In [1]:
```
from keras.layers import Input, Lambda, Dense, Flatten
from keras.models import Model
#from keras.applications.resnet50 import ResNet50
#from keras.applications.vgg16 import VGG16
from keras.applications.vgg16 import preprocess_input
from keras.applications.inception_v3 import InceptionV3
from keras.preprocessing import image
from keras.preprocessing.image import ImageDataGenerator
from keras.models import Sequential
import numpy as np
from glob import glob
import matplotlib.pyplot as plt
```

In [2]:
```
IMAGE_SIZE = [224, 224]

train_path = 'E:\\chest_xray\\train\\'
valid_path = 'E:\\chest_xray\\test\\'
```

In [3]:
```
inception = InceptionV3(input_shape=IMAGE_SIZE + [3], weights='imagenet', include_to
```

In [4]:
```
for layer in inception.layers:
    layer.trainable = False
```

In [5]:
```
folders = glob('E:\\chest_xray\\train\\*')
```

In [6]:
```
x = Flatten()(inception.output)
```

In [7]:
```
prediction = Dense(len(folders), activation='softmax')(x)
model = Model(inputs=inception.input, outputs=prediction)
```

In [8]:
```
model.summary()
```

```
Model: "functional_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
input_1 (InputLayer)         [(None, 224, 224, 3)      0
_________________________________________________________________
conv2d (Conv2D)              (None, 111, 111, 32)      864
_________________________________________________________________
batch_normalization (BatchNorma (None, 111, 111, 32)      96
_________________________________________________________________
activation (Activation)      (None, 111, 111, 32)      0
_________________________________________________________________
conv2d_1 (Conv2D)            (None, 109, 109, 32)      9216
_________________________________________________________________
```

