 to 0.83465, saving model to
model_save/weights-02-0.8346.hdf5

100/100 [=====] - 173s 2s/step - loss: 0.2226 -
accuracy: 0.9080 - val_loss: 0.4032 - val_accuracy: 0.8346

Epoch 3/10

100/100 [=====] - ETA: 0s - loss: 0.1804 - accuracy: 0.9244

Epoch 00003: val_accuracy improved from 0.83465 to 0.89291, saving model to
model_save/weights-03-0.8929.hdf5

100/100 [=====] - 169s 2s/step - loss: 0.1804 -
accuracy: 0.9244 - val_loss: 0.2612 - val_accuracy: 0.8929

Epoch 4/10
100/100 [=====] - ETA: 0s - loss: 0.1430 - accuracy: 0.9388
Epoch 00004: val_accuracy improved from 0.89291 to 0.89921, saving model to model_save/weights-04-0.8992.hdf5
100/100 [=====] - 169s 2s/step - loss: 0.1430 - accuracy: 0.9388 - val_loss: 0.2490 - val_accuracy: 0.8992
Epoch 5/10
100/100 [=====] - ETA: 0s - loss: 0.1364 - accuracy: 0.9425
Epoch 00005: val_accuracy did not improve from 0.89921
100/100 [=====] - 168s 2s/step - loss: 0.1364 - accuracy: 0.9425 - val_loss: 0.3200 - val_accuracy: 0.8835
Epoch 6/10
100/100 [=====] - ETA: 0s - loss: 0.1382 - accuracy: 0.9411
Epoch 00006: val_accuracy did not improve from 0.89921
100/100 [=====] - 168s 2s/step - loss: 0.1382 - accuracy: 0.9411 - val_loss: 0.3139 - val_accuracy: 0.8661
Epoch 7/10
100/100 [=====] - ETA: 0s - loss: 0.1176 - accuracy: 0.9528
Epoch 00007: val_accuracy improved from 0.89921 to 0.91024, saving model to model_save/weights-07-0.9102.hdf5
100/100 [=====] - 169s 2s/step - loss: 0.1176 - accuracy: 0.9528 - val_loss: 0.2349 - val_accuracy: 0.9102
Epoch 8/10
100/100 [=====] - ETA: 0s - loss: 0.1107 - accuracy: 0.9565
Epoch 00008: val_accuracy did not improve from 0.91024
100/100 [=====] - 167s 2s/step - loss: 0.1107 - accuracy: 0.9565 - val_loss: 0.2424 - val_accuracy: 0.9024
Epoch 9/10
100/100 [=====] - ETA: 0s - loss: 0.1002 - accuracy: 0.9584
Epoch 00009: val_accuracy did not improve from 0.91024
100/100 [=====] - 167s 2s/step - loss: 0.1002 - accuracy: 0.9584 - val_loss: 0.2238 - val_accuracy: 0.9102
Epoch 10/10
100/100 [=====] - ETA: 0s - loss: 0.0882 - accuracy: 0.9669
Epoch 00010: val_accuracy did not improve from 0.91024
100/100 [=====] - 167s 2s/step - loss: 0.0882 - accuracy: 0.9669 - val_loss: 0.4535 - val_accuracy: 0.8803
Epoch 1/10
100/100 [=====] - ETA: 0s - loss: 0.4731 - accuracy: 0.7950
Epoch 00001: val_accuracy improved from -inf to 0.67717, saving model to

```

model_save/weights-01-0.6772.hdf5
100/100 [=====] - 175s 2s/step - loss: 0.4731 -
accuracy: 0.7950 - val_loss: 0.7178 - val_accuracy: 0.6772
Epoch 2/10
100/100 [=====] - ETA: 0s - loss: 0.2226 - accuracy:
0.9080
Epoch 00002: val_accuracy improved from 0.67717 to 0.83465, saving model to
model_save/weights-02-0.8346.hdf5
100/100 [=====] - 173s 2s/step - loss: 0.2226 -
accuracy: 0.9080 - val_loss: 0.4032 - val_accuracy: 0.8346
Epoch 3/10
100/100 [=====] - ETA: 0s - loss: 0.1804 - accuracy:
0.9244
Epoch 00003: val_accuracy improved from 0.83465 to 0.89291, saving model to
model_save/weights-03-0.8929.hdf5
100/100 [=====] - 169s 2s/step - loss: 0.1804 -
accuracy: 0.9244 - val_loss: 0.2612 - val_accuracy: 0.8929
Epoch 4/10
100/100 [=====] - ETA: 0s - loss: 0.1430 - accuracy:
0.9388
Epoch 00004: val_accuracy improved from 0.89291 to 0.89921, saving model to
model_save/weights-04-0.8992.hdf5
100/100 [=====] - 169s 2s/step - loss: 0.1430 -
accuracy: 0.9388 - val_loss: 0.2490 - val_accuracy: 0.8992
Epoch 5/10
100/100 [=====] - ETA: 0s - loss: 0.1364 - accuracy:
0.9425
Epoch 00005: val_accuracy did not improve from 0.89921
100/100 [=====] - 168s 2s/step - loss: 0.1364 -
accuracy: 0.9425 - val_loss: 0.3200 - val_accuracy: 0.8835
Epoch 6/10
100/100 [=====] - ETA: 0s - loss: 0.1382 - accuracy:
0.9411
Epoch 00006: val_accuracy did not improve from 0.89921
100/100 [=====] - 168s 2s/step - loss: 0.1382 -
accuracy: 0.9411 - val_loss: 0.3139 - val_accuracy: 0.8661
Epoch 7/10
100/100 [=====] - ETA: 0s - loss: 0.1176 - accuracy:
0.9528
Epoch 00007: val_accuracy improved from 0.89921 to 0.91024, saving model to
model_save/weights-07-0.9102.hdf5
100/100 [=====] - 169s 2s/step - loss: 0.1176 -
accuracy: 0.9528 - val_loss: 0.2349 - val_accuracy: 0.9102
Epoch 8/10
100/100 [=====] - ETA: 0s - loss: 0.1107 - accuracy:
0.9565
Epoch 00008: val_accuracy did not improve from 0.91024
100/100 [=====] - 167s 2s/step - loss: 0.1107 -

```

```

accuracy: 0.9565 - val_loss: 0.2424 - val_accuracy: 0.9024
Epoch 9/10
100/100 [=====] - ETA: 0s - loss: 0.1002 - accuracy:
0.9584
Epoch 00009: val_accuracy did not improve from 0.91024
100/100 [=====] - 167s 2s/step - loss: 0.1002 -
accuracy: 0.9584 - val_loss: 0.2238 - val_accuracy: 0.9102
Epoch 10/10
100/100 [=====] - ETA: 0s - loss: 0.0882 - accuracy:
0.9669
Epoch 00010: val_accuracy did not improve from 0.91024
100/100 [=====] - 167s 2s/step - loss: 0.0882 -
accuracy: 0.9669 - val_loss: 0.4535 - val_accuracy: 0.8803