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__________________
batch_normalization_1 (BatchNor (None, 109, 109, 32) 96          conv2d_1[0][0]
_____________________________________________________________________________________
__________________
activation_1 (Activation)       (None, 109, 109, 32) 0           batch_normalization
_1[0][0]
_____________________________________________________________________________________
__________________
conv2d_2 (Conv2D)               (None, 109, 109, 64) 18432       activation_1[0][0]
_____________________________________________________________________________________
__________________
batch_normalization_2 (BatchNor (None, 109, 109, 64) 192         conv2d_2[0][0]
_____________________________________________________________________________________
__________________
activation_2 (Activation)       (None, 109, 109, 64) 0           batch_normalization
_2[0][0]
_____________________________________________________________________________________
__________________
max_pooling2d (MaxPooling2D)    (None, 54, 54, 64)   0           activation_2[0][0]
_____________________________________________________________________________________
__________________
conv2d_3 (Conv2D)               (None, 54, 54, 80)   5120        max_pooling2d[0][0]
_____________________________________________________________________________________
__________________
batch_normalization_3 (BatchNor (None, 54, 54, 80)   240         conv2d_3[0][0]
_____________________________________________________________________________________
__________________
activation_3 (Activation)       (None, 54, 54, 80)   0           batch_normalization
_3[0][0]
_____________________________________________________________________________________
__________________
conv2d_4 (Conv2D)               (None, 52, 52, 192)  138240      activation_3[0][0]
_____________________________________________________________________________________
__________________
batch_normalization_4 (BatchNor (None, 52, 52, 192)  576         conv2d_4[0][0]
_____________________________________________________________________________________
__________________
activation_4 (Activation)       (None, 52, 52, 192)  0           batch_normalization
_4[0][0]
_____________________________________________________________________________________
__________________
max_pooling2d_1 (MaxPooling2D)  (None, 25, 25, 192)  0           activation_4[0][0]
_____________________________________________________________________________________
__________________
conv2d_8 (Conv2D)               (None, 25, 25, 64)   12288       max_pooling2d_1[0]
[0]
_____________________________________________________________________________________
__________________
batch_normalization_8 (BatchNor (None, 25, 25, 64)   192         conv2d_8[0][0]
_____________________________________________________________________________________
__________________
activation_8 (Activation)       (None, 25, 25, 64)   0           batch_normalization
_8[0][0]
_____________________________________________________________________________________
__________________
conv2d_6 (Conv2D)               (None, 25, 25, 48)   9216        max_pooling2d_1[0]
[0]
_____________________________________________________________________________________
__________________
conv2d_9 (Conv2D)               (None, 25, 25, 96)   55296       activation_8[0][0]
_____________________________________________________________________________________
__________________
batch_normalization_6 (BatchNor (None, 25, 25, 48)   144         conv2d_6[0][0]
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batch_normalization_9 (BatchNor (None, 25, 25, 96)   288         conv2d_9[0][0]
__________________________________________________________________________________
__________________
activation_6 (Activation)       (None, 25, 25, 48)   0           batch_normalization
_6[0][0]
__________________________________________________________________________________
__________________
activation_9 (Activation)       (None, 25, 25, 96)   0           batch_normalization
_9[0][0]
__________________________________________________________________________________
__________________
average_pooling2d (AveragePooli (None, 25, 25, 192)  0           max_pooling2d_1[0]
[0]
__________________________________________________________________________________
__________________
conv2d_5 (Conv2D)               (None, 25, 25, 64)   12288       max_pooling2d_1[0]
[0]
__________________________________________________________________________________
__________________
conv2d_7 (Conv2D)               (None, 25, 25, 64)   76800       activation_6[0][0]
__________________________________________________________________________________
__________________
conv2d_10 (Conv2D)              (None, 25, 25, 96)   82944       activation_9[0][0]
__________________________________________________________________________________
__________________
conv2d_11 (Conv2D)              (None, 25, 25, 32)   6144        average_pooling2d
[0][0]
__________________________________________________________________________________
__________________
batch_normalization_5 (BatchNor (None, 25, 25, 64)   192         conv2d_5[0][0]
__________________________________________________________________________________
__________________
batch_normalization_7 (BatchNor (None, 25, 25, 64)   192         conv2d_7[0][0]
__________________________________________________________________________________
__________________
batch_normalization_10 (BatchNo (None, 25, 25, 96)   288         conv2d_10[0][0]
__________________________________________________________________________________
__________________
batch_normalization_11 (BatchNo (None, 25, 25, 32)   96          conv2d_11[0][0]
__________________________________________________________________________________
__________________
activation_5 (Activation)       (None, 25, 25, 64)   0           batch_normalization
_5[0][0]
__________________________________________________________________________________
__________________
activation_7 (Activation)       (None, 25, 25, 64)   0           batch_normalization
_7[0][0]
__________________________________________________________________________________
__________________
activation_10 (Activation)      (None, 25, 25, 96)   0           batch_normalization
_10[0][0]
__________________________________________________________________________________
__________________
activation_11 (Activation)      (None, 25, 25, 32)   0           batch_normalization
_11[0][0]
__________________________________________________________________________________
__________________
mixed0 (Concatenate)            (None, 25, 25, 256)  0           activation_5[0][0]
                                                                 activation_7[0][0]
                                                                 activation_10[0][0]
                                                                 activation_11[0][0]
__________________________________________________________________________________
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conv2d_15 (Conv2D)              (None, 25, 25, 64)   16384       mixed0[0][0]
__________________________________________________________________________________________________
batch_normalization_15 (BatchNo (None, 25, 25, 64)   192         conv2d_15[0][0]
__________________________________________________________________________________________________
activation_15 (Activation)      (None, 25, 25, 64)   0           batch_normalization
_15[0][0]
__________________________________________________________________________________________________
conv2d_13 (Conv2D)              (None, 25, 25, 48)   12288       mixed0[0][0]
__________________________________________________________________________________________________
conv2d_16 (Conv2D)              (None, 25, 25, 96)   55296       activation_15[0][0]
__________________________________________________________________________________________________
batch_normalization_13 (BatchNo (None, 25, 25, 48)   144         conv2d_13[0][0]
__________________________________________________________________________________________________
batch_normalization_16 (BatchNo (None, 25, 25, 96)   288         conv2d_16[0][0]
__________________________________________________________________________________________________
activation_13 (Activation)      (None, 25, 25, 48)   0           batch_normalization
_13[0][0]
__________________________________________________________________________________________________
activation_16 (Activation)      (None, 25, 25, 96)   0           batch_normalization
_16[0][0]
__________________________________________________________________________________________________
average_pooling2d_1 (AveragePoo (None, 25, 25, 256)  0           mixed0[0][0]
__________________________________________________________________________________________________
conv2d_12 (Conv2D)              (None, 25, 25, 64)   16384       mixed0[0][0]
__________________________________________________________________________________________________
conv2d_14 (Conv2D)              (None, 25, 25, 64)   76800       activation_13[0][0]
__________________________________________________________________________________________________
conv2d_17 (Conv2D)              (None, 25, 25, 96)   82944       activation_16[0][0]
__________________________________________________________________________________________________
conv2d_18 (Conv2D)              (None, 25, 25, 64)   16384       average_pooling2d_1
[0][0]
__________________________________________________________________________________________________
batch_normalization_12 (BatchNo (None, 25, 25, 64)   192         conv2d_12[0][0]
__________________________________________________________________________________________________
batch_normalization_14 (BatchNo (None, 25, 25, 64)   192         conv2d_14[0][0]
__________________________________________________________________________________________________
batch_normalization_17 (BatchNo (None, 25, 25, 96)   288         conv2d_17[0][0]
__________________________________________________________________________________________________
batch_normalization_18 (BatchNo (None, 25, 25, 64)   192         conv2d_18[0][0]
__________________________________________________________________________________________________
activation_12 (Activation)      (None, 25, 25, 64)   0           batch_normalization
_12[0][0]
__________________________________________________________________________________________________
activation_14 (Activation)      (None, 25, 25, 64)   0           batch_normalization
_14[0][0]
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__________________________________________________________________________________________________
activation_17 (Activation)      (None, 25, 25, 96)   0           batch_normalization_17[0][0]
__________________________________________________________________________________________________
activation_18 (Activation)      (None, 25, 25, 64)   0           batch_normalization_18[0][0]
__________________________________________________________________________________________________
mixed1 (Concatenate)            (None, 25, 25, 288)  0           activation_12[0][0]
                                                                 activation_14[0][0]
                                                                 activation_17[0][0]
                                                                 activation_18[0][0]
__________________________________________________________________________________________________
conv2d_22 (Conv2D)              (None, 25, 25, 64)   18432       mixed1[0][0]
__________________________________________________________________________________________________
batch_normalization_22 (BatchNo (None, 25, 25, 64)   192         conv2d_22[0][0]
__________________________________________________________________________________________________
activation_22 (Activation)      (None, 25, 25, 64)   0           batch_normalization_22[0][0]
__________________________________________________________________________________________________
conv2d_20 (Conv2D)              (None, 25, 25, 48)   13824       mixed1[0][0]
__________________________________________________________________________________________________
conv2d_23 (Conv2D)              (None, 25, 25, 96)   55296       activation_22[0][0]
__________________________________________________________________________________________________
batch_normalization_20 (BatchNo (None, 25, 25, 48)   144         conv2d_20[0][0]
__________________________________________________________________________________________________
batch_normalization_23 (BatchNo (None, 25, 25, 96)   288         conv2d_23[0][0]
__________________________________________________________________________________________________
activation_20 (Activation)      (None, 25, 25, 48)   0           batch_normalization_20[0][0]
__________________________________________________________________________________________________
activation_23 (Activation)      (None, 25, 25, 96)   0           batch_normalization_23[0][0]
__________________________________________________________________________________________________
average_pooling2d_2 (AveragePoo (None, 25, 25, 288)  0           mixed1[0][0]
__________________________________________________________________________________________________
conv2d_19 (Conv2D)              (None, 25, 25, 64)   18432       mixed1[0][0]
__________________________________________________________________________________________________
conv2d_21 (Conv2D)              (None, 25, 25, 64)   76800       activation_20[0][0]
__________________________________________________________________________________________________
conv2d_24 (Conv2D)              (None, 25, 25, 96)   82944       activation_23[0][0]
__________________________________________________________________________________________________
conv2d_25 (Conv2D)              (None, 25, 25, 64)   18432       average_pooling2d_2[0][0]
__________________________________________________________________________________________________
batch_normalization_19 (BatchNo (None, 25, 25, 64)   192         conv2d_19[0][0]
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batch_normalization_21 (BatchNo (None, 25, 25, 64)   192         conv2d_21[0][0]
__________________________________________________________________________________________
__________________
batch_normalization_24 (BatchNo (None, 25, 25, 96)   288         conv2d_24[0][0]
__________________________________________________________________________________________
__________________
batch_normalization_25 (BatchNo (None, 25, 25, 64)   192         conv2d_25[0][0]
__________________________________________________________________________________________
__________________
activation_19 (Activation)      (None, 25, 25, 64)   0           batch_normalization
_19[0][0]
__________________________________________________________________________________________
__________________
activation_21 (Activation)      (None, 25, 25, 64)   0           batch_normalization
_21[0][0]
__________________________________________________________________________________________
__________________
activation_24 (Activation)      (None, 25, 25, 96)   0           batch_normalization
_24[0][0]
__________________________________________________________________________________________
__________________
activation_25 (Activation)      (None, 25, 25, 64)   0           batch_normalization
_25[0][0]
__________________________________________________________________________________________
__________________
mixed2 (Concatenate)            (None, 25, 25, 288)  0           activation_19[0][0]
                                                                 activation_21[0][0]
                                                                 activation_24[0][0]
                                                                 activation_25[0][0]
__________________________________________________________________________________________
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conv2d_27 (Conv2D)              (None, 25, 25, 64)   18432       mixed2[0][0]
__________________________________________________________________________________________
__________________
batch_normalization_27 (BatchNo (None, 25, 25, 64)   192         conv2d_27[0][0]
__________________________________________________________________________________________
__________________
activation_27 (Activation)      (None, 25, 25, 64)   0           batch_normalization
_27[0][0]
__________________________________________________________________________________________
__________________
conv2d_28 (Conv2D)              (None, 25, 25, 96)   55296       activation_27[0][0]
__________________________________________________________________________________________
__________________
batch_normalization_28 (BatchNo (None, 25, 25, 96)   288         conv2d_28[0][0]
__________________________________________________________________________________________
__________________
activation_28 (Activation)      (None, 25, 25, 96)   0           batch_normalization
_28[0][0]
__________________________________________________________________________________________
__________________
conv2d_26 (Conv2D)              (None, 12, 12, 384)  995328      mixed2[0][0]
__________________________________________________________________________________________
__________________
conv2d_29 (Conv2D)              (None, 12, 12, 96)   82944       activation_28[0][0]
__________________________________________________________________________________________
__________________
batch_normalization_26 (BatchNo (None, 12, 12, 384)  1152        conv2d_26[0][0]
__________________________________________________________________________________________
__________________
batch_normalization_29 (BatchNo (None, 12, 12, 96)   288         conv2d_29[0][0]
__________________________________________________________________________________________
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activation_26 (Activation)      (None, 12, 12, 384)  0           batch_normalization
_26[0][0]
__________________________________________________________________________________
_______________
activation_29 (Activation)      (None, 12, 12, 96)   0           batch_normalization
_29[0][0]
__________________________________________________________________________________
_______________
max_pooling2d_2 (MaxPooling2D)  (None, 12, 12, 288)  0           mixed2[0][0]
__________________________________________________________________________________
_______________
mixed3 (Concatenate)            (None, 12, 12, 768)  0           activation_26[0][0]
                                                                 activation_29[0][0]
                                                                 max_pooling2d_2[0]
[0]
__________________________________________________________________________________
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conv2d_34 (Conv2D)              (None, 12, 12, 128)  98304       mixed3[0][0]
__________________________________________________________________________________
_______________
batch_normalization_34 (BatchNo (None, 12, 12, 128)  384         conv2d_34[0][0]
__________________________________________________________________________________
_______________
activation_34 (Activation)      (None, 12, 12, 128)  0           batch_normalization
_34[0][0]
__________________________________________________________________________________
_______________
conv2d_35 (Conv2D)              (None, 12, 12, 128)  114688      activation_34[0][0]
__________________________________________________________________________________
_______________
batch_normalization_35 (BatchNo (None, 12, 12, 128)  384         conv2d_35[0][0]
__________________________________________________________________________________
_______________
activation_35 (Activation)      (None, 12, 12, 128)  0           batch_normalization
_35[0][0]
__________________________________________________________________________________
_______________
conv2d_31 (Conv2D)              (None, 12, 12, 128)  98304       mixed3[0][0]
__________________________________________________________________________________
_______________
conv2d_36 (Conv2D)              (None, 12, 12, 128)  114688      activation_35[0][0]
__________________________________________________________________________________
_______________
batch_normalization_31 (BatchNo (None, 12, 12, 128)  384         conv2d_31[0][0]
__________________________________________________________________________________
_______________
batch_normalization_36 (BatchNo (None, 12, 12, 128)  384         conv2d_36[0][0]
__________________________________________________________________________________
_______________
activation_31 (Activation)      (None, 12, 12, 128)  0           batch_normalization
_31[0][0]
__________________________________________________________________________________
_______________
activation_36 (Activation)      (None, 12, 12, 128)  0           batch_normalization
_36[0][0]
__________________________________________________________________________________
_______________
conv2d_32 (Conv2D)              (None, 12, 12, 128)  114688      activation_31[0][0]
__________________________________________________________________________________
_______________
conv2d_37 (Conv2D)              (None, 12, 12, 128)  114688      activation_36[0][0]
__________________________________________________________________________________
_______________
batch_normalization_32 (BatchNo (None, 12, 12, 128)  384         conv2d_32[0][0]
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__________________________________________________________________________________________________
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batch_normalization_37 (BatchNo (None, 12, 12, 128)  384         conv2d_37[0][0]
__________________________________________________________________________________________________
_______________
activation_32 (Activation)      (None, 12, 12, 128)  0           batch_normalization
_32[0][0]
__________________________________________________________________________________________________
_______________
activation_37 (Activation)      (None, 12, 12, 128)  0           batch_normalization
_37[0][0]
__________________________________________________________________________________________________
_______________
average_pooling2d_3 (AveragePoo (None, 12, 12, 768)  0           mixed3[0][0]
__________________________________________________________________________________________________
_______________
conv2d_30 (Conv2D)              (None, 12, 12, 192)  147456      mixed3[0][0]
__________________________________________________________________________________________________
_______________
conv2d_33 (Conv2D)              (None, 12, 12, 192)  172032      activation_32[0][0]
__________________________________________________________________________________________________
_______________
conv2d_38 (Conv2D)              (None, 12, 12, 192)  172032      activation_37[0][0]
__________________________________________________________________________________________________
_______________
conv2d_39 (Conv2D)              (None, 12, 12, 192)  147456      average_pooling2d_3
[0][0]
__________________________________________________________________________________________________
_______________
batch_normalization_30 (BatchNo (None, 12, 12, 192)  576         conv2d_30[0][0]
__________________________________________________________________________________________________
_______________
batch_normalization_33 (BatchNo (None, 12, 12, 192)  576         conv2d_33[0][0]
__________________________________________________________________________________________________
_______________
batch_normalization_38 (BatchNo (None, 12, 12, 192)  576         conv2d_38[0][0]
__________________________________________________________________________________________________
_______________
batch_normalization_39 (BatchNo (None, 12, 12, 192)  576         conv2d_39[0][0]
__________________________________________________________________________________________________
_______________
activation_30 (Activation)      (None, 12, 12, 192)  0           batch_normalization
_30[0][0]
__________________________________________________________________________________________________
_______________
activation_33 (Activation)      (None, 12, 12, 192)  0           batch_normalization
_33[0][0]
__________________________________________________________________________________________________
_______________
activation_38 (Activation)      (None, 12, 12, 192)  0           batch_normalization
_38[0][0]
__________________________________________________________________________________________________
_______________
activation_39 (Activation)      (None, 12, 12, 192)  0           batch_normalization
_39[0][0]
__________________________________________________________________________________________________
_______________
mixed4 (Concatenate)            (None, 12, 12, 768)  0           activation_30[0][0]
                                                                 activation_33[0][0]
                                                                 activation_38[0][0]
                                                                 activation_39[0][0]
__________________________________________________________________________________________________
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conv2d_44 (Conv2D)              (None, 12, 12, 160)  122880      mixed4[0][0]
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__________________________________________________________________________________________________
batch_normalization_44 (BatchNo (None, 12, 12, 160)  480         conv2d_44[0][0]
__________________________________________________________________________________________________
activation_44 (Activation)      (None, 12, 12, 160)  0           batch_normalization
_44[0][0]
__________________________________________________________________________________________________
conv2d_45 (Conv2D)              (None, 12, 12, 160)  179200      activation_44[0][0]
__________________________________________________________________________________________________
batch_normalization_45 (BatchNo (None, 12, 12, 160)  480         conv2d_45[0][0]
__________________________________________________________________________________________________
activation_45 (Activation)      (None, 12, 12, 160)  0           batch_normalization
_45[0][0]
__________________________________________________________________________________________________
conv2d_41 (Conv2D)              (None, 12, 12, 160)  122880      mixed4[0][0]
__________________________________________________________________________________________________
conv2d_46 (Conv2D)              (None, 12, 12, 160)  179200      activation_45[0][0]
__________________________________________________________________________________________________
batch_normalization_41 (BatchNo (None, 12, 12, 160)  480         conv2d_41[0][0]
__________________________________________________________________________________________________
batch_normalization_46 (BatchNo (None, 12, 12, 160)  480         conv2d_46[0][0]
__________________________________________________________________________________________________
activation_41 (Activation)      (None, 12, 12, 160)  0           batch_normalization
_41[0][0]
__________________________________________________________________________________________________
activation_46 (Activation)      (None, 12, 12, 160)  0           batch_normalization
_46[0][0]
__________________________________________________________________________________________________
conv2d_42 (Conv2D)              (None, 12, 12, 160)  179200      activation_41[0][0]
__________________________________________________________________________________________________
conv2d_47 (Conv2D)              (None, 12, 12, 160)  179200      activation_46[0][0]
__________________________________________________________________________________________________
batch_normalization_42 (BatchNo (None, 12, 12, 160)  480         conv2d_42[0][0]
__________________________________________________________________________________________________
batch_normalization_47 (BatchNo (None, 12, 12, 160)  480         conv2d_47[0][0]
__________________________________________________________________________________________________
activation_42 (Activation)      (None, 12, 12, 160)  0           batch_normalization
_42[0][0]
__________________________________________________________________________________________________
activation_47 (Activation)      (None, 12, 12, 160)  0           batch_normalization
_47[0][0]
__________________________________________________________________________________________________
average_pooling2d_4 (AveragePoo (None, 12, 12, 768)  0           mixed4[0][0]
__________________________________________________________________________________________________
conv2d_40 (Conv2D)              (None, 12, 12, 192)  147456      mixed4[0][0]
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conv2d_43 (Conv2D)              (None, 12, 12, 192)  215040      activation_42[0][0]
__________________________________________________________________________________________
__________________
conv2d_48 (Conv2D)              (None, 12, 12, 192)  215040      activation_47[0][0]
__________________________________________________________________________________________
__________________
conv2d_49 (Conv2D)              (None, 12, 12, 192)  147456      average_pooling2d_4
[0][0]
__________________________________________________________________________________________
__________________
batch_normalization_40 (BatchNo (None, 12, 12, 192)  576         conv2d_40[0][0]
__________________________________________________________________________________________
__________________
batch_normalization_43 (BatchNo (None, 12, 12, 192)  576         conv2d_43[0][0]
__________________________________________________________________________________________
__________________
batch_normalization_48 (BatchNo (None, 12, 12, 192)  576         conv2d_48[0][0]
__________________________________________________________________________________________
__________________
batch_normalization_49 (BatchNo (None, 12, 12, 192)  576         conv2d_49[0][0]
__________________________________________________________________________________________
__________________
activation_40 (Activation)      (None, 12, 12, 192)  0           batch_normalization
_40[0][0]
__________________________________________________________________________________________
__________________
activation_43 (Activation)      (None, 12, 12, 192)  0           batch_normalization
_43[0][0]
__________________________________________________________________________________________
__________________
activation_48 (Activation)      (None, 12, 12, 192)  0           batch_normalization
_48[0][0]
__________________________________________________________________________________________
__________________
activation_49 (Activation)      (None, 12, 12, 192)  0           batch_normalization
_49[0][0]
__________________________________________________________________________________________
__________________
mixed5 (Concatenate)            (None, 12, 12, 768)  0           activation_40[0][0]
                                                                 activation_43[0][0]
                                                                 activation_48[0][0]
                                                                 activation_49[0][0]
__________________________________________________________________________________________
__________________
conv2d_54 (Conv2D)              (None, 12, 12, 160)  122880      mixed5[0][0]
__________________________________________________________________________________________
__________________
batch_normalization_54 (BatchNo (None, 12, 12, 160)  480         conv2d_54[0][0]
__________________________________________________________________________________________
__________________
activation_54 (Activation)      (None, 12, 12, 160)  0           batch_normalization
_54[0][0]
__________________________________________________________________________________________
__________________
conv2d_55 (Conv2D)              (None, 12, 12, 160)  179200      activation_54[0][0]
__________________________________________________________________________________________
__________________
batch_normalization_55 (BatchNo (None, 12, 12, 160)  480         conv2d_55[0][0]
__________________________________________________________________________________________
__________________
activation_55 (Activation)      (None, 12, 12, 160)  0           batch_normalization
_55[0][0]
__________________________________________________________________________________________
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conv2d_51 (Conv2D)              (None, 12, 12, 160)  122880      mixed5[0][0]
__________________________________________________________________________________________________
__________________
conv2d_56 (Conv2D)              (None, 12, 12, 160)  179200      activation_55[0][0]
__________________________________________________________________________________________________
__________________
batch_normalization_51 (BatchNo (None, 12, 12, 160)  480         conv2d_51[0][0]
__________________________________________________________________________________________________
__________________
batch_normalization_56 (BatchNo (None, 12, 12, 160)  480         conv2d_56[0][0]
__________________________________________________________________________________________________
__________________
activation_51 (Activation)      (None, 12, 12, 160)  0           batch_normalization
_51[0][0]
__________________________________________________________________________________________________
__________________
activation_56 (Activation)      (None, 12, 12, 160)  0           batch_normalization
_56[0][0]
__________________________________________________________________________________________________
__________________
conv2d_52 (Conv2D)              (None, 12, 12, 160)  179200      activation_51[0][0]
__________________________________________________________________________________________________
__________________
conv2d_57 (Conv2D)              (None, 12, 12, 160)  179200      activation_56[0][0]
__________________________________________________________________________________________________
__________________
batch_normalization_52 (BatchNo (None, 12, 12, 160)  480         conv2d_52[0][0]
__________________________________________________________________________________________________
__________________
batch_normalization_57 (BatchNo (None, 12, 12, 160)  480         conv2d_57[0][0]
__________________________________________________________________________________________________
__________________
activation_52 (Activation)      (None, 12, 12, 160)  0           batch_normalization
_52[0][0]
__________________________________________________________________________________________________
__________________
activation_57 (Activation)      (None, 12, 12, 160)  0           batch_normalization
_57[0][0]
__________________________________________________________________________________________________
__________________
average_pooling2d_5 (AveragePoo (None, 12, 12, 768)  0           mixed5[0][0]
__________________________________________________________________________________________________
__________________
conv2d_50 (Conv2D)              (None, 12, 12, 192)  147456      mixed5[0][0]
__________________________________________________________________________________________________
__________________
conv2d_53 (Conv2D)              (None, 12, 12, 192)  215040      activation_52[0][0]
__________________________________________________________________________________________________
__________________
conv2d_58 (Conv2D)              (None, 12, 12, 192)  215040      activation_57[0][0]
__________________________________________________________________________________________________
__________________
conv2d_59 (Conv2D)              (None, 12, 12, 192)  147456      average_pooling2d_5
[0][0]
__________________________________________________________________________________________________
__________________
batch_normalization_50 (BatchNo (None, 12, 12, 192)  576         conv2d_50[0][0]
__________________________________________________________________________________________________
__________________
batch_normalization_53 (BatchNo (None, 12, 12, 192)  576         conv2d_53[0][0]
__________________________________________________________________________________________________
__________________
batch_normalization_58 (BatchNo (None, 12, 12, 192)  576         conv2d_58[0][0]
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__________________________________________________________________________________________________
_________________
batch_normalization_59 (BatchNo (None, 12, 12, 192)  576         conv2d_59[0][0]
__________________________________________________________________________________________________
_________________
activation_50 (Activation)      (None, 12, 12, 192)  0           batch_normalization
_50[0][0]
__________________________________________________________________________________________________
_________________
activation_53 (Activation)      (None, 12, 12, 192)  0           batch_normalization
_53[0][0]
__________________________________________________________________________________________________
_________________
activation_58 (Activation)      (None, 12, 12, 192)  0           batch_normalization
_58[0][0]
__________________________________________________________________________________________________
_________________
activation_59 (Activation)      (None, 12, 12, 192)  0           batch_normalization
_59[0][0]
__________________________________________________________________________________________________
_________________
mixed6 (Concatenate)            (None, 12, 12, 768)  0           activation_50[0][0]
                                                                 activation_53[0][0]
                                                                 activation_58[0][0]
                                                                 activation_59[0][0]
__________________________________________________________________________________________________
_________________
conv2d_64 (Conv2D)              (None, 12, 12, 192)  147456      mixed6[0][0]
__________________________________________________________________________________________________
_________________
batch_normalization_64 (BatchNo (None, 12, 12, 192)  576         conv2d_64[0][0]
__________________________________________________________________________________________________
_________________
activation_64 (Activation)      (None, 12, 12, 192)  0           batch_normalization
_64[0][0]
__________________________________________________________________________________________________
_________________
conv2d_65 (Conv2D)              (None, 12, 12, 192)  258048      activation_64[0][0]
__________________________________________________________________________________________________
_________________
batch_normalization_65 (BatchNo (None, 12, 12, 192)  576         conv2d_65[0][0]
__________________________________________________________________________________________________
_________________
activation_65 (Activation)      (None, 12, 12, 192)  0           batch_normalization
_65[0][0]
__________________________________________________________________________________________________
_________________
conv2d_61 (Conv2D)              (None, 12, 12, 192)  147456      mixed6[0][0]
__________________________________________________________________________________________________
_________________
conv2d_66 (Conv2D)              (None, 12, 12, 192)  258048      activation_65[0][0]
__________________________________________________________________________________________________
_________________
batch_normalization_61 (BatchNo (None, 12, 12, 192)  576         conv2d_61[0][0]
__________________________________________________________________________________________________
_________________
batch_normalization_66 (BatchNo (None, 12, 12, 192)  576         conv2d_66[0][0]
__________________________________________________________________________________________________
_________________
activation_61 (Activation)      (None, 12, 12, 192)  0           batch_normalization
_61[0][0]
__________________________________________________________________________________________________
_________________
activation_66 (Activation)      (None, 12, 12, 192)  0           batch_normalization
```