```

```

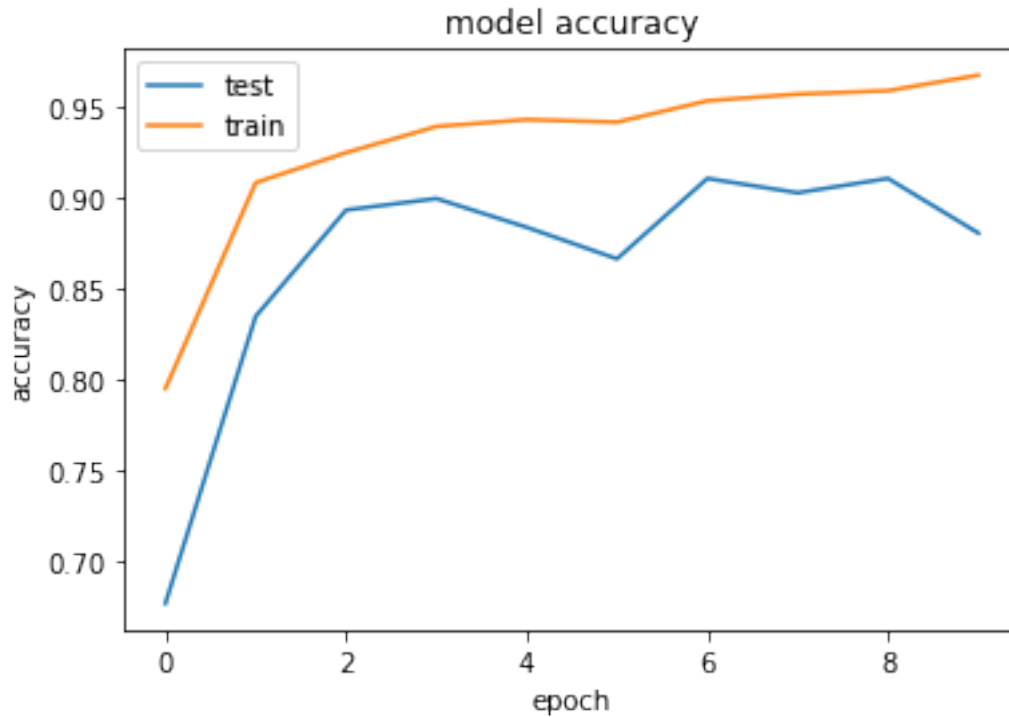
[82]: print('\nhistory dict:', history.history)
      # summarize history for loss
      plt.plot(history.history['val_accuracy'])
      plt.plot(history.history['accuracy'])
      plt.title('model accuracy')
      plt.ylabel('accuracy')
      plt.xlabel('epoch')
      plt.legend(['test', 'train'], loc='upper left')
      plt.show()

```

```

history dict: {'loss': [0.4731036424636841, 0.2225574404001236,
0.18043452501296997, 0.14295834302902222, 0.13642409443855286,
0.13817648589611053, 0.11755739897489548, 0.11074785143136978,
0.10024634748697281, 0.08818085491657257], 'accuracy': [0.7950000166893005,
0.9079524278640747, 0.9243749976158142, 0.9387500286102295, 0.9424999952316284,
0.9411396384239197, 0.9528124928474426, 0.9564809203147888, 0.95835942029953,
0.9668750166893005], 'val_loss': [0.7178003787994385, 0.4032028913497925,
0.2611502408981323, 0.248954176902771, 0.320049524307251, 0.3139122426509857,
0.2348976731300354, 0.24242058396339417, 0.2238277941942215,
0.45353326201438904], 'val_accuracy': [0.6771653294563293, 0.834645688533783,
0.8929134011268616, 0.8992125988006592, 0.8834645748138428, 0.8661417365074158,
0.9102362394332886, 0.9023622274398804, 0.9102362394332886, 0.8803149461746216]}

```

```
[83]: !rm -r vgg16_trained
```

```
rm: cannot remove 'vgg16_trained': No such file or directory
```

```
[84]: model.load_weights('model_save/weights-07-0.9102.hdf5')
```

```
[85]: inception_model = InceptionV3(include_top=False, weights='imagenet',
    ↳pooling='avg', input_shape=(299,299,3))
    for i, layer in enumerate(inception_model.layers):
        layer.set_weights(model.layers[i].get_weights())
```

```
[88]: inception_model.save_weights("trained_weights-07-0.9102.hdf5")
```

2 Training without Imagenet weights

```
[90]: InceptionV3_model_no_wts = InceptionV3(include_top=False, weights=None,
    ↳pooling='avg', input_shape=(299,299,3))
    InceptionV3_model_no_wts.input, InceptionV3_model_no_wts.output
    x=tf.keras.layers.Dense(256, activation='relu')(InceptionV3_model_no_wts.output)
    x=tf.keras.layers.Dense(64, activation='relu')(x)
    output_layer = tf.keras.layers.Dense(3, activation='softmax')(x)
    model_2 = tf.keras.Model(InceptionV3_model_no_wts.input, output_layer)
```

```
model_2.summary()
```

Model: "model_12"

```
-----
Layer (type)                 Output Shape          Param #   Connected to
=====
input_13 (InputLayer)        [(None, 299, 299, 3) 0
-----
conv2d_376 (Conv2D)          (None, 149, 149, 32) 864        input_13[0][0]
-----
batch_normalization_376 (BatchN (None, 149, 149, 32) 96
conv2d_376[0][0]
-----
activation_376 (Activation)   (None, 149, 149, 32) 0
batch_normalization_376[0][0]
-----
conv2d_377 (Conv2D)          (None, 147, 147, 32) 9216
activation_376[0][0]
-----
batch_normalization_377 (BatchN (None, 147, 147, 32) 96
conv2d_377[0][0]
-----
activation_377 (Activation)   (None, 147, 147, 32) 0
batch_normalization_377[0][0]
-----
conv2d_378 (Conv2D)          (None, 147, 147, 64) 18432
activation_377[0][0]
-----
batch_normalization_378 (BatchN (None, 147, 147, 64) 192
conv2d_378[0][0]
-----
activation_378 (Activation)   (None, 147, 147, 64) 0
batch_normalization_378[0][0]
-----
max_pooling2d_16 (MaxPooling2D) (None, 73, 73, 64) 0
```

activation_378[0][0]

conv2d_379 (Conv2D) (None, 73, 73, 80) 5120
max_pooling2d_16[0][0]

batch_normalization_379 (BatchN (None, 73, 73, 80) 240
conv2d_379[0][0]

activation_379 (Activation) (None, 73, 73, 80) 0
batch_normalization_379[0][0]

conv2d_380 (Conv2D) (None, 71, 71, 192) 138240
activation_379[0][0]

batch_normalization_380 (BatchN (None, 71, 71, 192) 576
conv2d_380[0][0]

activation_380 (Activation) (None, 71, 71, 192) 0
batch_normalization_380[0][0]