```
_66[0][0]
__________________________________________________________________________________________________
conv2d_62 (Conv2D)              (None, 12, 12, 192)  258048      activation_61[0][0]
__________________________________________________________________________________________________
conv2d_67 (Conv2D)              (None, 12, 12, 192)  258048      activation_66[0][0]
__________________________________________________________________________________________________
batch_normalization_62 (BatchNo (None, 12, 12, 192)  576         conv2d_62[0][0]
__________________________________________________________________________________________________
batch_normalization_67 (BatchNo (None, 12, 12, 192)  576         conv2d_67[0][0]
__________________________________________________________________________________________________
activation_62 (Activation)      (None, 12, 12, 192)  0           batch_normalization
_62[0][0]
__________________________________________________________________________________________________
activation_67 (Activation)      (None, 12, 12, 192)  0           batch_normalization
_67[0][0]
__________________________________________________________________________________________________
average_pooling2d_6 (AveragePoo (None, 12, 12, 768)  0           mixed6[0][0]
__________________________________________________________________________________________________
conv2d_60 (Conv2D)              (None, 12, 12, 192)  147456      mixed6[0][0]
__________________________________________________________________________________________________
conv2d_63 (Conv2D)              (None, 12, 12, 192)  258048      activation_62[0][0]
__________________________________________________________________________________________________
conv2d_68 (Conv2D)              (None, 12, 12, 192)  258048      activation_67[0][0]
__________________________________________________________________________________________________
conv2d_69 (Conv2D)              (None, 12, 12, 192)  147456      average_pooling2d_6
[0][0]
__________________________________________________________________________________________________
batch_normalization_60 (BatchNo (None, 12, 12, 192)  576         conv2d_60[0][0]
__________________________________________________________________________________________________
batch_normalization_63 (BatchNo (None, 12, 12, 192)  576         conv2d_63[0][0]
__________________________________________________________________________________________________
batch_normalization_68 (BatchNo (None, 12, 12, 192)  576         conv2d_68[0][0]
__________________________________________________________________________________________________
batch_normalization_69 (BatchNo (None, 12, 12, 192)  576         conv2d_69[0][0]
__________________________________________________________________________________________________
activation_60 (Activation)      (None, 12, 12, 192)  0           batch_normalization
_60[0][0]
__________________________________________________________________________________________________
activation_63 (Activation)      (None, 12, 12, 192)  0           batch_normalization
_63[0][0]
__________________________________________________________________________________________________
activation_68 (Activation)      (None, 12, 12, 192)  0           batch_normalization
_68[0][0]
__________________________________________________________________________________________________
activation_69 (Activation)      (None, 12, 12, 192)  0           batch_normalization
```

```
_69[0][0]
__________________________________________________________________________________________________
mixed7 (Concatenate)            (None, 12, 12, 768)  0           activation_60[0][0]
                                                                 activation_63[0][0]
                                                                 activation_68[0][0]
                                                                 activation_69[0][0]
__________________________________________________________________________________________________
conv2d_72 (Conv2D)              (None, 12, 12, 192)  147456      mixed7[0][0]
__________________________________________________________________________________________________
batch_normalization_72 (BatchNo (None, 12, 12, 192)  576         conv2d_72[0][0]
__________________________________________________________________________________________________
activation_72 (Activation)      (None, 12, 12, 192)  0           batch_normalization
_72[0][0]
__________________________________________________________________________________________________
conv2d_73 (Conv2D)              (None, 12, 12, 192)  258048      activation_72[0][0]
__________________________________________________________________________________________________
batch_normalization_73 (BatchNo (None, 12, 12, 192)  576         conv2d_73[0][0]
__________________________________________________________________________________________________
activation_73 (Activation)      (None, 12, 12, 192)  0           batch_normalization
_73[0][0]
__________________________________________________________________________________________________
conv2d_70 (Conv2D)              (None, 12, 12, 192)  147456      mixed7[0][0]
__________________________________________________________________________________________________
conv2d_74 (Conv2D)              (None, 12, 12, 192)  258048      activation_73[0][0]
__________________________________________________________________________________________________
batch_normalization_70 (BatchNo (None, 12, 12, 192)  576         conv2d_70[0][0]
__________________________________________________________________________________________________
batch_normalization_74 (BatchNo (None, 12, 12, 192)  576         conv2d_74[0][0]
__________________________________________________________________________________________________
activation_70 (Activation)      (None, 12, 12, 192)  0           batch_normalization
_70[0][0]
__________________________________________________________________________________________________
activation_74 (Activation)      (None, 12, 12, 192)  0           batch_normalization
_74[0][0]
__________________________________________________________________________________________________
conv2d_71 (Conv2D)              (None, 5, 5, 320)    552960      activation_70[0][0]
__________________________________________________________________________________________________
conv2d_75 (Conv2D)              (None, 5, 5, 192)    331776      activation_74[0][0]
__________________________________________________________________________________________________
batch_normalization_71 (BatchNo (None, 5, 5, 320)    960         conv2d_71[0][0]
__________________________________________________________________________________________________
batch_normalization_75 (BatchNo (None, 5, 5, 192)    576         conv2d_75[0][0]
__________________________________________________________________________________________________
activation_71 (Activation)      (None, 5, 5, 320)    0           batch_normalization
_71[0][0]
__________________________________________________________________________________________________
```

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__________________
activation_75 (Activation)      (None, 5, 5, 192)    0           batch_normalization
_75[0][0]
__________________________________________________________________________________
__________________
max_pooling2d_3 (MaxPooling2D)  (None, 5, 5, 768)    0           mixed7[0][0]
__________________________________________________________________________________
__________________
mixed8 (Concatenate)            (None, 5, 5, 1280)   0           activation_71[0][0]
                                                                 activation_75[0][0]
                                                                 max_pooling2d_3[0]
[0]
__________________________________________________________________________________
__________________
conv2d_80 (Conv2D)              (None, 5, 5, 448)    573440      mixed8[0][0]
__________________________________________________________________________________
__________________
batch_normalization_80 (BatchNo (None, 5, 5, 448)    1344        conv2d_80[0][0]
__________________________________________________________________________________
__________________
activation_80 (Activation)      (None, 5, 5, 448)    0           batch_normalization
_80[0][0]
__________________________________________________________________________________
__________________
conv2d_77 (Conv2D)              (None, 5, 5, 384)    491520      mixed8[0][0]
__________________________________________________________________________________
__________________
conv2d_81 (Conv2D)              (None, 5, 5, 384)    1548288     activation_80[0][0]
__________________________________________________________________________________
__________________
batch_normalization_77 (BatchNo (None, 5, 5, 384)    1152        conv2d_77[0][0]
__________________________________________________________________________________
__________________
batch_normalization_81 (BatchNo (None, 5, 5, 384)    1152        conv2d_81[0][0]
__________________________________________________________________________________
__________________
activation_77 (Activation)      (None, 5, 5, 384)    0           batch_normalization
_77[0][0]
__________________________________________________________________________________
__________________
activation_81 (Activation)      (None, 5, 5, 384)    0           batch_normalization
_81[0][0]
__________________________________________________________________________________
__________________
conv2d_78 (Conv2D)              (None, 5, 5, 384)    442368      activation_77[0][0]
__________________________________________________________________________________
__________________
conv2d_79 (Conv2D)              (None, 5, 5, 384)    442368      activation_77[0][0]
__________________________________________________________________________________
__________________
conv2d_82 (Conv2D)              (None, 5, 5, 384)    442368      activation_81[0][0]
__________________________________________________________________________________
__________________
conv2d_83 (Conv2D)              (None, 5, 5, 384)    442368      activation_81[0][0]
__________________________________________________________________________________
__________________
average_pooling2d_7 (AveragePoo (None, 5, 5, 1280)   0           mixed8[0][0]
__________________________________________________________________________________
__________________
conv2d_76 (Conv2D)              (None, 5, 5, 320)    409600      mixed8[0][0]
__________________________________________________________________________________
__________________
batch_normalization_78 (BatchNo (None, 5, 5, 384)    1152        conv2d_78[0][0]
__________________________________________________________________________________
```