max_pooling2d_17 (MaxPooling2D) (None, 35, 35, 192) 0
activation_380[0][0]

conv2d_384 (Conv2D) (None, 35, 35, 64) 12288
max_pooling2d_17[0][0]

batch_normalization_384 (BatchN (None, 35, 35, 64) 192
conv2d_384[0][0]

activation_384 (Activation) (None, 35, 35, 64) 0
batch_normalization_384[0][0]

conv2d_382 (Conv2D) (None, 35, 35, 48) 9216
max_pooling2d_17[0][0]

conv2d_385 (Conv2D) (None, 35, 35, 96) 55296

activation_384[0][0]

batch_normalization_382 (BatchN (None, 35, 35, 48) 144
conv2d_382[0][0]

batch_normalization_385 (BatchN (None, 35, 35, 96) 288
conv2d_385[0][0]

activation_382 (Activation) (None, 35, 35, 48) 0
batch_normalization_382[0][0]

activation_385 (Activation) (None, 35, 35, 96) 0
batch_normalization_385[0][0]

average_pooling2d_36 (AveragePo (None, 35, 35, 192) 0
max_pooling2d_17[0][0]

conv2d_381 (Conv2D) (None, 35, 35, 64) 12288
max_pooling2d_17[0][0]

conv2d_383 (Conv2D) (None, 35, 35, 64) 76800
activation_382[0][0]

conv2d_386 (Conv2D) (None, 35, 35, 96) 82944
activation_385[0][0]

conv2d_387 (Conv2D) (None, 35, 35, 32) 6144
average_pooling2d_36[0][0]

batch_normalization_381 (BatchN (None, 35, 35, 64) 192
conv2d_381[0][0]

batch_normalization_383 (BatchN (None, 35, 35, 64) 192
conv2d_383[0][0]

batch_normalization_386 (BatchN (None, 35, 35, 96) 288

```

conv2d_386[0][0]
-----
-----
batch_normalization_387 (BatchN (None, 35, 35, 32) 96
conv2d_387[0][0]
-----
-----
activation_381 (Activation) (None, 35, 35, 64) 0
batch_normalization_381[0][0]
-----
-----
activation_383 (Activation) (None, 35, 35, 64) 0
batch_normalization_383[0][0]
-----
-----
activation_386 (Activation) (None, 35, 35, 96) 0
batch_normalization_386[0][0]
-----
-----
activation_387 (Activation) (None, 35, 35, 32) 0
batch_normalization_387[0][0]
-----
-----
mixed0 (Concatenate) (None, 35, 35, 256) 0
activation_381[0][0]
activation_383[0][0]
activation_386[0][0]
activation_387[0][0]
-----
-----
conv2d_391 (Conv2D) (None, 35, 35, 64) 16384 mixed0[0][0]
-----
-----
batch_normalization_391 (BatchN (None, 35, 35, 64) 192
conv2d_391[0][0]
-----
-----
activation_391 (Activation) (None, 35, 35, 64) 0
batch_normalization_391[0][0]
-----
-----
conv2d_389 (Conv2D) (None, 35, 35, 48) 12288 mixed0[0][0]
-----
-----
conv2d_392 (Conv2D) (None, 35, 35, 96) 55296
activation_391[0][0]
-----
-----

```

batch_normalization_389 (BatchN	(None, 35, 35, 48)	144	
conv2d_389[0][0]			

batch_normalization_392 (BatchN	(None, 35, 35, 96)	288	
conv2d_392[0][0]			

activation_389 (Activation)	(None, 35, 35, 48)	0	
batch_normalization_389[0][0]			

activation_392 (Activation)	(None, 35, 35, 96)	0	
batch_normalization_392[0][0]			

average_pooling2d_37 (AveragePo	(None, 35, 35, 256)	0	mixed0[0][0]

conv2d_388 (Conv2D)	(None, 35, 35, 64)	16384	mixed0[0][0]

conv2d_390 (Conv2D)	(None, 35, 35, 64)	76800	
activation_389[0][0]			

conv2d_393 (Conv2D)	(None, 35, 35, 96)	82944	
activation_392[0][0]			

conv2d_394 (Conv2D)	(None, 35, 35, 64)	16384	
average_pooling2d_37[0][0]			

batch_normalization_388 (BatchN	(None, 35, 35, 64)	192	
conv2d_388[0][0]			

batch_normalization_390 (BatchN	(None, 35, 35, 64)	192	
conv2d_390[0][0]			

batch_normalization_393 (BatchN	(None, 35, 35, 96)	288	
conv2d_393[0][0]			

batch_normalization_394 (BatchN	(None, 35, 35, 64)	192	
conv2d_394[0][0]			

```

-----
-----
activation_388 (Activation)      (None, 35, 35, 64)    0
batch_normalization_388[0][0]

-----
-----
activation_390 (Activation)      (None, 35, 35, 64)    0
batch_normalization_390[0][0]

-----
-----
activation_393 (Activation)      (None, 35, 35, 96)    0
batch_normalization_393[0][0]

-----
-----
activation_394 (Activation)      (None, 35, 35, 64)    0
batch_normalization_394[0][0]

-----
-----
mixed1 (Concatenate)            (None, 35, 35, 288)   0
activation_388[0][0]
activation_390[0][0]
activation_393[0][0]
activation_394[0][0]

-----
-----
conv2d_398 (Conv2D)             (None, 35, 35, 64)    18432      mixed1[0][0]

-----
-----
batch_normalization_398 (BatchN (None, 35, 35, 64)    192
conv2d_398[0][0]

-----
-----
activation_398 (Activation)      (None, 35, 35, 64)    0
batch_normalization_398[0][0]

-----
-----
conv2d_396 (Conv2D)             (None, 35, 35, 48)    13824      mixed1[0][0]

-----
-----
conv2d_399 (Conv2D)             (None, 35, 35, 96)    55296
activation_398[0][0]

-----
-----
batch_normalization_396 (BatchN (None, 35, 35, 48)    144
conv2d_396[0][0]

-----
-----
batch_normalization_399 (BatchN (None, 35, 35, 96)    288