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__________________
batch_normalization_79 (BatchNo (None, 5, 5, 384)    1152        conv2d_79[0][0]
__________________________________________________________________________________________
__________________
batch_normalization_82 (BatchNo (None, 5, 5, 384)    1152        conv2d_82[0][0]
__________________________________________________________________________________________
__________________
batch_normalization_83 (BatchNo (None, 5, 5, 384)    1152        conv2d_83[0][0]
__________________________________________________________________________________________
__________________
conv2d_84 (Conv2D)              (None, 5, 5, 192)    245760      average_pooling2d_7
[0][0]
__________________________________________________________________________________________
__________________
batch_normalization_76 (BatchNo (None, 5, 5, 320)    960         conv2d_76[0][0]
__________________________________________________________________________________________
__________________
activation_78 (Activation)      (None, 5, 5, 384)    0           batch_normalization
_78[0][0]
__________________________________________________________________________________________
__________________
activation_79 (Activation)      (None, 5, 5, 384)    0           batch_normalization
_79[0][0]
__________________________________________________________________________________________
__________________
activation_82 (Activation)      (None, 5, 5, 384)    0           batch_normalization
_82[0][0]
__________________________________________________________________________________________
__________________
activation_83 (Activation)      (None, 5, 5, 384)    0           batch_normalization
_83[0][0]
__________________________________________________________________________________________
__________________
batch_normalization_84 (BatchNo (None, 5, 5, 192)    576         conv2d_84[0][0]
__________________________________________________________________________________________
__________________
activation_76 (Activation)      (None, 5, 5, 320)    0           batch_normalization
_76[0][0]
__________________________________________________________________________________________
__________________
mixed9_0 (Concatenate)          (None, 5, 5, 768)    0           activation_78[0][0]
                                                                 activation_79[0][0]
__________________________________________________________________________________________
__________________
concatenate (Concatenate)       (None, 5, 5, 768)    0           activation_82[0][0]
                                                                 activation_83[0][0]
__________________________________________________________________________________________
__________________
activation_84 (Activation)      (None, 5, 5, 192)    0           batch_normalization
_84[0][0]
__________________________________________________________________________________________
__________________
mixed9 (Concatenate)            (None, 5, 5, 2048)   0           activation_76[0][0]
                                                                 mixed9_0[0][0]
                                                                 concatenate[0][0]
                                                                 activation_84[0][0]
__________________________________________________________________________________________
__________________
conv2d_89 (Conv2D)              (None, 5, 5, 448)    917504      mixed9[0][0]
__________________________________________________________________________________________
__________________
batch_normalization_89 (BatchNo (None, 5, 5, 448)    1344        conv2d_89[0][0]
__________________________________________________________________________________________
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```

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activation_89 (Activation)      (None, 5, 5, 448)    0           batch_normalization
_89[0][0]
__________________________________________________________________________________________
_______________
conv2d_86 (Conv2D)              (None, 5, 5, 384)    786432      mixed9[0][0]
__________________________________________________________________________________________
_______________
conv2d_90 (Conv2D)              (None, 5, 5, 384)    1548288     activation_89[0][0]
__________________________________________________________________________________________
_______________
batch_normalization_86 (BatchNo (None, 5, 5, 384)    1152        conv2d_86[0][0]
__________________________________________________________________________________________
_______________
batch_normalization_90 (BatchNo (None, 5, 5, 384)    1152        conv2d_90[0][0]
__________________________________________________________________________________________
_______________
activation_86 (Activation)      (None, 5, 5, 384)    0           batch_normalization
_86[0][0]
__________________________________________________________________________________________
_______________
activation_90 (Activation)      (None, 5, 5, 384)    0           batch_normalization
_90[0][0]
__________________________________________________________________________________________
_______________
conv2d_87 (Conv2D)              (None, 5, 5, 384)    442368      activation_86[0][0]
__________________________________________________________________________________________
_______________
conv2d_88 (Conv2D)              (None, 5, 5, 384)    442368      activation_86[0][0]
__________________________________________________________________________________________
_______________
conv2d_91 (Conv2D)              (None, 5, 5, 384)    442368      activation_90[0][0]
__________________________________________________________________________________________
_______________
conv2d_92 (Conv2D)              (None, 5, 5, 384)    442368      activation_90[0][0]
__________________________________________________________________________________________
_______________
average_pooling2d_8 (AveragePoo (None, 5, 5, 2048)   0           mixed9[0][0]
__________________________________________________________________________________________
_______________
conv2d_85 (Conv2D)              (None, 5, 5, 320)    655360      mixed9[0][0]
__________________________________________________________________________________________
_______________
batch_normalization_87 (BatchNo (None, 5, 5, 384)    1152        conv2d_87[0][0]
__________________________________________________________________________________________
_______________
batch_normalization_88 (BatchNo (None, 5, 5, 384)    1152        conv2d_88[0][0]
__________________________________________________________________________________________
_______________
batch_normalization_91 (BatchNo (None, 5, 5, 384)    1152        conv2d_91[0][0]
__________________________________________________________________________________________
_______________
batch_normalization_92 (BatchNo (None, 5, 5, 384)    1152        conv2d_92[0][0]
__________________________________________________________________________________________
_______________
conv2d_93 (Conv2D)              (None, 5, 5, 192)    393216      average_pooling2d_8
[0][0]
__________________________________________________________________________________________
_______________
batch_normalization_85 (BatchNo (None, 5, 5, 320)    960         conv2d_85[0][0]
__________________________________________________________________________________________
_______________
activation_87 (Activation)      (None, 5, 5, 384)    0           batch_normalization
_87[0][0]
__________________________________________________________________________________________
```

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__________________
activation_88 (Activation)      (None, 5, 5, 384)    0           batch_normalization
_88[0][0]
__________________________________________________________________________________
__________________
activation_91 (Activation)      (None, 5, 5, 384)    0           batch_normalization
_91[0][0]
__________________________________________________________________________________
__________________
activation_92 (Activation)      (None, 5, 5, 384)    0           batch_normalization
_92[0][0]
__________________________________________________________________________________
__________________
batch_normalization_93 (BatchNo (None, 5, 5, 192)    576         conv2d_93[0][0]
__________________________________________________________________________________
__________________
activation_85 (Activation)      (None, 5, 5, 320)    0           batch_normalization
_85[0][0]
__________________________________________________________________________________
__________________
mixed9_1 (Concatenate)          (None, 5, 5, 768)    0           activation_87[0][0]
                                                                 activation_88[0][0]
__________________________________________________________________________________
__________________
concatenate_1 (Concatenate)     (None, 5, 5, 768)    0           activation_91[0][0]
                                                                 activation_92[0][0]
__________________________________________________________________________________
__________________
activation_93 (Activation)      (None, 5, 5, 192)    0           batch_normalization
_93[0][0]
__________________________________________________________________________________
__________________
mixed10 (Concatenate)           (None, 5, 5, 2048)   0           activation_85[0][0]
                                                                 mixed9_1[0][0]
                                                                 concatenate_1[0][0]
                                                                 activation_93[0][0]
__________________________________________________________________________________
__________________
flatten (Flatten)               (None, 51200)        0           mixed10[0][0]
__________________________________________________________________________________
__________________
dense (Dense)                   (None, 2)            102402      flatten[0][0]
==================================================================================
==============
Total params: 21,905,186
Trainable params: 102,402
Non-trainable params: 21,802,784
__________________________________________________________________________________
__________________
```