```

conv2d_399[0][0]

activation_396 (Activation) (None, 35, 35, 48) 0
batch_normalization_396[0][0]

activation_399 (Activation) (None, 35, 35, 96) 0
batch_normalization_399[0][0]

average_pooling2d_38 (AveragePo (None, 35, 35, 288) 0 mixed1[0][0]

conv2d_395 (Conv2D) (None, 35, 35, 64) 18432 mixed1[0][0]

conv2d_397 (Conv2D) (None, 35, 35, 64) 76800
activation_396[0][0]

conv2d_400 (Conv2D) (None, 35, 35, 96) 82944
activation_399[0][0]

conv2d_401 (Conv2D) (None, 35, 35, 64) 18432
average_pooling2d_38[0][0]

batch_normalization_395 (BatchN (None, 35, 35, 64) 192
conv2d_395[0][0]

batch_normalization_397 (BatchN (None, 35, 35, 64) 192
conv2d_397[0][0]

batch_normalization_400 (BatchN (None, 35, 35, 96) 288
conv2d_400[0][0]

batch_normalization_401 (BatchN (None, 35, 35, 64) 192
conv2d_401[0][0]

activation_395 (Activation) (None, 35, 35, 64) 0
batch_normalization_395[0][0]


```

-----
activation_397 (Activation)      (None, 35, 35, 64)    0
batch_normalization_397[0][0]

-----

activation_400 (Activation)      (None, 35, 35, 96)    0
batch_normalization_400[0][0]

-----

activation_401 (Activation)      (None, 35, 35, 64)    0
batch_normalization_401[0][0]

-----

mixed2 (Concatenate)            (None, 35, 35, 288)   0
activation_395[0][0]
activation_397[0][0]
activation_400[0][0]
activation_401[0][0]

-----

conv2d_403 (Conv2D)              (None, 35, 35, 64)   18432      mixed2[0][0]

-----

batch_normalization_403 (BatchN (None, 35, 35, 64)   192
conv2d_403[0][0]

-----

activation_403 (Activation)      (None, 35, 35, 64)    0
batch_normalization_403[0][0]

-----

conv2d_404 (Conv2D)              (None, 35, 35, 96)   55296
activation_403[0][0]

-----

batch_normalization_404 (BatchN (None, 35, 35, 96)   288
conv2d_404[0][0]

-----

activation_404 (Activation)      (None, 35, 35, 96)    0
batch_normalization_404[0][0]

-----

conv2d_402 (Conv2D)              (None, 17, 17, 384)  995328      mixed2[0][0]

-----

conv2d_405 (Conv2D)              (None, 17, 17, 96)   82944
activation_404[0][0]

```

```

-----
batch_normalization_402 (BatchN (None, 17, 17, 384) 1152
conv2d_402[0][0]
-----

batch_normalization_405 (BatchN (None, 17, 17, 96) 288
conv2d_405[0][0]
-----

activation_402 (Activation) (None, 17, 17, 384) 0
batch_normalization_402[0][0]
-----

activation_405 (Activation) (None, 17, 17, 96) 0
batch_normalization_405[0][0]
-----

max_pooling2d_18 (MaxPooling2D) (None, 17, 17, 288) 0 mixed2[0][0]
-----

mixed3 (Concatenate) (None, 17, 17, 768) 0
activation_402[0][0]
activation_405[0][0]
max_pooling2d_18[0][0]
-----

conv2d_410 (Conv2D) (None, 17, 17, 128) 98304 mixed3[0][0]
-----

batch_normalization_410 (BatchN (None, 17, 17, 128) 384
conv2d_410[0][0]
-----

activation_410 (Activation) (None, 17, 17, 128) 0
batch_normalization_410[0][0]
-----

conv2d_411 (Conv2D) (None, 17, 17, 128) 114688
activation_410[0][0]
-----

batch_normalization_411 (BatchN (None, 17, 17, 128) 384
conv2d_411[0][0]
-----

activation_411 (Activation) (None, 17, 17, 128) 0
batch_normalization_411[0][0]

```

```

-----
conv2d_407 (Conv2D)          (None, 17, 17, 128) 98304      mixed3[0][0]
-----

conv2d_412 (Conv2D)          (None, 17, 17, 128) 114688
activation_411[0][0]
-----

batch_normalization_407 (BatchN (None, 17, 17, 128) 384
conv2d_407[0][0]
-----

batch_normalization_412 (BatchN (None, 17, 17, 128) 384
conv2d_412[0][0]
-----

activation_407 (Activation)    (None, 17, 17, 128) 0
batch_normalization_407[0][0]
-----

activation_412 (Activation)    (None, 17, 17, 128) 0
batch_normalization_412[0][0]
-----

conv2d_408 (Conv2D)          (None, 17, 17, 128) 114688
activation_407[0][0]
-----

conv2d_413 (Conv2D)          (None, 17, 17, 128) 114688
activation_412[0][0]
-----

batch_normalization_408 (BatchN (None, 17, 17, 128) 384
conv2d_408[0][0]
-----

batch_normalization_413 (BatchN (None, 17, 17, 128) 384
conv2d_413[0][0]
-----

activation_408 (Activation)    (None, 17, 17, 128) 0
batch_normalization_408[0][0]
-----

activation_413 (Activation)    (None, 17, 17, 128) 0
batch_normalization_413[0][0]
-----

```

```

-----
average_pooling2d_39 (AveragePo (None, 17, 17, 768) 0          mixed3[0][0]
-----
conv2d_406 (Conv2D)          (None, 17, 17, 192) 147456      mixed3[0][0]
-----
conv2d_409 (Conv2D)          (None, 17, 17, 192) 172032
activation_408[0][0]
-----
conv2d_414 (Conv2D)          (None, 17, 17, 192) 172032
activation_413[0][0]
-----
conv2d_415 (Conv2D)          (None, 17, 17, 192) 147456
average_pooling2d_39[0][0]
-----
batch_normalization_406 (BatchN (None, 17, 17, 192) 576
conv2d_406[0][0]
-----
batch_normalization_409 (BatchN (None, 17, 17, 192) 576
conv2d_409[0][0]
-----
batch_normalization_414 (BatchN (None, 17, 17, 192) 576
conv2d_414[0][0]
-----
batch_normalization_415 (BatchN (None, 17, 17, 192) 576
conv2d_415[0][0]
-----
activation_406 (Activation)   (None, 17, 17, 192) 0
batch_normalization_406[0][0]
-----
activation_409 (Activation)   (None, 17, 17, 192) 0
batch_normalization_409[0][0]
-----
activation_414 (Activation)   (None, 17, 17, 192) 0
batch_normalization_414[0][0]
-----
activation_415 (Activation)   (None, 17, 17, 192) 0

```

batch_normalization_415[0][0]

mixed4 (Concatenate) (None, 17, 17, 768) 0
activation_406[0][0]
activation_409[0][0]
activation_414[0][0]
activation_415[0][0]

conv2d_420 (Conv2D) (None, 17, 17, 160) 122880 mixed4[0][0]

batch_normalization_420 (BatchN (None, 17, 17, 160) 480
conv2d_420[0][0]

activation_420 (Activation) (None, 17, 17, 160) 0
batch_normalization_420[0][0]

conv2d_421 (Conv2D) (None, 17, 17, 160) 179200
activation_420[0][0]

batch_normalization_421 (BatchN (None, 17, 17, 160) 480
conv2d_421[0][0]

activation_421 (Activation) (None, 17, 17, 160) 0
batch_normalization_421[0][0]

conv2d_417 (Conv2D) (None, 17, 17, 160) 122880 mixed4[0][0]

conv2d_422 (Conv2D) (None, 17, 17, 160) 179200
activation_421[0][0]

batch_normalization_417 (BatchN (None, 17, 17, 160) 480
conv2d_417[0][0]

batch_normalization_422 (BatchN (None, 17, 17, 160) 480
conv2d_422[0][0]


```

activation_417 (Activation)      (None, 17, 17, 160)  0
batch_normalization_417[0][0]

-----

activation_422 (Activation)      (None, 17, 17, 160)  0
batch_normalization_422[0][0]

-----

conv2d_418 (Conv2D)             (None, 17, 17, 160)  179200
activation_417[0][0]

-----

conv2d_423 (Conv2D)             (None, 17, 17, 160)  179200
activation_422[0][0]

-----

batch_normalization_418 (BatchN (None, 17, 17, 160)  480
conv2d_418[0][0]

-----

batch_normalization_423 (BatchN (None, 17, 17, 160)  480
conv2d_423[0][0]

-----

activation_418 (Activation)      (None, 17, 17, 160)  0
batch_normalization_418[0][0]

-----

activation_423 (Activation)      (None, 17, 17, 160)  0
batch_normalization_423[0][0]

-----

average_pooling2d_40 (AveragePo (None, 17, 17, 768)  0          mixed4[0][0]

-----

conv2d_416 (Conv2D)             (None, 17, 17, 192)  147456      mixed4[0][0]

-----

conv2d_419 (Conv2D)             (None, 17, 17, 192)  215040
activation_418[0][0]

-----

conv2d_424 (Conv2D)             (None, 17, 17, 192)  215040
activation_423[0][0]

-----

conv2d_425 (Conv2D)             (None, 17, 17, 192)  147456
average_pooling2d_40[0][0]

```

```

-----
batch_normalization_416 (BatchN (None, 17, 17, 192) 576
conv2d_416[0][0]
-----
batch_normalization_419 (BatchN (None, 17, 17, 192) 576
conv2d_419[0][0]
-----
batch_normalization_424 (BatchN (None, 17, 17, 192) 576
conv2d_424[0][0]
-----
batch_normalization_425 (BatchN (None, 17, 17, 192) 576
conv2d_425[0][0]
-----
activation_416 (Activation) (None, 17, 17, 192) 0
batch_normalization_416[0][0]
-----
activation_419 (Activation) (None, 17, 17, 192) 0
batch_normalization_419[0][0]
-----
activation_424 (Activation) (None, 17, 17, 192) 0
batch_normalization_424[0][0]
-----
activation_425 (Activation) (None, 17, 17, 192) 0
batch_normalization_425[0][0]
-----
mixed5 (Concatenate) (None, 17, 17, 768) 0
activation_416[0][0]
activation_419[0][0]
activation_424[0][0]
activation_425[0][0]
-----
conv2d_430 (Conv2D) (None, 17, 17, 160) 122880 mixed5[0][0]
-----
batch_normalization_430 (BatchN (None, 17, 17, 160) 480
conv2d_430[0][0]
-----

```

```

activation_430 (Activation)      (None, 17, 17, 160)  0
batch_normalization_430[0][0]

-----

conv2d_431 (Conv2D)             (None, 17, 17, 160)  179200
activation_430[0][0]

-----

batch_normalization_431 (BatchN (None, 17, 17, 160)  480
conv2d_431[0][0]

-----

activation_431 (Activation)      (None, 17, 17, 160)  0
batch_normalization_431[0][0]

-----

conv2d_427 (Conv2D)             (None, 17, 17, 160)  122880      mixed5[0][0]

-----

conv2d_432 (Conv2D)             (None, 17, 17, 160)  179200
activation_431[0][0]

-----

batch_normalization_427 (BatchN (None, 17, 17, 160)  480
conv2d_427[0][0]

-----

batch_normalization_432 (BatchN (None, 17, 17, 160)  480
conv2d_432[0][0]

-----

activation_427 (Activation)      (None, 17, 17, 160)  0
batch_normalization_427[0][0]

-----

activation_432 (Activation)      (None, 17, 17, 160)  0
batch_normalization_432[0][0]

-----

conv2d_428 (Conv2D)             (None, 17, 17, 160)  179200
activation_427[0][0]

-----

conv2d_433 (Conv2D)             (None, 17, 17, 160)  179200
activation_432[0][0]

-----

batch_normalization_428 (BatchN (None, 17, 17, 160)  480

```



```

conv2d_428[0][0]
-----
-----
batch_normalization_433 (BatchN (None, 17, 17, 160) 480
conv2d_433[0][0]
-----
-----
activation_428 (Activation) (None, 17, 17, 160) 0
batch_normalization_428[0][0]
-----
-----
activation_433 (Activation) (None, 17, 17, 160) 0
batch_normalization_433[0][0]
-----
-----
average_pooling2d_41 (AveragePo (None, 17, 17, 768) 0 mixed5[0][0]
-----
-----
conv2d_426 (Conv2D) (None, 17, 17, 192) 147456 mixed5[0][0]
-----
-----
conv2d_429 (Conv2D) (None, 17, 17, 192) 215040
activation_428[0][0]
-----
-----
conv2d_434 (Conv2D) (None, 17, 17, 192) 215040
activation_433[0][0]
-----
-----
conv2d_435 (Conv2D) (None, 17, 17, 192) 147456
average_pooling2d_41[0][0]
-----
-----
batch_normalization_426 (BatchN (None, 17, 17, 192) 576
conv2d_426[0][0]
-----
-----
batch_normalization_429 (BatchN (None, 17, 17, 192) 576
conv2d_429[0][0]
-----
-----
batch_normalization_434 (BatchN (None, 17, 17, 192) 576
conv2d_434[0][0]
-----
-----
batch_normalization_435 (BatchN (None, 17, 17, 192) 576
conv2d_435[0][0]
-----

```

```

-----
activation_426 (Activation)      (None, 17, 17, 192)  0
batch_normalization_426[0][0]

-----

activation_429 (Activation)      (None, 17, 17, 192)  0
batch_normalization_429[0][0]

-----

activation_434 (Activation)      (None, 17, 17, 192)  0
batch_normalization_434[0][0]

-----

activation_435 (Activation)      (None, 17, 17, 192)  0
batch_normalization_435[0][0]

-----

mixed6 (Concatenate)            (None, 17, 17, 768)  0
activation_426[0][0]
activation_429[0][0]
activation_434[0][0]
activation_435[0][0]

-----

conv2d_440 (Conv2D)              (None, 17, 17, 192)  147456      mixed6[0][0]

-----

batch_normalization_440 (BatchN (None, 17, 17, 192)  576
conv2d_440[0][0]

-----

activation_440 (Activation)      (None, 17, 17, 192)  0
batch_normalization_440[0][0]

-----

conv2d_441 (Conv2D)              (None, 17, 17, 192)  258048
activation_440[0][0]

-----

batch_normalization_441 (BatchN (None, 17, 17, 192)  576
conv2d_441[0][0]

-----

activation_441 (Activation)      (None, 17, 17, 192)  0
batch_normalization_441[0][0]

-----

conv2d_437 (Conv2D)              (None, 17, 17, 192)  147456      mixed6[0][0]

```

```

-----
conv2d_442 (Conv2D) (None, 17, 17, 192) 258048
activation_441[0][0]
-----

batch_normalization_437 (BatchN (None, 17, 17, 192) 576
conv2d_437[0][0]
-----

batch_normalization_442 (BatchN (None, 17, 17, 192) 576
conv2d_442[0][0]
-----

activation_437 (Activation) (None, 17, 17, 192) 0
batch_normalization_437[0][0]
-----

activation_442 (Activation) (None, 17, 17, 192) 0
batch_normalization_442[0][0]
-----

conv2d_438 (Conv2D) (None, 17, 17, 192) 258048
activation_437[0][0]
-----

conv2d_443 (Conv2D) (None, 17, 17, 192) 258048
activation_442[0][0]
-----

batch_normalization_438 (BatchN (None, 17, 17, 192) 576
conv2d_438[0][0]
-----

batch_normalization_443 (BatchN (None, 17, 17, 192) 576
conv2d_443[0][0]
-----

activation_438 (Activation) (None, 17, 17, 192) 0
batch_normalization_438[0][0]
-----

activation_443 (Activation) (None, 17, 17, 192) 0
batch_normalization_443[0][0]
-----

average_pooling2d_42 (AveragePo (None, 17, 17, 768) 0 mixed6[0][0]
-----

```

conv2d_436 (Conv2D) (None, 17, 17, 192) 147456 mixed6[0][0]

conv2d_439 (Conv2D) (None, 17, 17, 192) 258048
activation_438[0][0]

conv2d_444 (Conv2D) (None, 17, 17, 192) 258048
activation_443[0][0]

conv2d_445 (Conv2D) (None, 17, 17, 192) 147456
average_pooling2d_42[0][0]

batch_normalization_436 (BatchN (None, 17, 17, 192) 576
conv2d_436[0][0]

batch_normalization_439 (BatchN (None, 17, 17, 192) 576
conv2d_439[0][0]

batch_normalization_444 (BatchN (None, 17, 17, 192) 576
conv2d_444[0][0]

batch_normalization_445 (BatchN (None, 17, 17, 192) 576
conv2d_445[0][0]

activation_436 (Activation) (None, 17, 17, 192) 0
batch_normalization_436[0][0]

activation_439 (Activation) (None, 17, 17, 192) 0
batch_normalization_439[0][0]

activation_444 (Activation) (None, 17, 17, 192) 0
batch_normalization_444[0][0]

activation_445 (Activation) (None, 17, 17, 192) 0
batch_normalization_445[0][0]


```

mixed7 (Concatenate)          (None, 17, 17, 768)  0
activation_436[0][0]
activation_439[0][0]
activation_444[0][0]
activation_445[0][0]
-----

-----
conv2d_448 (Conv2D)           (None, 17, 17, 192)  147456      mixed7[0][0]
-----

-----
batch_normalization_448 (BatchN (None, 17, 17, 192)  576
conv2d_448[0][0]
-----

-----
activation_448 (Activation)    (None, 17, 17, 192)  0
batch_normalization_448[0][0]
-----

-----
conv2d_449 (Conv2D)           (None, 17, 17, 192)  258048
activation_448[0][0]
-----

-----
batch_normalization_449 (BatchN (None, 17, 17, 192)  576
conv2d_449[0][0]
-----

-----
activation_449 (Activation)    (None, 17, 17, 192)  0
batch_normalization_449[0][0]
-----

-----
conv2d_446 (Conv2D)           (None, 17, 17, 192)  147456      mixed7[0][0]
-----

-----
conv2d_450 (Conv2D)           (None, 17, 17, 192)  258048
activation_449[0][0]
-----

-----
batch_normalization_446 (BatchN (None, 17, 17, 192)  576
conv2d_446[0][0]
-----

-----
batch_normalization_450 (BatchN (None, 17, 17, 192)  576
conv2d_450[0][0]
-----

-----
activation_446 (Activation)    (None, 17, 17, 192)  0
batch_normalization_446[0][0]
-----

```

```

-----
activation_450 (Activation)      (None, 17, 17, 192)  0
batch_normalization_450[0][0]

-----

conv2d_447 (Conv2D)             (None, 8, 8, 320)    552960
activation_446[0][0]

-----

conv2d_451 (Conv2D)             (None, 8, 8, 192)    331776
activation_450[0][0]

-----

batch_normalization_447 (BatchN (None, 8, 8, 320)    960
conv2d_447[0][0]

-----

batch_normalization_451 (BatchN (None, 8, 8, 192)    576
conv2d_451[0][0]

-----

activation_447 (Activation)      (None, 8, 8, 320)    0
batch_normalization_447[0][0]

-----

activation_451 (Activation)      (None, 8, 8, 192)    0
batch_normalization_451[0][0]

-----

max_pooling2d_19 (MaxPooling2D) (None, 8, 8, 768)    0          mixed7[0][0]

-----

mixed8 (Concatenate)            (None, 8, 8, 1280)   0
activation_447[0][0]
activation_451[0][0]
max_pooling2d_19[0][0]

-----

conv2d_456 (Conv2D)             (None, 8, 8, 448)    573440      mixed8[0][0]

-----

batch_normalization_456 (BatchN (None, 8, 8, 448)    1344
conv2d_456[0][0]

-----

activation_456 (Activation)      (None, 8, 8, 448)    0
batch_normalization_456[0][0]

```

conv2d_453 (Conv2D)	(None, 8, 8, 384)	491520	mixed8[0][0]

conv2d_457 (Conv2D)	(None, 8, 8, 384)	1548288	
activation_456[0][0]			

batch_normalization_453 (BatchN	(None, 8, 8, 384)	1152	
conv2d_453[0][0]			

batch_normalization_457 (BatchN	(None, 8, 8, 384)	1152	
conv2d_457[0][0]			

activation_453 (Activation)	(None, 8, 8, 384)	0	
batch_normalization_453[0][0]			

activation_457 (Activation)	(None, 8, 8, 384)	0	
batch_normalization_457[0][0]			

conv2d_454 (Conv2D)	(None, 8, 8, 384)	442368	
activation_453[0][0]			

conv2d_455 (Conv2D)	(None, 8, 8, 384)	442368	
activation_453[0][0]			

conv2d_458 (Conv2D)	(None, 8, 8, 384)	442368	
activation_457[0][0]			

conv2d_459 (Conv2D)	(None, 8, 8, 384)	442368	
activation_457[0][0]			

average_pooling2d_43 (AveragePo	(None, 8, 8, 1280)	0	mixed8[0][0]

conv2d_452 (Conv2D)	(None, 8, 8, 320)	409600	mixed8[0][0]

batch_normalization_454 (BatchN	(None, 8, 8, 384)	1152	
conv2d_454[0][0]			

```

-----
-----
batch_normalization_455 (BatchN (None, 8, 8, 384)    1152
conv2d_455[0][0]
-----
-----
batch_normalization_458 (BatchN (None, 8, 8, 384)    1152
conv2d_458[0][0]
-----
-----
batch_normalization_459 (BatchN (None, 8, 8, 384)    1152
conv2d_459[0][0]
-----
-----
conv2d_460 (Conv2D)          (None, 8, 8, 192)    245760
average_pooling2d_43[0][0]
-----
-----
batch_normalization_452 (BatchN (None, 8, 8, 320)    960
conv2d_452[0][0]
-----
-----
activation_454 (Activation)   (None, 8, 8, 384)    0
batch_normalization_454[0][0]
-----
-----
activation_455 (Activation)   (None, 8, 8, 384)    0
batch_normalization_455[0][0]
-----
-----
activation_458 (Activation)   (None, 8, 8, 384)    0
batch_normalization_458[0][0]
-----
-----
activation_459 (Activation)   (None, 8, 8, 384)    0
batch_normalization_459[0][0]
-----
-----
batch_normalization_460 (BatchN (None, 8, 8, 192)    576
conv2d_460[0][0]
-----
-----
activation_452 (Activation)   (None, 8, 8, 320)    0
batch_normalization_452[0][0]
-----
-----
mixed9_0 (Concatenate)       (None, 8, 8, 768)    0
activation_454[0][0]

```



```

activation_455[0][0]
-----
-----
concatenate_8 (Concatenate)      (None, 8, 8, 768)      0
activation_458[0][0]
activation_459[0][0]
-----
-----
activation_460 (Activation)      (None, 8, 8, 192)      0
batch_normalization_460[0][0]
-----
-----
mixed9 (Concatenate)            (None, 8, 8, 2048)      0
activation_452[0][0]
mixed9_0[0][0]
concatenate_8[0][0]
activation_460[0][0]
-----
-----
conv2d_465 (Conv2D)              (None, 8, 8, 448)      917504      mixed9[0][0]
-----
-----
batch_normalization_465 (BatchN (None, 8, 8, 448)      1344
conv2d_465[0][0]
-----
-----
activation_465 (Activation)      (None, 8, 8, 448)      0
batch_normalization_465[0][0]
-----
-----
conv2d_462 (Conv2D)              (None, 8, 8, 384)      786432      mixed9[0][0]
-----
-----
conv2d_466 (Conv2D)              (None, 8, 8, 384)      1548288
activation_465[0][0]
-----
-----
batch_normalization_462 (BatchN (None, 8, 8, 384)      1152
conv2d_462[0][0]
-----
-----
batch_normalization_466 (BatchN (None, 8, 8, 384)      1152
conv2d_466[0][0]
-----
-----
activation_462 (Activation)      (None, 8, 8, 384)      0
batch_normalization_462[0][0]
-----

```

activation_466 (Activation)	(None, 8, 8, 384)	0	
batch_normalization_466[0][0]			

conv2d_463 (Conv2D)	(None, 8, 8, 384)	442368	
activation_462[0][0]			

conv2d_464 (Conv2D)	(None, 8, 8, 384)	442368	
activation_462[0][0]			

conv2d_467 (Conv2D)	(None, 8, 8, 384)	442368	
activation_466[0][0]			

conv2d_468 (Conv2D)	(None, 8, 8, 384)	442368	
activation_466[0][0]			

average_pooling2d_44 (AveragePo	(None, 8, 8, 2048)	0	mixed9[0][0]

conv2d_461 (Conv2D)	(None, 8, 8, 320)	655360	mixed9[0][0]

batch_normalization_463 (BatchN	(None, 8, 8, 384)	1152	
conv2d_463[0][0]			

batch_normalization_464 (BatchN	(None, 8, 8, 384)	1152	
conv2d_464[0][0]			

batch_normalization_467 (BatchN	(None, 8, 8, 384)	1152	
conv2d_467[0][0]			

batch_normalization_468 (BatchN	(None, 8, 8, 384)	1152	
conv2d_468[0][0]			

conv2d_469 (Conv2D)	(None, 8, 8, 192)	393216	
average_pooling2d_44[0][0]			

batch_normalization_461 (BatchN	(None, 8, 8, 320)	960	

```

conv2d_461[0][0]
-----
-----
activation_463 (Activation)      (None, 8, 8, 384)      0
batch_normalization_463[0][0]
-----
-----
activation_464 (Activation)      (None, 8, 8, 384)      0
batch_normalization_464[0][0]
-----
-----
activation_467 (Activation)      (None, 8, 8, 384)      0
batch_normalization_467[0][0]
-----
-----
activation_468 (Activation)      (None, 8, 8, 384)      0
batch_normalization_468[0][0]
-----
-----
batch_normalization_469 (BatchN (None, 8, 8, 192)      576
conv2d_469[0][0]
-----
-----
activation_461 (Activation)      (None, 8, 8, 320)      0
batch_normalization_461[0][0]
-----
-----
mixed9_1 (Concatenate)          (None, 8, 8, 768)      0
activation_463[0][0]
activation_464[0][0]
-----
-----
concatenate_9 (Concatenate)      (None, 8, 8, 768)      0
activation_467[0][0]
activation_468[0][0]
-----
-----
activation_469 (Activation)      (None, 8, 8, 192)      0
batch_normalization_469[0][0]
-----
-----
mixed10 (Concatenate)           (None, 8, 8, 2048)     0
activation_461[0][0]
mixed9_1[0][0]
concatenate_9[0][0]
activation_469[0][0]
-----
-----

```

```

global_average_pooling2d_12 (Gl (None, 2048)          0          mixed10[0][0]
-----
dense_30 (Dense)                (None, 256)      524544
global_average_pooling2d_12[0][0]
-----
dense_31 (Dense)                (None, 64)       16448      dense_30[0][0]
-----
dense_32 (Dense)                (None, 3)        195       dense_31[0][0]
=====
Total params: 22,343,971
Trainable params: 22,309,539
Non-trainable params: 34,432
-----

```

```
[92]: !rm -r logs_2/
```

```
[91]: from datetime import datetime
log_dir="logs_2/" + datetime.now().strftime("%Y%m%d-%H%M%S")
tensorboard_callback = tf.keras.callbacks.
    ↳TensorBoard(log_dir=log_dir,histogram_freq=1,
    ↳write_graph=True,write_grads=True)
# 4. Save your model at every epoch if your validation accuracy is improved
    ↳from previous epoch.
filepath="model_save_2/weights-{epoch:02d}-{val_accuracy:.4f}.hdf5"
# Saving the model
checkpoint = tf.keras.callbacks.ModelCheckpoint(filepath=filepath,
    ↳monitor='val_accuracy', save_best_only=True, verbose=1, mode='auto')
```

WARNING:tensorflow: `write_grads` will be ignored in TensorFlow 2.0 for the `TensorBoard` Callback.

```
[93]: model_2.compile(loss='categorical_crossentropy', optimizer=tf.keras.optimizers.
    ↳SGD(learning_rate=0.001, momentum=0.9, nesterov=True), metrics=['accuracy'])
history_2 = model_2.fit(
    train_generator,
    validation_data = validation_generator,
    steps_per_epoch = 100,
    epochs = 10,
    validation_steps = 20,
    verbose = 1,
    callbacks=[tensorboard_callback, checkpoint])
```

Epoch 1/10

100/100 [=====] - ETA: 0s - loss: 0.6166 - accuracy: 0.7563
Epoch 00001: val_accuracy improved from -inf to 0.61417, saving model to model_save_2/weights-01-0.6142.hdf5
100/100 [=====] - 168s 2s/step - loss: 0.6166 - accuracy: 0.7563 - val_loss: 1.2320 - val_accuracy: 0.6142
Epoch 2/10
100/100 [=====] - ETA: 0s - loss: 0.5191 - accuracy: 0.7940
Epoch 00002: val_accuracy did not improve from 0.61417
100/100 [=====] - 165s 2s/step - loss: 0.5191 - accuracy: 0.7940 - val_loss: 2.3692 - val_accuracy: 0.6142
Epoch 3/10
100/100 [=====] - ETA: 0s - loss: 0.4322 - accuracy: 0.8309
Epoch 00003: val_accuracy did not improve from 0.61417
100/100 [=====] - 166s 2s/step - loss: 0.4322 - accuracy: 0.8309 - val_loss: 2.6709 - val_accuracy: 0.6126
Epoch 4/10
100/100 [=====] - ETA: 0s - loss: 0.3837 - accuracy: 0.8478
Epoch 00004: val_accuracy improved from 0.61417 to 0.62520, saving model to model_save_2/weights-04-0.6252.hdf5
100/100 [=====] - 168s 2s/step - loss: 0.3837 - accuracy: 0.8478 - val_loss: 1.6058 - val_accuracy: 0.6252
Epoch 5/10
100/100 [=====] - ETA: 0s - loss: 0.3513 - accuracy: 0.8513
Epoch 00005: val_accuracy improved from 0.62520 to 0.66614, saving model to model_save_2/weights-05-0.6661.hdf5
100/100 [=====] - 170s 2s/step - loss: 0.3513 - accuracy: 0.8513 - val_loss: 1.1842 - val_accuracy: 0.6661
Epoch 6/10
100/100 [=====] - ETA: 0s - loss: 0.3301 - accuracy: 0.8613
Epoch 00006: val_accuracy improved from 0.66614 to 0.80000, saving model to model_save_2/weights-06-0.8000.hdf5
100/100 [=====] - 167s 2s/step - loss: 0.3301 - accuracy: 0.8613 - val_loss: 0.6688 - val_accuracy: 0.8000
Epoch 7/10
100/100 [=====] - ETA: 0s - loss: 0.3150 - accuracy: 0.8738
Epoch 00007: val_accuracy improved from 0.80000 to 0.81260, saving model to model_save_2/weights-07-0.8126.hdf5
100/100 [=====] - 166s 2s/step - loss: 0.3150 - accuracy: 0.8738 - val_loss: 0.6004 - val_accuracy: 0.8126
Epoch 8/10
100/100 [=====] - ETA: 0s - loss: 0.2897 - accuracy:

```

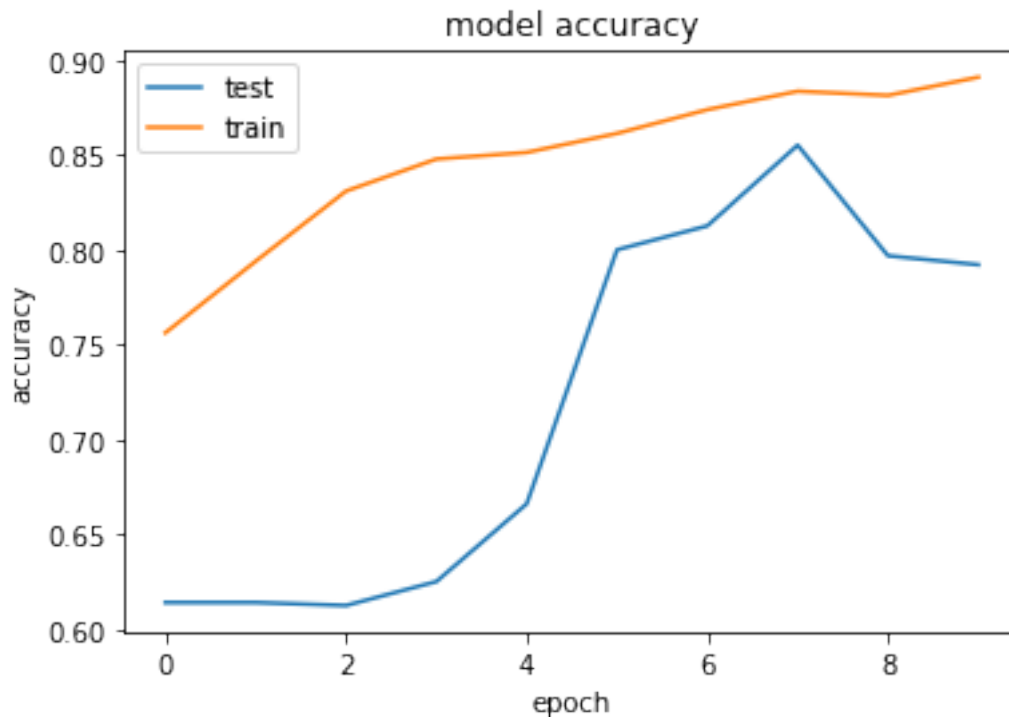
0.8835
Epoch 00008: val_accuracy improved from 0.81260 to 0.85512, saving model to
model_save_2/weights-08-0.8551.hdf5
100/100 [=====] - 166s 2s/step - loss: 0.2897 -
accuracy: 0.8835 - val_loss: 0.3754 - val_accuracy: 0.8551
Epoch 9/10
100/100 [=====] - ETA: 0s - loss: 0.2854 - accuracy:
0.8813
Epoch 00009: val_accuracy did not improve from 0.85512
100/100 [=====] - 165s 2s/step - loss: 0.2854 -
accuracy: 0.8813 - val_loss: 0.7809 - val_accuracy: 0.7969
Epoch 10/10
100/100 [=====] - ETA: 0s - loss: 0.2596 - accuracy:
0.8909
Epoch 00010: val_accuracy did not improve from 0.85512
100/100 [=====] - 166s 2s/step - loss: 0.2596 -
accuracy: 0.8909 - val_loss: 0.7767 - val_accuracy: 0.7921

```

```

[96]: # summarize history for loss
plt.plot(history_2.history['val_accuracy'])
plt.plot(history_2.history['accuracy'])
plt.title('model accuracy')
plt.ylabel('accuracy')
plt.xlabel('epoch')
plt.legend(['test', 'train'], loc='upper left')
plt.show()

```



Conclusion - Model did not perform well. without imagenet weights. - Lets consider the 1st model trained on imagenet weight initialization.