In [9]:

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

In [10]:

```
from keras.preprocessing.image import ImageDataGenerator

train_datagen = ImageDataGenerator(rescale = 1./255,
                                   shear_range = 0.2,
                                   zoom_range = 0.2,
```

```
                                   horizontal_flip = True)

test_datagen = ImageDataGenerator(rescale = 1./255)
```

In [11]:
```
training_set = train_datagen.flow_from_directory('E:\\chest_xray\\train',
                                                 target_size = (224, 224),
                                                 batch_size = 32,
                                                 class_mode = 'categorical')
```

```
Found 5216 images belonging to 2 classes.
```

In [12]:
```
test_set = test_datagen.flow_from_directory('E:\\chest_xray\\test',
                                            target_size = (224, 224),
                                            batch_size = 32,
                                            class_mode = 'categorical')
```

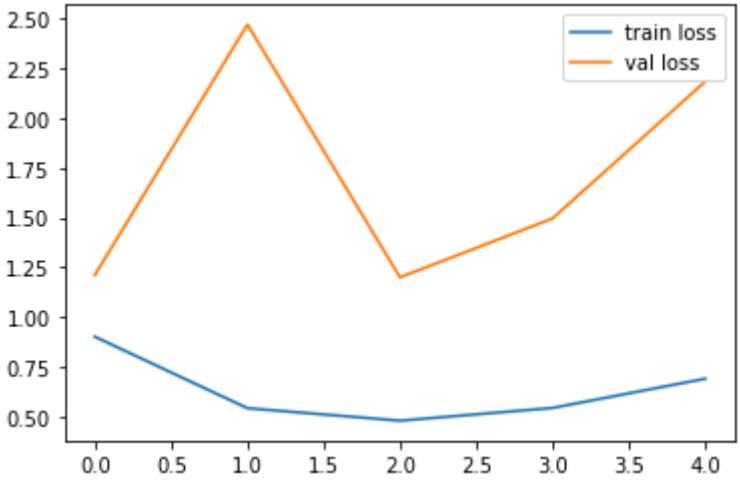
```
Found 624 images belonging to 2 classes.
```

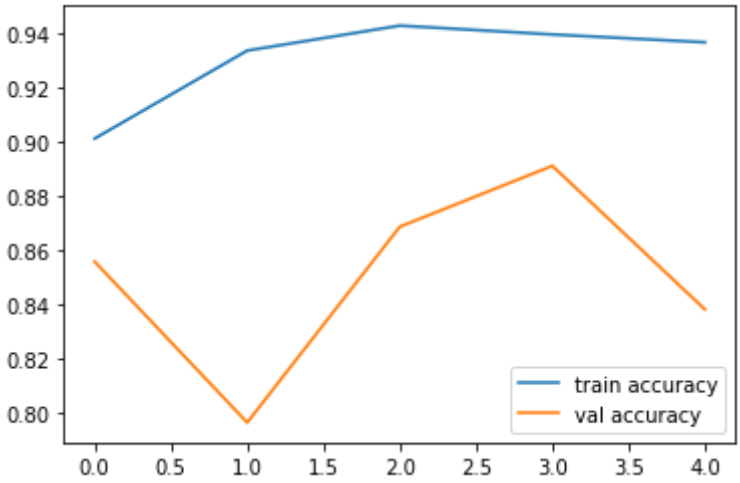
In [13]:
```
r = model.fit_generator(
  training_set,
  validation_data=test_set,
  epochs=5,
  steps_per_epoch=len(training_set),
  validation_steps=len(test_set)
)
```

```
WARNING:tensorflow:From C:\Users\MCHOME\AppData\Local\Temp/ipykernel_3908/675562961.
py:6: Model.fit_generator (from tensorflow.python.keras.engine.training) is deprecat
ed and will be removed in a future version.
Instructions for updating:
Please use Model.fit, which supports generators.
Epoch 1/5
163/163 [==============================] - 621s 4s/step - loss: 0.9003 - accuracy:
0.9011 - val_loss: 1.2112 - val_accuracy: 0.8558
Epoch 2/5
163/163 [==============================] - 669s 4s/step - loss: 0.5406 - accuracy:
0.9335 - val_loss: 2.4713 - val_accuracy: 0.7965
Epoch 3/5
163/163 [==============================] - 627s 4s/step - loss: 0.4778 - accuracy:
0.9427 - val_loss: 1.1989 - val_accuracy: 0.8686
Epoch 4/5
163/163 [==============================] - 624s 4s/step - loss: 0.5419 - accuracy:
0.9394 - val_loss: 1.4954 - val_accuracy: 0.8910
Epoch 5/5
163/163 [==============================] - 618s 4s/step - loss: 0.6889 - accuracy:
0.9365 - val_loss: 2.1845 - val_accuracy: 0.8381
```

In [14]:
```
plt.plot(r.history['loss'], label='train loss')
plt.plot(r.history['val_loss'], label='val loss')
plt.legend()
plt.show()
plt.savefig('LossVal_loss')

# plot the accuracy
plt.plot(r.history['accuracy'], label='train accuracy')
plt.plot(r.history['val_accuracy'], label='val accuracy')
plt.legend()
plt.show()
plt.savefig('AccVal_accuracy')
```






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

In [15]:
```
import tensorflow as tf

from keras.models import load_model

model.save('E:\\chest_xray\\val\\model_inceptionV3.h5')
```

In [ ]:

In [ ]:

In [ ]: