



In [1]:

```
# This Python 3 environment comes with many helpful analytics libraries installed
# It is defined by the kaggle/python docker image: https://github.com/kaggle/docker-python
# For example, here's several helpful packages to load in

import numpy as np # linear algebra
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)

# Input data files are available in the "../input/" directory.
# For example, running this (by clicking run or pressing Shift+Enter) will list the files in the input directory

import os
print(os.listdir("../input"))
import keras
print(keras.__version__)
# Any results you write to the current directory are saved as output.
```

['humpback-whale-identification', 'whales-cropped']

Using TensorFlow backend.

2.2.4

In [2]:

```
HW = 'humpback-whale-identification'
# TRAIN = '../input/humpback-whale-identification/train/'
TRAIN_CROPPED = "whales-cropped/cropped_train/cropped_train/"
TRAIN_CROPPED_IN = '../input/' + TRAIN_CROPPED

# TEST = '../input/humpback-whale-identification/test/'
TEST_CROPPED = "whales-cropped/cropped_test/cropped_test/"
TEST_CROPPED_IN = '../input/' + TEST_CROPPED

LABELS = '../input/humpback-whale-identification/train.csv'
SAMPLE_SUB = '../input/humpback-whale-identification/sample_submission.csv'

train = pd.read_csv(LABELS)
print("With new_whale:")
train.head()
```

With new_whale:

Out[2]:

	Image	Id
0	0000e88ab.jpg	w_f48451c
1	0001f9222.jpg	w_c3d896a
2	00029d126.jpg	w_20df2c5
3	00050a15a.jpg	new_whale
4	0005c1ef8.jpg	new_whale

In [3]:

```
MODEL_F = 'Model_InceptionResNetV2.h5'
WEIGHTS_F = 'Weights_InceptionResNetV2.h5'
MODEL = '../input/InceptionResNetV2/' + MODEL_F
WEIGHTS = '../input/InceptionResNetV2/' + WEIGHTS_F
```

In [4]:

```
train.describe()
```

Out[4]:

	Image	Id
count	25361	25361
unique	25361	5005
top	a580b7844.jpg	new_whale
freq	1	9664

In [5]:

```
import random
from IPython.display import Image
print("Example whale image")

#show sample image
name = random.choice(train['Image'])
print(name)
Image(filename = TRAIN_CROPPED_IN + name)
```

Example whale image
f59a20f64.jpg

Out[5]:



In [6]:

```
criteria = train['Id'] != 'new_whale'
whales_train = train[criteria]

print("Without new_whale:")
whales_train.head()
```

Without new_whale:

Out[6]:

	Image	Id
0	0000e88ab.jpg	w_f48451c
1	0001f9222.jpg	w_c3d896a
2	00029d126.jpg	w_20df2c5
6	000a6daec.jpg	w_dd88965
8	0016b897a.jpg	w_64404ac

In [7]:

```
unique_labels = np.unique(whales_train.Id.values)
labels_list = unique_labels
```

In [8]:

```
whales_train.describe()
```

Out[8]:

	Image	Id
count	15697	15697
unique	15697	5004
top	a580b7844.jpg	w_23a388d
freq	1	73

In [9]:

```
import matplotlib.pyplot as plt
import matplotlib.image as mpimg
from matplotlib.pyplot import imshow

from sklearn.preprocessing import LabelEncoder
from sklearn.preprocessing import OneHotEncoder

from keras import layers
from keras.preprocessing import image
from keras.preprocessing.image import ImageDataGenerator

# from keras.applications.imagenet_utils import preprocess_input
# from keras.applications.resnet50 import ResNet50, preprocess_input
# from keras.applications.xception import Xception, preprocess_input
from keras.applications.inception_resnet_v2 import InceptionResNetV2, preprocess_input

from keras.losses import binary_crossentropy
from keras.preprocessing.image import ImageDataGenerator
from keras.layers import Input, Dense, Activation,
BatchNormalization, Flatten, Conv2D, GlobalAveragePooling2D
from keras.layers import AveragePooling2D, MaxPooling2D, Dropout
```

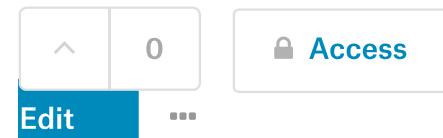
```
ng2D, Dropout
from keras.models import Model
from keras.metrics import top_k_categorical_accuracy

import keras.backend as K
```



lr finder

Python notebook using data from [multiple data sources](#) · 22 views · multiple data sources
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Version 8

9 commits

forked from Xception

```
warnings.simplefilter("ignore", category=DeprecationWarning)

%matplotlib inline
```

Notebook

Data

Output

Log

Comments

In [10]:

```
IMAGE_HEIGHT = 128
IMAGE_WIDTH = 128
IMAGE_SHAPE = (IMAGE_HEIGHT, IMAGE_WIDTH, 3)
```

In [11]:

```
CLASSES = 5004
EPOCHS = 5
BATCH_SIZE = 32

def top_5_accuracy(y_true, y_pred):
    return top_k_categorical_accuracy(y_true, y_pred, k=5)

# setup model
base_model = InceptionResNetV2(weights='imagenet',
include_top=False, input_shape = IMAGE_SHAPE)

x = base_model.output
x = GlobalAveragePooling2D(name='avg_pool')(x)
x = Dropout(0.4)(x)
predictions = Dense(CLASSES, activation='softmax')(x)
model = Model(inputs=base_model.input, outputs=predictions)

# transfer learning
for layer in base_model.layers:
    layer.trainable = True

model.compile(optimizer='adam',
              loss='categorical_crossentropy',
              metrics=['accuracy', 'mae', top_5_accuracy])

model.summary()
```

```
Downloading data from https://github.com/fchollet/deep-learning-models/releases/download/v0.7/inception_resnet_v2_weights_tf_dim_ordering_tf_kernels_notop.h5
219062272/219055592 [=====] - 16s 0us/step
```

Layer (type)	Output Shape			
	Param #	Connected to		
Notebook	Data	Output	Log	Comments
input_1 (InputLayer)			(None, 128, 128, 3)	
0				
conv2d_1 (Conv2D)			(None, 63, 63, 32)	
864		input_1[0][0]		
batch_normalization_1 (BatchNor)			(None, 63, 63, 32)	
96		conv2d_1[0][0]		
activation_1 (Activation)			(None, 63, 63, 32)	
0		batch_normalization_1[0][0]		
conv2d_2 (Conv2D)			(None, 61, 61, 32)	
9216		activation_1[0][0]		
batch_normalization_2 (BatchNor)			(None, 61, 61, 32)	
96		conv2d_2[0][0]		
activation_2 (Activation)			(None, 61, 61, 32)	
0		batch_normalization_2[0][0]		
conv2d_3 (Conv2D)			(None, 61, 61, 64)	
18432		activation_2[0][0]		
batch_normalization_3 (BatchNor)			(None, 61, 61, 64)	
192		conv2d_3[0][0]		
activation_3 (Activation)			(None, 61, 61, 64)	
0		batch_normalization_3[0][0]		
max_pooling2d_1 (MaxPooling2D)			(None, 30, 30, 64)	
0		activation_3[0][0]		
conv2d_4 (Conv2D)			(None, 30, 30, 80)	
5120		max_pooling2d_1[0][0]		
batch_normalization_4 (BatchNor)			(None, 30, 30, 80)	
240		conv2d_4[0][0]		
activation_4 (Activation)			(None, 30, 30, 80)	
0		batch_normalization_4[0][0]		

conv2d_5 (Conv2D) (None, 28, 28, 192)
138240 activation_4[0][0]

batch_normalization_5 (BatchNor (None, 28, 28, 192)
576 conv2d_5[0][0]

activation_5 (Activation) (None, 28, 28, 192)
0 batch_normalization_5[0][0]

max_pooling2d_2 (MaxPooling2D) (None, 13, 13, 192)
0 activation_5[0][0]

conv2d_9 (Conv2D) (None, 13, 13, 64)
12288 max_pooling2d_2[0][0]

batch_normalization_9 (BatchNor (None, 13, 13, 64)
192 conv2d_9[0][0]

activation_9 (Activation) (None, 13, 13, 64)
0 batch_normalization_9[0][0]

conv2d_7 (Conv2D) (None, 13, 13, 48)
9216 max_pooling2d_2[0][0]

conv2d_10 (Conv2D) (None, 13, 13, 96)
55296 activation_9[0][0]

batch_normalization_7 (BatchNor (None, 13, 13, 48)
144 conv2d_7[0][0]

batch_normalization_10 (BatchNo (None, 13, 13, 96)
288 conv2d_10[0][0]

activation_7 (Activation) (None, 13, 13, 48)
0 batch_normalization_7[0][0]

activation_10 (Activation) (None, 13, 13, 96)
0 batch_normalization_10[0][0]

average_pooling2d_1 (AveragePoo (None, 13, 13, 192)
0 max_pooling2d_2[0][0]

conv2d_6 (Conv2D) (None, 13, 13, 96)
18432 max_pooling2d_2[0][0]

conv2d_8 (Conv2D) (None, 13, 13, 64)
76800 activation_7[0][0]

conv2d_11 (Conv2D) (None, 13, 13, 96)
82944 activation_10[0][0]

conv2d_12 (Conv2D) (None, 13, 13, 64)
12288 average_pooling2d_1[0][0]

batch_normalization_6 (BatchNor (None, 13, 13, 96)
288 conv2d_6[0][0]

batch_normalization_8 (BatchNor (None, 13, 13, 64)
192 conv2d_8[0][0]

batch_normalization_11 (BatchNo (None, 13, 13, 96)
288 conv2d_11[0][0]

batch_normalization_12 (BatchNo (None, 13, 13, 64)
192 conv2d_12[0][0]

activation_6 (Activation) (None, 13, 13, 96)
0 batch_normalization_6[0][0]

activation_8 (Activation) (None, 13, 13, 64)
0 batch_normalization_8[0][0]

activation_11 (Activation) (None, 13, 13, 96)
0 batch_normalization_11[0][0]

activation_12 (Activation) (None, 13, 13, 64)
0 batch_normalization_12[0][0]

mixed_5b (Concatenate) (None, 13, 13, 320)
0 activation_6[0][0]
activation_8[0][0]
activation_11[0][0]
activation_12[0][0]

conv2d_16 (Conv2D) (None, 13, 13, 32)
10240 mixed_5b[0][0]

```
batch_normalization_16 (BatchNo (None, 13, 13, 32)
    96          conv2d_16[0][0]
-----
activation_16 (Activation)      (None, 13, 13, 32)
    0          batch_normalization_16[0][0]
-----
conv2d_14 (Conv2D)           (None, 13, 13, 32)
    10240        mixed_5b[0][0]
-----
conv2d_17 (Conv2D)           (None, 13, 13, 48)
    13824        activation_16[0][0]
-----
batch_normalization_14 (BatchNo (None, 13, 13, 32)
    96          conv2d_14[0][0]
-----
batch_normalization_17 (BatchNo (None, 13, 13, 48)
    144          conv2d_17[0][0]
-----
activation_14 (Activation)     (None, 13, 13, 32)
    0          batch_normalization_14[0][0]
-----
activation_17 (Activation)     (None, 13, 13, 48)
    0          batch_normalization_17[0][0]
-----
conv2d_13 (Conv2D)           (None, 13, 13, 32)
    10240        mixed_5b[0][0]
-----
conv2d_15 (Conv2D)           (None, 13, 13, 32)
    9216        activation_14[0][0]
-----
conv2d_18 (Conv2D)           (None, 13, 13, 64)
    27648        activation_17[0][0]
-----
batch_normalization_13 (BatchNo (None, 13, 13, 32)
    96          conv2d_13[0][0]
-----
batch_normalization_15 (BatchNo (None, 13, 13, 32)
    96          conv2d_15[0][0]
-----
batch_normalization_18 (BatchNo (None, 13, 13, 64)
    192          conv2d_18[0][0]
-----
activation_13 (Activation)     (None, 13, 13, 32)
    0          batch_normalization_13[0][0]
```

```
activation_15 (Activation)      (None, 13, 13, 32)
    0          batch_normalization_15[0][0]
-----
activation_18 (Activation)      (None, 13, 13, 64)
    0          batch_normalization_18[0][0]
-----
block35_1_mixed (Concatenate)  (None, 13, 13, 128)
    0          activation_13[0][0]
                    activation_15[0][0]
                    activation_18[0][0]
-----
block35_1_conv (Conv2D)        (None, 13, 13, 320)
    41280      block35_1_mixed[0][0]
-----
block35_1 (Lambda)            (None, 13, 13, 320)
    0          mixed_5b[0][0]
                    block35_1_conv[0][0]
-----
block35_1_ac (Activation)     (None, 13, 13, 320)
    0          block35_1[0][0]
-----
conv2d_22 (Conv2D)           (None, 13, 13, 32)
    10240      block35_1_ac[0][0]
-----
batch_normalization_22 (BatchNo (None, 13, 13, 32)
    96         conv2d_22[0][0]
-----
activation_22 (Activation)    (None, 13, 13, 32)
    0          batch_normalization_22[0][0]
-----
conv2d_20 (Conv2D)           (None, 13, 13, 32)
    10240      block35_1_ac[0][0]
-----
conv2d_23 (Conv2D)           (None, 13, 13, 48)
    13824      activation_22[0][0]
-----
batch_normalization_20 (BatchNo (None, 13, 13, 32)
    96         conv2d_20[0][0]
-----
batch_normalization_23 (BatchNo (None, 13, 13, 48)
    144         conv2d_23[0][0]
-----
activation_20 (Activation)    (None, 13, 13, 32)
    0          batch_normalization_20[0][0]
```

```
-----  
activation_23 (Activation)      (None, 13, 13, 48)  
0          batch_normalization_23[0][0]  
-----  
conv2d_19 (Conv2D)           (None, 13, 13, 32)  
10240      block35_1_ac[0][0]  
-----  
conv2d_21 (Conv2D)           (None, 13, 13, 32)  
9216       activation_20[0][0]  
-----  
conv2d_24 (Conv2D)           (None, 13, 13, 64)  
27648      activation_23[0][0]  
-----  
batch_normalization_19 (BatchNo (None, 13, 13, 32)  
96         conv2d_19[0][0]  
-----  
batch_normalization_21 (BatchNo (None, 13, 13, 32)  
96         conv2d_21[0][0]  
-----  
batch_normalization_24 (BatchNo (None, 13, 13, 64)  
192        conv2d_24[0][0]  
-----  
activation_19 (Activation)    (None, 13, 13, 32)  
0          batch_normalization_19[0][0]  
-----  
activation_21 (Activation)    (None, 13, 13, 32)  
0          batch_normalization_21[0][0]  
-----  
activation_24 (Activation)    (None, 13, 13, 64)  
0          batch_normalization_24[0][0]  
-----  
block35_2_mixed (Concatenate) (None, 13, 13, 128)  
0          activation_19[0][0]  
activation_21[0][0]  
activation_24[0][0]  
-----  
block35_2_conv (Conv2D)       (None, 13, 13, 320)  
41280      block35_2_mixed[0][0]  
-----  
block35_2 (Lambda)           (None, 13, 13, 320)  
0          block35_1_ac[0][0]  
block35_2_conv[0][0]
```

```
block35_2_ac (Activation)      (None, 13, 13, 320)
    0          block35_2[0][0]
-----
conv2d_28 (Conv2D)           (None, 13, 13, 32)
    10240      block35_2_ac[0][0]
-----
batch_normalization_28 (BatchNo (None, 13, 13, 32)
    96         conv2d_28[0][0]
-----
activation_28 (Activation)   (None, 13, 13, 32)
    0          batch_normalization_28[0][0]
-----
conv2d_26 (Conv2D)           (None, 13, 13, 32)
    10240      block35_2_ac[0][0]
-----
conv2d_29 (Conv2D)           (None, 13, 13, 48)
    13824      activation_28[0][0]
-----
batch_normalization_26 (BatchNo (None, 13, 13, 32)
    96         conv2d_26[0][0]
-----
batch_normalization_29 (BatchNo (None, 13, 13, 48)
    144         conv2d_29[0][0]
-----
activation_26 (Activation)   (None, 13, 13, 32)
    0          batch_normalization_26[0][0]
-----
activation_29 (Activation)   (None, 13, 13, 48)
    0          batch_normalization_29[0][0]
-----
conv2d_25 (Conv2D)           (None, 13, 13, 32)
    10240      block35_2_ac[0][0]
-----
conv2d_27 (Conv2D)           (None, 13, 13, 32)
    9216       activation_26[0][0]
-----
conv2d_30 (Conv2D)           (None, 13, 13, 64)
    27648      activation_29[0][0]
-----
batch_normalization_25 (BatchNo (None, 13, 13, 32)
    96         conv2d_25[0][0]
-----
batch_normalization_27 (BatchNo (None, 13, 13, 32)
    96         conv2d_27[0][0]
```

```
batch_normalization_30 (BatchNo (None, 13, 13, 64)
    192          conv2d_30[0][0]
-----
activation_25 (Activation)      (None, 13, 13, 32)
    0          batch_normalization_25[0][0]
-----
activation_27 (Activation)      (None, 13, 13, 32)
    0          batch_normalization_27[0][0]
-----
activation_30 (Activation)      (None, 13, 13, 64)
    0          batch_normalization_30[0][0]
-----
block35_3_mixed (Concatenate)  (None, 13, 13, 128)
    0          activation_25[0][0]
                               activation_27[0][0]
                               activation_30[0][0]
-----
block35_3_conv (Conv2D)        (None, 13, 13, 320)
    41280        block35_3_mixed[0][0]
-----
block35_3 (Lambda)            (None, 13, 13, 320)
    0          block35_2_ac[0][0]
                               block35_3_conv[0][0]
-----
block35_3_ac (Activation)     (None, 13, 13, 320)
    0          block35_3[0][0]
-----
conv2d_34 (Conv2D)            (None, 13, 13, 32)
    10240        block35_3_ac[0][0]
-----
batch_normalization_34 (BatchNo (None, 13, 13, 32)
    96          conv2d_34[0][0]
-----
activation_34 (Activation)     (None, 13, 13, 32)
    0          batch_normalization_34[0][0]
-----
conv2d_32 (Conv2D)            (None, 13, 13, 32)
    10240        block35_3_ac[0][0]
-----
conv2d_35 (Conv2D)            (None, 13, 13, 48)
    13824        activation_34[0][0]
-----
batch_normalization_32 (BatchNo (None, 13, 13, 32)
    96          conv2d_35[0][0]
```

96 conv2d_32[0][0]

batch_normalization_35 (BatchNo (None, 13, 13, 48)
144 conv2d_35[0][0]

activation_32 (Activation) (None, 13, 13, 32)
0 batch_normalization_32[0][0]

activation_35 (Activation) (None, 13, 13, 48)
0 batch_normalization_35[0][0]

conv2d_31 (Conv2D) (None, 13, 13, 32)
10240 block35_3_ac[0][0]

conv2d_33 (Conv2D) (None, 13, 13, 32)
9216 activation_32[0][0]

conv2d_36 (Conv2D) (None, 13, 13, 64)
27648 activation_35[0][0]

batch_normalization_31 (BatchNo (None, 13, 13, 32)
96 conv2d_31[0][0]

batch_normalization_33 (BatchNo (None, 13, 13, 32)
96 conv2d_33[0][0]

batch_normalization_36 (BatchNo (None, 13, 13, 64)
192 conv2d_36[0][0]

activation_31 (Activation) (None, 13, 13, 32)
0 batch_normalization_31[0][0]

activation_33 (Activation) (None, 13, 13, 32)
0 batch_normalization_33[0][0]

activation_36 (Activation) (None, 13, 13, 64)
0 batch_normalization_36[0][0]

block35_4_mixed (Concatenate) (None, 13, 13, 128)
0 activation_31[0][0]

activation_33[0][0]

activation_36[0][0]

block35_4_conv (Conv2D) (None, 13, 13, 320)

41280 block35_4_mixed[0][0]

block35_4 (Lambda) (None, 13, 13, 320)

0 block35_3_ac[0][0]

block35_4_conv[0][0]

block35_4_ac (Activation) (None, 13, 13, 320)

0 block35_4[0][0]

conv2d_40 (Conv2D) (None, 13, 13, 32)

10240 block35_4_ac[0][0]

batch_normalization_40 (BatchNo (None, 13, 13, 32))

96 conv2d_40[0][0]

activation_40 (Activation) (None, 13, 13, 32)

0 batch_normalization_40[0][0]

conv2d_38 (Conv2D) (None, 13, 13, 32)

10240 block35_4_ac[0][0]

conv2d_41 (Conv2D) (None, 13, 13, 48)

13824 activation_40[0][0]

batch_normalization_38 (BatchNo (None, 13, 13, 32))

96 conv2d_38[0][0]

batch_normalization_41 (BatchNo (None, 13, 13, 48))

144 conv2d_41[0][0]

activation_38 (Activation) (None, 13, 13, 32)

0 batch_normalization_38[0][0]

activation_41 (Activation) (None, 13, 13, 48)

0 batch_normalization_41[0][0]

conv2d_37 (Conv2D) (None, 13, 13, 32)

10240 block35_4_ac[0][0]

conv2d_39 (Conv2D) (None, 13, 13, 32)

9216 activation_38[0][0]

conv2d_42 (Conv2D) (None, 13, 13, 64)

27648 activation_41[0][0]

```
batch_normalization_37 (BatchNo (None, 13, 13, 32)
    96          conv2d_37[0][0]
-----  
batch_normalization_39 (BatchNo (None, 13, 13, 32)
    96          conv2d_39[0][0]
-----  
batch_normalization_42 (BatchNo (None, 13, 13, 64)
    192         conv2d_42[0][0]
-----  
activation_37 (Activation)      (None, 13, 13, 32)
    0          batch_normalization_37[0][0]
-----  
activation_39 (Activation)      (None, 13, 13, 32)
    0          batch_normalization_39[0][0]
-----  
activation_42 (Activation)      (None, 13, 13, 64)
    0          batch_normalization_42[0][0]
-----  
block35_5_mixed (Concatenate)  (None, 13, 13, 128)
    0          activation_37[0][0]
                               activation_39[0][0]
                               activation_42[0][0]
-----  
block35_5_conv (Conv2D)        (None, 13, 13, 320)
    41280       block35_5_mixed[0][0]
-----  
block35_5 (Lambda)            (None, 13, 13, 320)
    0          block35_4_ac[0][0]
                               block35_5_conv[0][0]
-----  
block35_5_ac (Activation)     (None, 13, 13, 320)
    0          block35_5[0][0]
-----  
conv2d_46 (Conv2D)           (None, 13, 13, 32)
    10240       block35_5_ac[0][0]
-----  
batch_normalization_46 (BatchNo (None, 13, 13, 32)
    96          conv2d_46[0][0]
-----  
activation_46 (Activation)     (None, 13, 13, 32)
    0          batch_normalization_46[0][0]
-----  
conv2d_44 (Conv2D)           (None, 13, 13, 32)
```

10240 block35_5_ac[0][0]

conv2d_47 (Conv2D) (None, 13, 13, 48)
13824 activation_46[0][0]

batch_normalization_44 (BatchNo (None, 13, 13, 32)
96 conv2d_44[0][0]

batch_normalization_47 (BatchNo (None, 13, 13, 48)
144 conv2d_47[0][0]

activation_44 (Activation) (None, 13, 13, 32)
0 batch_normalization_44[0][0]

activation_47 (Activation) (None, 13, 13, 48)
0 batch_normalization_47[0][0]

conv2d_43 (Conv2D) (None, 13, 13, 32)
10240 block35_5_ac[0][0]

conv2d_45 (Conv2D) (None, 13, 13, 32)
9216 activation_44[0][0]

conv2d_48 (Conv2D) (None, 13, 13, 64)
27648 activation_47[0][0]

batch_normalization_43 (BatchNo (None, 13, 13, 32)
96 conv2d_43[0][0]

batch_normalization_45 (BatchNo (None, 13, 13, 32)
96 conv2d_45[0][0]

batch_normalization_48 (BatchNo (None, 13, 13, 64)
192 conv2d_48[0][0]

activation_43 (Activation) (None, 13, 13, 32)
0 batch_normalization_43[0][0]

activation_45 (Activation) (None, 13, 13, 32)
0 batch_normalization_45[0][0]

activation_48 (Activation) (None, 13, 13, 64)
0 batch_normalization_48[0][0]

block35_6_mixed (Concatenate) (None, 13, 13, 128)

```
          0           activation_43[0][0]

                           activation_45[0][0]

                           activation_48[0][0]
-----
-----  
block35_6_conv (Conv2D)      (None, 13, 13, 320)
  41280       block35_6_mixed[0][0]
-----
-----  
block35_6 (Lambda)          (None, 13, 13, 320)
  0           block35_5_ac[0][0]

                           block35_6_conv[0][0]
-----
-----  
block35_6_ac (Activation)   (None, 13, 13, 320)
  0           block35_6[0][0]
-----
-----  
conv2d_52 (Conv2D)          (None, 13, 13, 32)
  10240       block35_6_ac[0][0]
-----
-----  
batch_normalization_52 (BatchNo (None, 13, 13, 32)
  96          conv2d_52[0][0]
-----
-----  
activation_52 (Activation)   (None, 13, 13, 32)
  0           batch_normalization_52[0][0]
-----
-----  
conv2d_50 (Conv2D)          (None, 13, 13, 32)
  10240       block35_6_ac[0][0]
-----
-----  
conv2d_53 (Conv2D)          (None, 13, 13, 48)
  13824       activation_52[0][0]
-----
-----  
batch_normalization_50 (BatchNo (None, 13, 13, 32)
  96          conv2d_50[0][0]
-----
-----  
batch_normalization_53 (BatchNo (None, 13, 13, 48)
  144          conv2d_53[0][0]
-----
-----  
activation_50 (Activation)   (None, 13, 13, 32)
  0           batch_normalization_50[0][0]
-----
-----  
activation_53 (Activation)   (None, 13, 13, 48)
  0           batch_normalization_53[0][0]
-----
-----  
conv2d_49 (Conv2D)          (None, 13, 13, 32)
  10240       block35_6_ac[0][0]
```

```
-----  
conv2d_51 (Conv2D)           (None, 13, 13, 32)  
9216      activation_50[0][0]  
-----  
conv2d_54 (Conv2D)           (None, 13, 13, 64)  
27648      activation_53[0][0]  
-----  
batch_normalization_49 (BatchNo (None, 13, 13, 32)  
96         conv2d_49[0][0]  
-----  
batch_normalization_51 (BatchNo (None, 13, 13, 32)  
96         conv2d_51[0][0]  
-----  
batch_normalization_54 (BatchNo (None, 13, 13, 64)  
192        conv2d_54[0][0]  
-----  
activation_49 (Activation)   (None, 13, 13, 32)  
0          batch_normalization_49[0][0]  
-----  
activation_51 (Activation)   (None, 13, 13, 32)  
0          batch_normalization_51[0][0]  
-----  
activation_54 (Activation)   (None, 13, 13, 64)  
0          batch_normalization_54[0][0]  
-----  
block35_7_mixed (Concatenate) (None, 13, 13, 128)  
0          activation_49[0][0]  
-----  
activation_51[0][0]  
-----  
activation_54[0][0]  
-----  
block35_7_conv (Conv2D)      (None, 13, 13, 320)  
41280      block35_7_mixed[0][0]  
-----  
block35_7 (Lambda)           (None, 13, 13, 320)  
0          block35_6_ac[0][0]  
-----  
block35_7_conv[0][0]  
-----  
block35_7_ac (Activation)   (None, 13, 13, 320)  
0          block35_7[0][0]  
-----  
conv2d_58 (Conv2D)           (None, 13, 13, 32)  
10240      block35_7_ac[0][0]  
-----  
batch_normalization_59 (BatchNo (None, 13, 13, 32)  
96         conv2d_59[0][0]  
-----
```

batch_normalization_58 (BatchNo (None, 13, 13, 32)

96 conv2d_58[0][0]

activation_58 (Activation) (None, 13, 13, 32)

0 batch_normalization_58[0][0]

conv2d_56 (Conv2D) (None, 13, 13, 32)

10240 block35_7_ac[0][0]

conv2d_59 (Conv2D) (None, 13, 13, 48)

13824 activation_58[0][0]

batch_normalization_56 (BatchNo (None, 13, 13, 32)

96 conv2d_56[0][0]

batch_normalization_59 (BatchNo (None, 13, 13, 48)

144 conv2d_59[0][0]

activation_56 (Activation) (None, 13, 13, 32)

0 batch_normalization_56[0][0]

activation_59 (Activation) (None, 13, 13, 48)

0 batch_normalization_59[0][0]

conv2d_55 (Conv2D) (None, 13, 13, 32)

10240 block35_7_ac[0][0]

conv2d_57 (Conv2D) (None, 13, 13, 32)

9216 activation_56[0][0]

conv2d_60 (Conv2D) (None, 13, 13, 64)

27648 activation_59[0][0]

batch_normalization_55 (BatchNo (None, 13, 13, 32)

96 conv2d_55[0][0]

batch_normalization_57 (BatchNo (None, 13, 13, 32)

96 conv2d_57[0][0]

batch_normalization_60 (BatchNo (None, 13, 13, 64)

192 conv2d_60[0][0]

activation_55 (Activation) (None, 13, 13, 32)

0 batch_normalization_55[0][0]

```
activation_57 (Activation)      (None, 13, 13, 32)
    0          batch_normalization_57[0][0]
-----
activation_60 (Activation)      (None, 13, 13, 64)
    0          batch_normalization_60[0][0]
-----
block35_8_mixed (Concatenate)  (None, 13, 13, 128)
    0          activation_55[0][0]

    activation_57[0][0]

    activation_60[0][0]
-----
block35_8_conv (Conv2D)        (None, 13, 13, 320)
    41280      block35_8_mixed[0][0]
-----
block35_8 (Lambda)            (None, 13, 13, 320)
    0          block35_7_ac[0][0]

    block35_8_conv[0][0]
-----
block35_8_ac (Activation)     (None, 13, 13, 320)
    0          block35_8[0][0]
-----
conv2d_64 (Conv2D)            (None, 13, 13, 32)
    10240      block35_8_ac[0][0]
-----
batch_normalization_64 (BatchNo (None, 13, 13, 32)
    96         conv2d_64[0][0]
-----
activation_64 (Activation)    (None, 13, 13, 32)
    0          batch_normalization_64[0][0]
-----
conv2d_62 (Conv2D)            (None, 13, 13, 32)
    10240      block35_8_ac[0][0]
-----
conv2d_65 (Conv2D)            (None, 13, 13, 48)
    13824      activation_64[0][0]
-----
batch_normalization_62 (BatchNo (None, 13, 13, 32)
    96         conv2d_62[0][0]
-----
batch_normalization_65 (BatchNo (None, 13, 13, 48)
    144         conv2d_65[0][0]
-----
activation_62 (Activation)    (None, 13, 13, 32)
    0          batch_normalization_62[0][0]
```

activation_65 (Activation) (None, 13, 13, 48)
0 batch_normalization_65[0][0]

conv2d_61 (Conv2D) (None, 13, 13, 32)
10240 block35_8_ac[0][0]

conv2d_63 (Conv2D) (None, 13, 13, 32)
9216 activation_62[0][0]

conv2d_66 (Conv2D) (None, 13, 13, 64)
27648 activation_65[0][0]

batch_normalization_61 (BatchNo (None, 13, 13, 32)
96 conv2d_61[0][0]

batch_normalization_63 (BatchNo (None, 13, 13, 32)
96 conv2d_63[0][0]

batch_normalization_66 (BatchNo (None, 13, 13, 64)
192 conv2d_66[0][0]

activation_61 (Activation) (None, 13, 13, 32)
0 batch_normalization_61[0][0]

activation_63 (Activation) (None, 13, 13, 32)
0 batch_normalization_63[0][0]

activation_66 (Activation) (None, 13, 13, 64)
0 batch_normalization_66[0][0]

block35_9_mixed (Concatenate) (None, 13, 13, 128)
0 activation_61[0][0]

activation_63[0][0]

activation_66[0][0]

block35_9_conv (Conv2D) (None, 13, 13, 320)
41280 block35_9_mixed[0][0]

block35_9 (Lambda) (None, 13, 13, 320)
0 block35_8_ac[0][0]

block35_9_conv[0][0]

```
block35_9_ac (Activation)      (None, 13, 13, 320)
    0          block35_9[0][0]
-----
conv2d_70 (Conv2D)           (None, 13, 13, 32)
    10240     block35_9_ac[0][0]
-----
batch_normalization_70 (BatchNo (None, 13, 13, 32)
    96         conv2d_70[0][0]
-----
activation_70 (Activation)   (None, 13, 13, 32)
    0          batch_normalization_70[0][0]
-----
conv2d_68 (Conv2D)           (None, 13, 13, 32)
    10240     block35_9_ac[0][0]
-----
conv2d_71 (Conv2D)           (None, 13, 13, 48)
    13824     activation_70[0][0]
-----
batch_normalization_68 (BatchNo (None, 13, 13, 32)
    96         conv2d_68[0][0]
-----
batch_normalization_71 (BatchNo (None, 13, 13, 48)
    144        conv2d_71[0][0]
-----
activation_68 (Activation)   (None, 13, 13, 32)
    0          batch_normalization_68[0][0]
-----
activation_71 (Activation)   (None, 13, 13, 48)
    0          batch_normalization_71[0][0]
-----
conv2d_67 (Conv2D)           (None, 13, 13, 32)
    10240     block35_9_ac[0][0]
-----
conv2d_69 (Conv2D)           (None, 13, 13, 32)
    9216      activation_68[0][0]
-----
conv2d_72 (Conv2D)           (None, 13, 13, 64)
    27648     activation_71[0][0]
-----
batch_normalization_67 (BatchNo (None, 13, 13, 32)
    96         conv2d_67[0][0]
-----
batch_normalization_69 (BatchNo (None, 13, 13, 32)
    96         conv2d_69[0][0]
```

```
batch_normalization_72 (BatchNo (None, 13, 13, 64)
    192          conv2d_72[0][0]
-----
activation_67 (Activation)      (None, 13, 13, 32)
    0          batch_normalization_67[0][0]
-----
activation_69 (Activation)      (None, 13, 13, 32)
    0          batch_normalization_69[0][0]
-----
activation_72 (Activation)      (None, 13, 13, 64)
    0          batch_normalization_72[0][0]
-----
block35_10_mixed (Concatenate) (None, 13, 13, 128)
    0          activation_67[0][0]
                    activation_69[0][0]
                    activation_72[0][0]
-----
block35_10_conv (Conv2D)        (None, 13, 13, 320)
    41280        block35_10_mixed[0][0]
-----
block35_10 (Lambda)            (None, 13, 13, 320)
    0          block35_9_ac[0][0]
                    block35_10_conv[0][0]
-----
block35_10_ac (Activation)     (None, 13, 13, 320)
    0          block35_10[0][0]
-----
conv2d_74 (Conv2D)             (None, 13, 13, 256)
    81920        block35_10_ac[0][0]
-----
batch_normalization_74 (BatchNo (None, 13, 13, 256)
    768          conv2d_74[0][0]
-----
activation_74 (Activation)     (None, 13, 13, 256)
    0          batch_normalization_74[0][0]
-----
conv2d_75 (Conv2D)             (None, 13, 13, 256)
    589824        activation_74[0][0]
-----
batch_normalization_75 (BatchNo (None, 13, 13, 256)
    768          conv2d_75[0][0]
-----
activation_75 (Activation)     (None, 13, 13, 256)
    0          batch_normalization_75[0][0]
```

0 batch_normalization_73[0][0]

conv2d_73 (Conv2D) (None, 6, 6, 384)
1105920 block35_10_ac[0][0]

conv2d_76 (Conv2D) (None, 6, 6, 384)
884736 activation_75[0][0]

batch_normalization_73 (BatchNo (None, 6, 6, 384)
1152 conv2d_73[0][0]

batch_normalization_76 (BatchNo (None, 6, 6, 384)
1152 conv2d_76[0][0]

activation_73 (Activation) (None, 6, 6, 384)
0 batch_normalization_73[0][0]

activation_76 (Activation) (None, 6, 6, 384)
0 batch_normalization_76[0][0]

max_pooling2d_3 (MaxPooling2D) (None, 6, 6, 320)
0 block35_10_ac[0][0]

mixed_6a (Concatenate) (None, 6, 6, 1088)
0 activation_73[0][0]

activation_76[0][0]

max_pooling2d_3[0][0]

conv2d_78 (Conv2D) (None, 6, 6, 128)
139264 mixed_6a[0][0]

batch_normalization_78 (BatchNo (None, 6, 6, 128)
384 conv2d_78[0][0]

activation_78 (Activation) (None, 6, 6, 128)
0 batch_normalization_78[0][0]

conv2d_79 (Conv2D) (None, 6, 6, 160)
143360 activation_78[0][0]

batch_normalization_79 (BatchNo (None, 6, 6, 160)
480 conv2d_79[0][0]

activation_79 (Activation) (None, 6, 6, 160)

0 batch_normalization_79[0][0]

conv2d_77 (Conv2D) (None, 6, 6, 192)
208896 mixed_6a[0][0]

conv2d_80 (Conv2D) (None, 6, 6, 192)
215040 activation_79[0][0]

batch_normalization_77 (BatchNo (None, 6, 6, 192)
576 conv2d_77[0][0]

batch_normalization_80 (BatchNo (None, 6, 6, 192)
576 conv2d_80[0][0]

activation_77 (Activation) (None, 6, 6, 192)
0 batch_normalization_77[0][0]

activation_80 (Activation) (None, 6, 6, 192)
0 batch_normalization_80[0][0]

block17_1_mixed (Concatenate) (None, 6, 6, 384)
0 activation_77[0][0]

activation_80[0][0]

block17_1_conv (Conv2D) (None, 6, 6, 1088)
418880 block17_1_mixed[0][0]

block17_1 (Lambda) (None, 6, 6, 1088)
0 mixed_6a[0][0]

block17_1_conv[0][0]

block17_1_ac (Activation) (None, 6, 6, 1088)
0 block17_1[0][0]

conv2d_82 (Conv2D) (None, 6, 6, 128)
139264 block17_1_ac[0][0]

batch_normalization_82 (BatchNo (None, 6, 6, 128)
384 conv2d_82[0][0]

activation_82 (Activation) (None, 6, 6, 128)
0 batch_normalization_82[0][0]

conv2d_83 (Conv2D) (None, 6, 6, 160)

143360 activation_82[0][0]

batch_normalization_83 (BatchNo (None, 6, 6, 160)
480 conv2d_83[0][0]

activation_83 (Activation) (None, 6, 6, 160)
0 batch_normalization_83[0][0]

conv2d_81 (Conv2D) (None, 6, 6, 192)
208896 block17_1_ac[0][0]

conv2d_84 (Conv2D) (None, 6, 6, 192)
215040 activation_83[0][0]

batch_normalization_81 (BatchNo (None, 6, 6, 192)
576 conv2d_81[0][0]

batch_normalization_84 (BatchNo (None, 6, 6, 192)
576 conv2d_84[0][0]

activation_81 (Activation) (None, 6, 6, 192)
0 batch_normalization_81[0][0]

activation_84 (Activation) (None, 6, 6, 192)
0 batch_normalization_84[0][0]

block17_2_mixed (Concatenate) (None, 6, 6, 384)
0 activation_81[0][0]

activation_84[0][0]

block17_2_conv (Conv2D) (None, 6, 6, 1088)
418880 block17_2_mixed[0][0]

block17_2 (Lambda) (None, 6, 6, 1088)
0 block17_1_ac[0][0]

block17_2_conv[0][0]

block17_2_ac (Activation) (None, 6, 6, 1088)
0 block17_2[0][0]

conv2d_86 (Conv2D) (None, 6, 6, 128)
139264 block17_2_ac[0][0]

batch_normalization_86 (BatchNo (None, 6, 6, 128)

```
activation_86 (Activation)      (None, 6, 6, 128)
    0           batch_normalization_86[0][0]
```

```
conv2d_87 (Conv2D)            (None, 6, 6, 160)
    143360       activation_86[0][0]
```

```
batch_normalization_87 (BatchNo (None, 6, 6, 160)
    480           conv2d_87[0][0]
```

```
activation_87 (Activation)      (None, 6, 6, 160)
    0           batch_normalization_87[0][0]
```

```
conv2d_85 (Conv2D)            (None, 6, 6, 192)
    208896       block17_2_ac[0][0]
```

```
conv2d_88 (Conv2D)            (None, 6, 6, 192)
    215040       activation_87[0][0]
```

```
batch_normalization_85 (BatchNo (None, 6, 6, 192)
    576           conv2d_85[0][0]
```

```
batch_normalization_88 (BatchNo (None, 6, 6, 192)
    576           conv2d_88[0][0]
```

```
activation_85 (Activation)      (None, 6, 6, 192)
    0           batch_normalization_85[0][0]
```

```
activation_88 (Activation)      (None, 6, 6, 192)
    0           batch_normalization_88[0][0]
```

```
block17_3_mixed (Concatenate)  (None, 6, 6, 384)
    0           activation_85[0][0]
```

```
activation_88[0][0]
```

```
block17_3_conv (Conv2D)        (None, 6, 6, 1088)
    418880       block17_3_mixed[0][0]
```

```
block17_3 (Lambda)            (None, 6, 6, 1088)
    0           block17_2_ac[0][0]
```

```
block17_3_conv[0][0]
```

```
block17_3_ac (Activation)     (None, 6, 6, 1088)
```

0 block17_3[0][0]

conv2d_90 (Conv2D) (None, 6, 6, 128)
139264 block17_3_ac[0][0]

batch_normalization_90 (BatchNo (None, 6, 6, 128)
384 conv2d_90[0][0]

activation_90 (Activation) (None, 6, 6, 128)
0 batch_normalization_90[0][0]

conv2d_91 (Conv2D) (None, 6, 6, 160)
143360 activation_90[0][0]

batch_normalization_91 (BatchNo (None, 6, 6, 160)
480 conv2d_91[0][0]

activation_91 (Activation) (None, 6, 6, 160)
0 batch_normalization_91[0][0]

conv2d_89 (Conv2D) (None, 6, 6, 192)
208896 block17_3_ac[0][0]

conv2d_92 (Conv2D) (None, 6, 6, 192)
215040 activation_91[0][0]

batch_normalization_89 (BatchNo (None, 6, 6, 192)
576 conv2d_89[0][0]

batch_normalization_92 (BatchNo (None, 6, 6, 192)
576 conv2d_92[0][0]

activation_89 (Activation) (None, 6, 6, 192)
0 batch_normalization_89[0][0]

activation_92 (Activation) (None, 6, 6, 192)
0 batch_normalization_92[0][0]

block17_4_mixed (Concatenate) (None, 6, 6, 384)
0 activation_89[0][0]

activation_92[0][0]

block17_4_conv (Conv2D) (None, 6, 6, 1088)
418880 block17_4_mixed[0][0]

```
-----  
block17_4 (Lambda)           (None, 6, 6, 1088)  
0                      block17_3_ac[0][0]  
  
                                block17_4_conv[0][0]  
-----  
-----  
block17_4_ac (Activation)    (None, 6, 6, 1088)  
0                      block17_4[0][0]  
-----  
-----  
conv2d_94 (Conv2D)          (None, 6, 6, 128)  
139264      block17_4_ac[0][0]  
-----  
-----  
batch_normalization_94 (BatchNo (None, 6, 6, 128)  
384          conv2d_94[0][0]  
-----  
-----  
activation_94 (Activation)   (None, 6, 6, 128)  
0          batch_normalization_94[0][0]  
-----  
-----  
conv2d_95 (Conv2D)          (None, 6, 6, 160)  
143360      activation_94[0][0]  
-----  
-----  
batch_normalization_95 (BatchNo (None, 6, 6, 160)  
480          conv2d_95[0][0]  
-----  
-----  
activation_95 (Activation)   (None, 6, 6, 160)  
0          batch_normalization_95[0][0]  
-----  
-----  
conv2d_93 (Conv2D)          (None, 6, 6, 192)  
208896      block17_4_ac[0][0]  
-----  
-----  
conv2d_96 (Conv2D)          (None, 6, 6, 192)  
215040      activation_95[0][0]  
-----  
-----  
batch_normalization_93 (BatchNo (None, 6, 6, 192)  
576          conv2d_93[0][0]  
-----  
-----  
batch_normalization_96 (BatchNo (None, 6, 6, 192)  
576          conv2d_96[0][0]  
-----  
-----  
activation_93 (Activation)   (None, 6, 6, 192)  
0          batch_normalization_93[0][0]  
-----  
-----  
activation_96 (Activation)   (None, 6, 6, 192)  
0          batch_normalization_96[0][0]  
-----  
-----  
block17_5_mixed (Concatenate) (None, 6, 6, 384)
```

```
    0           activation_93[0][0]

                                         activation_96[0][0]
-----
-----
```

block17_5_conv (Conv2D) (None, 6, 6, 1088)
418880 block17_5_mixed[0][0]

```
-----
```

block17_5 (Lambda) (None, 6, 6, 1088)
0 block17_4_ac[0][0]

```
-----
```

block17_5_conv[0][0]

```
-----
```

block17_5_ac (Activation) (None, 6, 6, 1088)
0 block17_5[0][0]

```
-----
```

conv2d_98 (Conv2D) (None, 6, 6, 128)
139264 block17_5_ac[0][0]

```
-----
```

batch_normalization_98 (BatchNo (None, 6, 6, 128)
384 conv2d_98[0][0]

```
-----
```

activation_98 (Activation) (None, 6, 6, 128)
0 batch_normalization_98[0][0]

```
-----
```

conv2d_99 (Conv2D) (None, 6, 6, 160)
143360 activation_98[0][0]

```
-----
```

batch_normalization_99 (BatchNo (None, 6, 6, 160)
480 conv2d_99[0][0]

```
-----
```

activation_99 (Activation) (None, 6, 6, 160)
0 batch_normalization_99[0][0]

```
-----
```

conv2d_97 (Conv2D) (None, 6, 6, 192)
208896 block17_5_ac[0][0]

```
-----
```

conv2d_100 (Conv2D) (None, 6, 6, 192)
215040 activation_99[0][0]

```
-----
```

batch_normalization_97 (BatchNo (None, 6, 6, 192)
576 conv2d_97[0][0]

```
-----
```

batch_normalization_100 (BatchN (None, 6, 6, 192)
576 conv2d_100[0][0]

```
-----
```

```
activation_97 (Activation)      (None, 6, 6, 192)
    0          batch_normalization_97[0][0]
-----
activation_100 (Activation)      (None, 6, 6, 192)
    0          batch_normalization_100[0][0]
-----
block17_6_mixed (Concatenate)   (None, 6, 6, 384)
    0          activation_97[0][0]
                               activation_100[0][0]
-----
block17_6_conv (Conv2D)         (None, 6, 6, 1088)
    418880      block17_6_mixed[0][0]
-----
block17_6 (Lambda)             (None, 6, 6, 1088)
    0          block17_5_ac[0][0]
                               block17_6_conv[0][0]
-----
block17_6_ac (Activation)      (None, 6, 6, 1088)
    0          block17_6[0][0]
-----
conv2d_102 (Conv2D)            (None, 6, 6, 128)
    139264      block17_6_ac[0][0]
-----
batch_normalization_102 (BatchN (None, 6, 6, 128)
    384          conv2d_102[0][0]
-----
activation_102 (Activation)    (None, 6, 6, 128)
    0          batch_normalization_102[0][0]
-----
conv2d_103 (Conv2D)            (None, 6, 6, 160)
    143360      activation_102[0][0]
-----
batch_normalization_103 (BatchN (None, 6, 6, 160)
    480          conv2d_103[0][0]
-----
activation_103 (Activation)    (None, 6, 6, 160)
    0          batch_normalization_103[0][0]
-----
conv2d_101 (Conv2D)            (None, 6, 6, 192)
    208896      block17_6_ac[0][0]
-----
conv2d_104 (Conv2D)            (None, 6, 6, 192)
    215040      activation_103[0][0]
```

```
batch_normalization_101 (BatchN (None, 6, 6, 192)
    576      conv2d_101[0][0]
-----
batch_normalization_104 (BatchN (None, 6, 6, 192)
    576      conv2d_104[0][0]
-----
activation_101 (Activation)      (None, 6, 6, 192)
    0          batch_normalization_101[0][0]
-----
activation_104 (Activation)      (None, 6, 6, 192)
    0          batch_normalization_104[0][0]
-----
block17_7_mixed (Concatenate)   (None, 6, 6, 384)
    0          activation_101[0][0]
                               activation_104[0][0]
-----
block17_7_conv (Conv2D)         (None, 6, 6, 1088)
    418880     block17_7_mixed[0][0]
-----
block17_7 (Lambda)              (None, 6, 6, 1088)
    0          block17_6_ac[0][0]
                               block17_7_conv[0][0]
-----
block17_7_ac (Activation)      (None, 6, 6, 1088)
    0          block17_7[0][0]
-----
conv2d_106 (Conv2D)            (None, 6, 6, 128)
    139264     block17_7_ac[0][0]
-----
batch_normalization_106 (BatchN (None, 6, 6, 128)
    384      conv2d_106[0][0]
-----
activation_106 (Activation)    (None, 6, 6, 128)
    0          batch_normalization_106[0][0]
-----
conv2d_107 (Conv2D)            (None, 6, 6, 160)
    143360     activation_106[0][0]
-----
batch_normalization_107 (BatchN (None, 6, 6, 160)
    480      conv2d_107[0][0]
-----
activation_107 (Activation)    (None, 6, 6, 160)
    0          batch_normalization_107[0][0]
```

```
conv2d_105 (Conv2D)           (None, 6, 6, 192)
208896      block17_7_ac[0][0]
-----
conv2d_108 (Conv2D)           (None, 6, 6, 192)
215040      activation_107[0][0]
-----
batch_normalization_105 (BatchN (None, 6, 6, 192)
576          conv2d_105[0][0]
-----
batch_normalization_108 (BatchN (None, 6, 6, 192)
576          conv2d_108[0][0]
-----
activation_105 (Activation)   (None, 6, 6, 192)
0            batch_normalization_105[0][0]
-----
activation_108 (Activation)   (None, 6, 6, 192)
0            batch_normalization_108[0][0]
-----
block17_8_mixed (Concatenate) (None, 6, 6, 384)
0            activation_105[0][0]
                                         activation_108[0][0]
-----
block17_8_conv (Conv2D)        (None, 6, 6, 1088)
418880      block17_8_mixed[0][0]
-----
block17_8 (Lambda)            (None, 6, 6, 1088)
0            block17_7_ac[0][0]
                                         block17_8_conv[0][0]
-----
block17_8_ac (Activation)     (None, 6, 6, 1088)
0            block17_8[0][0]
-----
conv2d_110 (Conv2D)           (None, 6, 6, 128)
139264      block17_8_ac[0][0]
-----
batch_normalization_110 (BatchN (None, 6, 6, 128)
384          conv2d_110[0][0]
-----
activation_110 (Activation)   (None, 6, 6, 128)
0            batch_normalization_110[0][0]
-----
conv2d_111 (Conv2D)           (None, 6, 6, 160)
143360      activation_110[0][0]
```

```
batch_normalization_111 (BatchN (None, 6, 6, 160)
    480          conv2d_111[0][0]
-----
activation_111 (Activation)      (None, 6, 6, 160)
    0          batch_normalization_111[0][0]
-----
conv2d_109 (Conv2D)           (None, 6, 6, 192)
    208896     block17_8_ac[0][0]
-----
conv2d_112 (Conv2D)           (None, 6, 6, 192)
    215040     activation_111[0][0]
-----
batch_normalization_109 (BatchN (None, 6, 6, 192)
    576          conv2d_109[0][0]
-----
batch_normalization_112 (BatchN (None, 6, 6, 192)
    576          conv2d_112[0][0]
-----
activation_109 (Activation)    (None, 6, 6, 192)
    0          batch_normalization_109[0][0]
-----
activation_112 (Activation)    (None, 6, 6, 192)
    0          batch_normalization_112[0][0]
-----
block17_9_mixed (Concatenate) (None, 6, 6, 384)
    0          activation_109[0][0]
    activation_112[0][0]
-----
block17_9_conv (Conv2D)       (None, 6, 6, 1088)
    418880     block17_9_mixed[0][0]
-----
block17_9 (Lambda)           (None, 6, 6, 1088)
    0          block17_8_ac[0][0]
    block17_9_conv[0][0]
-----
block17_9_ac (Activation)    (None, 6, 6, 1088)
    0          block17_9[0][0]
-----
conv2d_114 (Conv2D)           (None, 6, 6, 128)
    139264     block17_9_ac[0][0]
-----
batch_normalization_114 (BatchN (None, 6, 6, 128)
    384          conv2d_114[0][0]
```

```
activation_114 (Activation)      (None, 6, 6, 128)
    0          batch_normalization_114[0][0]
-----
conv2d_115 (Conv2D)            (None, 6, 6, 160)
    143360     activation_114[0][0]
-----
batch_normalization_115 (BatchN (None, 6, 6, 160)
    480         conv2d_115[0][0]
-----
activation_115 (Activation)    (None, 6, 6, 160)
    0          batch_normalization_115[0][0]
-----
conv2d_113 (Conv2D)            (None, 6, 6, 192)
    208896     block17_9_ac[0][0]
-----
conv2d_116 (Conv2D)            (None, 6, 6, 192)
    215040     activation_115[0][0]
-----
batch_normalization_113 (BatchN (None, 6, 6, 192)
    576         conv2d_113[0][0]
-----
batch_normalization_116 (BatchN (None, 6, 6, 192)
    576         conv2d_116[0][0]
-----
activation_113 (Activation)    (None, 6, 6, 192)
    0          batch_normalization_113[0][0]
-----
activation_116 (Activation)    (None, 6, 6, 192)
    0          batch_normalization_116[0][0]
-----
block17_10_mixed (Concatenate) (None, 6, 6, 384)
    0          activation_113[0][0]
                               activation_116[0][0]
-----
block17_10_conv (Conv2D)       (None, 6, 6, 1088)
    418880     block17_10_mixed[0][0]
-----
block17_10 (Lambda)           (None, 6, 6, 1088)
    0          block17_9_ac[0][0]
                               block17_10_conv[0][0]
-----
block17_10_ac (Activation)    (None, 6, 6, 1088)
    0          block17_10[0][0]
```

```
-----  
conv2d_118 (Conv2D)           (None, 6, 6, 128)  
    139264      block17_10_ac[0][0]  
-----  
  
batch_normalization_118 (BatchN (None, 6, 6, 128)  
    384          conv2d_118[0][0]  
-----  
  
activation_118 (Activation)   (None, 6, 6, 128)  
    0            batch_normalization_118[0][0]  
-----  
  
conv2d_119 (Conv2D)           (None, 6, 6, 160)  
    143360      activation_118[0][0]  
-----  
  
batch_normalization_119 (BatchN (None, 6, 6, 160)  
    480          conv2d_119[0][0]  
-----  
  
activation_119 (Activation)   (None, 6, 6, 160)  
    0            batch_normalization_119[0][0]  
-----  
  
conv2d_117 (Conv2D)           (None, 6, 6, 192)  
    208896      block17_10_ac[0][0]  
-----  
  
conv2d_120 (Conv2D)           (None, 6, 6, 192)  
    215040      activation_119[0][0]  
-----  
  
batch_normalization_117 (BatchN (None, 6, 6, 192)  
    576          conv2d_117[0][0]  
-----  
  
batch_normalization_120 (BatchN (None, 6, 6, 192)  
    576          conv2d_120[0][0]  
-----  
  
activation_117 (Activation)   (None, 6, 6, 192)  
    0            batch_normalization_117[0][0]  
-----  
  
activation_120 (Activation)   (None, 6, 6, 192)  
    0            batch_normalization_120[0][0]  
-----  
  
block17_11_mixed (Concatenate) (None, 6, 6, 384)  
    0            activation_117[0][0]  
           activation_120[0][0]  
-----  
  
block17_11_conv (Conv2D)       (None, 6, 6, 1088)  
    418880      block17_11_mixed[0][0]  
-----  
  
block17_11 (Lambda)           (None, 6, 6, 1088)
```

0 block17_10_ac[0][0]

block17_11_conv[0][0]

block17_11_ac (Activation) (None, 6, 6, 1088)
0 block17_11[0][0]

conv2d_122 (Conv2D) (None, 6, 6, 128)
139264 block17_11_ac[0][0]

batch_normalization_122 (BatchN (None, 6, 6, 128)
384 conv2d_122[0][0]

activation_122 (Activation) (None, 6, 6, 128)
0 batch_normalization_122[0][0]

conv2d_123 (Conv2D) (None, 6, 6, 160)
143360 activation_122[0][0]

batch_normalization_123 (BatchN (None, 6, 6, 160)
480 conv2d_123[0][0]

activation_123 (Activation) (None, 6, 6, 160)
0 batch_normalization_123[0][0]

conv2d_121 (Conv2D) (None, 6, 6, 192)
208896 block17_11_ac[0][0]

conv2d_124 (Conv2D) (None, 6, 6, 192)
215040 activation_123[0][0]

batch_normalization_121 (BatchN (None, 6, 6, 192)
576 conv2d_121[0][0]

batch_normalization_124 (BatchN (None, 6, 6, 192)
576 conv2d_124[0][0]

activation_121 (Activation) (None, 6, 6, 192)
0 batch_normalization_121[0][0]

activation_124 (Activation) (None, 6, 6, 192)
0 batch_normalization_124[0][0]

block17_12_mixed (Concatenate) (None, 6, 6, 384)
0 activation_121[0][0]

activation_124[0][0]

block17_12_conv (Conv2D) (None, 6, 6, 1088)
418880 block17_12_mixed[0][0]

block17_12 (Lambda) (None, 6, 6, 1088)
0 block17_11_ac[0][0]

block17_12_conv[0][0]

block17_12_ac (Activation) (None, 6, 6, 1088)
0 block17_12[0][0]

conv2d_126 (Conv2D) (None, 6, 6, 128)
139264 block17_12_ac[0][0]

batch_normalization_126 (BatchN (None, 6, 6, 128)
384 conv2d_126[0][0]

activation_126 (Activation) (None, 6, 6, 128)
0 batch_normalization_126[0][0]

conv2d_127 (Conv2D) (None, 6, 6, 160)
143360 activation_126[0][0]

batch_normalization_127 (BatchN (None, 6, 6, 160)
480 conv2d_127[0][0]

activation_127 (Activation) (None, 6, 6, 160)
0 batch_normalization_127[0][0]

conv2d_125 (Conv2D) (None, 6, 6, 192)
208896 block17_12_ac[0][0]

conv2d_128 (Conv2D) (None, 6, 6, 192)
215040 activation_127[0][0]

batch_normalization_125 (BatchN (None, 6, 6, 192)
576 conv2d_125[0][0]

batch_normalization_128 (BatchN (None, 6, 6, 192)
576 conv2d_128[0][0]

activation_125 (Activation) (None, 6, 6, 192)
0 batch_normalization_125[0][0]

```
-----  
activation_128 (Activation)      (None, 6, 6, 192)  
          0           batch_normalization_128[0][0]  
-----  
-----  
block17_13_mixed (Concatenate)  (None, 6, 6, 384)  
          0           activation_125[0][0]  
  
          activation_128[0][0]  
-----  
-----  
block17_13_conv (Conv2D)        (None, 6, 6, 1088)  
          418880       block17_13_mixed[0][0]  
-----  
-----  
block17_13 (Lambda)            (None, 6, 6, 1088)  
          0           block17_12_ac[0][0]  
  
          block17_13_conv[0][0]  
-----  
-----  
block17_13_ac (Activation)     (None, 6, 6, 1088)  
          0           block17_13[0][0]  
-----  
-----  
conv2d_130 (Conv2D)           (None, 6, 6, 128)  
          139264       block17_13_ac[0][0]  
-----  
-----  
batch_normalization_130 (BatchN (None, 6, 6, 128)  
          384         conv2d_130[0][0]  
-----  
-----  
activation_130 (Activation)    (None, 6, 6, 128)  
          0           batch_normalization_130[0][0]  
-----  
-----  
conv2d_131 (Conv2D)           (None, 6, 6, 160)  
          143360       activation_130[0][0]  
-----  
-----  
batch_normalization_131 (BatchN (None, 6, 6, 160)  
          480         conv2d_131[0][0]  
-----  
-----  
activation_131 (Activation)    (None, 6, 6, 160)  
          0           batch_normalization_131[0][0]  
-----  
-----  
conv2d_129 (Conv2D)           (None, 6, 6, 192)  
          208896       block17_13_ac[0][0]  
-----  
-----  
conv2d_132 (Conv2D)           (None, 6, 6, 192)  
          215040       activation_131[0][0]  
-----  
-----  
batch_normalization_129 (BatchN (None, 6, 6, 192)  
          576         conv2d_129[0][0]
```

```
-----  
batch_normalization_132 (BatchN (None, 6, 6, 192)  
576          conv2d_132[0][0]  
-----  
activation_129 (Activation)      (None, 6, 6, 192)  
0            batch_normalization_129[0][0]  
-----  
activation_132 (Activation)      (None, 6, 6, 192)  
0            batch_normalization_132[0][0]  
-----  
block17_14_mixed (Concatenate)  (None, 6, 6, 384)  
0            activation_129[0][0]  
-----  
activation_132[0][0]  
-----  
block17_14_conv (Conv2D)        (None, 6, 6, 1088)  
418880       block17_14_mixed[0][0]  
-----  
block17_14 (Lambda)            (None, 6, 6, 1088)  
0            block17_13_ac[0][0]  
-----  
block17_14_conv[0][0]  
-----  
block17_14_ac (Activation)    (None, 6, 6, 1088)  
0            block17_14[0][0]  
-----  
conv2d_134 (Conv2D)           (None, 6, 6, 128)  
139264       block17_14_ac[0][0]  
-----  
batch_normalization_134 (BatchN (None, 6, 6, 128)  
384          conv2d_134[0][0]  
-----  
activation_134 (Activation)    (None, 6, 6, 128)  
0            batch_normalization_134[0][0]  
-----  
conv2d_135 (Conv2D)           (None, 6, 6, 160)  
143360       activation_134[0][0]  
-----  
batch_normalization_135 (BatchN (None, 6, 6, 160)  
480          conv2d_135[0][0]  
-----  
activation_135 (Activation)    (None, 6, 6, 160)  
0            batch_normalization_135[0][0]  
-----  
conv2d_133 (Conv2D)           (None, 6, 6, 192)  
208896       block17_14_ac[0][0]
```

```
-----  
conv2d_136 (Conv2D)           (None, 6, 6, 192)  
215040      activation_135[0][0]  
-----  
batch_normalization_133 (BatchN (None, 6, 6, 192)  
576          conv2d_133[0][0]  
-----  
batch_normalization_136 (BatchN (None, 6, 6, 192)  
576          conv2d_136[0][0]  
-----  
activation_133 (Activation)   (None, 6, 6, 192)  
0            batch_normalization_133[0][0]  
-----  
activation_136 (Activation)   (None, 6, 6, 192)  
0            batch_normalization_136[0][0]  
-----  
block17_15_mixed (Concatenate) (None, 6, 6, 384)  
0            activation_133[0][0]  
-----  
                                activation_136[0][0]  
-----  
block17_15_conv (Conv2D)       (None, 6, 6, 1088)  
418880      block17_15_mixed[0][0]  
-----  
block17_15 (Lambda)           (None, 6, 6, 1088)  
0            block17_14_ac[0][0]  
-----  
                                block17_15_conv[0][0]  
-----  
block17_15_ac (Activation)   (None, 6, 6, 1088)  
0            block17_15[0][0]  
-----  
conv2d_138 (Conv2D)           (None, 6, 6, 128)  
139264      block17_15_ac[0][0]  
-----  
batch_normalization_138 (BatchN (None, 6, 6, 128)  
384          conv2d_138[0][0]  
-----  
activation_138 (Activation)   (None, 6, 6, 128)  
0            batch_normalization_138[0][0]  
-----  
conv2d_139 (Conv2D)           (None, 6, 6, 160)  
143360      activation_138[0][0]  
-----  
batch_normalization_139 (BatchN (None, 6, 6, 160)  
480          conv2d_139[0][0]
```

```
-----  
activation_139 (Activation)      (None, 6, 6, 160)  
0          batch_normalization_139[0][0]  
-----  
  
conv2d_137 (Conv2D)           (None, 6, 6, 192)  
208896      block17_15_ac[0][0]  
-----  
  
conv2d_140 (Conv2D)           (None, 6, 6, 192)  
215040      activation_139[0][0]  
-----  
  
batch_normalization_137 (BatchN (None, 6, 6, 192)  
576          conv2d_137[0][0]  
-----  
  
batch_normalization_140 (BatchN (None, 6, 6, 192)  
576          conv2d_140[0][0]  
-----  
  
activation_137 (Activation)    (None, 6, 6, 192)  
0          batch_normalization_137[0][0]  
-----  
  
activation_140 (Activation)    (None, 6, 6, 192)  
0          batch_normalization_140[0][0]  
-----  
  
block17_16_mixed (Concatenate) (None, 6, 6, 384)  
0          activation_137[0][0]  
  
                                activation_140[0][0]  
-----  
  
block17_16_conv (Conv2D)       (None, 6, 6, 1088)  
418880      block17_16_mixed[0][0]  
-----  
  
block17_16 (Lambda)           (None, 6, 6, 1088)  
0          block17_15_ac[0][0]  
  
                                block17_16_conv[0][0]  
-----  
  
block17_16_ac (Activation)    (None, 6, 6, 1088)  
0          block17_16[0][0]  
-----  
  
conv2d_142 (Conv2D)           (None, 6, 6, 128)  
139264      block17_16_ac[0][0]  
-----  
  
batch_normalization_142 (BatchN (None, 6, 6, 128)  
384          conv2d_142[0][0]  
-----  
  
activation_142 (Activation)    (None, 6, 6, 128)  
0          batch_normalization_142[0][0]
```

```
-----  
conv2d_143 (Conv2D)           (None, 6, 6, 160)  
143360      activation_142[0][0]  
-----  
batch_normalization_143 (BatchN (None, 6, 6, 160)  
480          conv2d_143[0][0]  
-----  
activation_143 (Activation)   (None, 6, 6, 160)  
0            batch_normalization_143[0][0]  
-----  
conv2d_141 (Conv2D)           (None, 6, 6, 192)  
208896      block17_16_ac[0][0]  
-----  
conv2d_144 (Conv2D)           (None, 6, 6, 192)  
215040      activation_143[0][0]  
-----  
batch_normalization_141 (BatchN (None, 6, 6, 192)  
576          conv2d_141[0][0]  
-----  
batch_normalization_144 (BatchN (None, 6, 6, 192)  
576          conv2d_144[0][0]  
-----  
activation_141 (Activation)   (None, 6, 6, 192)  
0            batch_normalization_141[0][0]  
-----  
activation_144 (Activation)   (None, 6, 6, 192)  
0            batch_normalization_144[0][0]  
-----  
block17_17_mixed (Concatenate) (None, 6, 6, 384)  
0            activation_141[0][0]  
                               activation_144[0][0]  
-----  
block17_17_conv (Conv2D)       (None, 6, 6, 1088)  
418880      block17_17_mixed[0][0]  
-----  
block17_17 (Lambda)           (None, 6, 6, 1088)  
0            block17_16_ac[0][0]  
                               block17_17_conv[0][0]  
-----  
block17_17_ac (Activation)    (None, 6, 6, 1088)  
0            block17_17[0][0]  
-----  
conv2d_146 (Conv2D)           (None, 6, 6, 128)  
139264      block17_17_ac[0][0]
```

```
-----  
batch_normalization_146 (BatchN (None, 6, 6, 128)  
    384          conv2d_146[0][0]  
  
-----  
activation_146 (Activation)      (None, 6, 6, 128)  
    0          batch_normalization_146[0][0]  
  
-----  
conv2d_147 (Conv2D)           (None, 6, 6, 160)  
    143360        activation_146[0][0]  
  
-----  
batch_normalization_147 (BatchN (None, 6, 6, 160)  
    480          conv2d_147[0][0]  
  
-----  
activation_147 (Activation)      (None, 6, 6, 160)  
    0          batch_normalization_147[0][0]  
  
-----  
conv2d_145 (Conv2D)           (None, 6, 6, 192)  
    208896        block17_17_ac[0][0]  
  
-----  
conv2d_148 (Conv2D)           (None, 6, 6, 192)  
    215040        activation_147[0][0]  
  
-----  
batch_normalization_145 (BatchN (None, 6, 6, 192)  
    576          conv2d_145[0][0]  
  
-----  
batch_normalization_148 (BatchN (None, 6, 6, 192)  
    576          conv2d_148[0][0]  
  
-----  
activation_145 (Activation)      (None, 6, 6, 192)  
    0          batch_normalization_145[0][0]  
  
-----  
activation_148 (Activation)      (None, 6, 6, 192)  
    0          batch_normalization_148[0][0]  
  
-----  
block17_18_mixed (Concatenate) (None, 6, 6, 384)  
    0          activation_145[0][0]  
  
                        activation_148[0][0]  
  
-----  
block17_18_conv (Conv2D)       (None, 6, 6, 1088)  
    418880        block17_18_mixed[0][0]  
  
-----  
block17_18 (Lambda)           (None, 6, 6, 1088)  
    0          block17_17_ac[0][0]  
  
                        block17_18_conv[0][0]
```

```
-----  
-----  
block17_18_ac (Activation)      (None, 6, 6, 1088)  
0                      block17_18[0][0]  
-----  
-----  
conv2d_150 (Conv2D)           (None, 6, 6, 128)  
139264          block17_18_ac[0][0]  
-----  
-----  
batch_normalization_150 (BatchN (None, 6, 6, 128)  
384          conv2d_150[0][0]  
-----  
-----  
activation_150 (Activation)    (None, 6, 6, 128)  
0          batch_normalization_150[0][0]  
-----  
-----  
conv2d_151 (Conv2D)           (None, 6, 6, 160)  
143360          activation_150[0][0]  
-----  
-----  
batch_normalization_151 (BatchN (None, 6, 6, 160)  
480          conv2d_151[0][0]  
-----  
-----  
activation_151 (Activation)    (None, 6, 6, 160)  
0          batch_normalization_151[0][0]  
-----  
-----  
conv2d_149 (Conv2D)           (None, 6, 6, 192)  
208896          block17_18_ac[0][0]  
-----  
-----  
conv2d_152 (Conv2D)           (None, 6, 6, 192)  
215040          activation_151[0][0]  
-----  
-----  
batch_normalization_149 (BatchN (None, 6, 6, 192)  
576          conv2d_149[0][0]  
-----  
-----  
batch_normalization_152 (BatchN (None, 6, 6, 192)  
576          conv2d_152[0][0]  
-----  
-----  
activation_149 (Activation)    (None, 6, 6, 192)  
0          batch_normalization_149[0][0]  
-----  
-----  
activation_152 (Activation)    (None, 6, 6, 192)  
0          batch_normalization_152[0][0]  
-----  
-----  
block17_19_mixed (Concatenate) (None, 6, 6, 384)  
0          activation_149[0][0]  
-----  
-----  
activation_152[0][0]  
-----
```

```
block17_19_conv (Conv2D)      (None, 6, 6, 1088)
418880      block17_19_mixed[0][0]
-----
block17_19 (Lambda)          (None, 6, 6, 1088)
0          block17_18_ac[0][0]
                               block17_19_conv[0][0]
-----
block17_19_ac (Activation)   (None, 6, 6, 1088)
0          block17_19[0][0]
-----
conv2d_154 (Conv2D)          (None, 6, 6, 128)
139264      block17_19_ac[0][0]
-----
batch_normalization_154 (BatchN (None, 6, 6, 128)
384          conv2d_154[0][0]
-----
activation_154 (Activation)  (None, 6, 6, 128)
0          batch_normalization_154[0][0]
-----
conv2d_155 (Conv2D)          (None, 6, 6, 160)
143360      activation_154[0][0]
-----
batch_normalization_155 (BatchN (None, 6, 6, 160)
480          conv2d_155[0][0]
-----
activation_155 (Activation)  (None, 6, 6, 160)
0          batch_normalization_155[0][0]
-----
conv2d_153 (Conv2D)          (None, 6, 6, 192)
208896      block17_19_ac[0][0]
-----
conv2d_156 (Conv2D)          (None, 6, 6, 192)
215040      activation_155[0][0]
-----
batch_normalization_153 (BatchN (None, 6, 6, 192)
576          conv2d_153[0][0]
-----
batch_normalization_156 (BatchN (None, 6, 6, 192)
576          conv2d_156[0][0]
-----
activation_153 (Activation)  (None, 6, 6, 192)
0          batch_normalization_153[0][0]
-----
activation_156 (Activation)  (None, 6, 6, 192)
0          batch_normalization_156[0][0]
```

0 batch_normalization_150[0][0]

block17_20_mixed (Concatenate) (None, 6, 6, 384)

0 activation_153[0][0]

activation_156[0][0]

block17_20_conv (Conv2D) (None, 6, 6, 1088)

418880 block17_20_mixed[0][0]

block17_20 (Lambda) (None, 6, 6, 1088)

0 block17_19_ac[0][0]

block17_20_conv[0][0]

block17_20_ac (Activation) (None, 6, 6, 1088)

0 block17_20[0][0]

conv2d_161 (Conv2D) (None, 6, 6, 256)

278528 block17_20_ac[0][0]

batch_normalization_161 (BatchN (None, 6, 6, 256))

768 conv2d_161[0][0]

activation_161 (Activation) (None, 6, 6, 256)

0 batch_normalization_161[0][0]

conv2d_157 (Conv2D) (None, 6, 6, 256)

278528 block17_20_ac[0][0]

conv2d_159 (Conv2D) (None, 6, 6, 256)

278528 block17_20_ac[0][0]

conv2d_162 (Conv2D) (None, 6, 6, 288)

663552 activation_161[0][0]

batch_normalization_157 (BatchN (None, 6, 6, 256))

768 conv2d_157[0][0]

batch_normalization_159 (BatchN (None, 6, 6, 256))

768 conv2d_159[0][0]

batch_normalization_162 (BatchN (None, 6, 6, 288))

864 conv2d_162[0][0]

activation_157 (Activation) (None, 6, 6, 256)

0 activation_157[0][0]

0 batch_normalization_157[0][0]

activation_159 (Activation) (None, 6, 6, 256)
0 batch_normalization_159[0][0]

activation_162 (Activation) (None, 6, 6, 288)
0 batch_normalization_162[0][0]

conv2d_158 (Conv2D) (None, 2, 2, 384)
884736 activation_157[0][0]

conv2d_160 (Conv2D) (None, 2, 2, 288)
663552 activation_159[0][0]

conv2d_163 (Conv2D) (None, 2, 2, 320)
829440 activation_162[0][0]

batch_normalization_158 (BatchN (None, 2, 2, 384)
1152 conv2d_158[0][0]

batch_normalization_160 (BatchN (None, 2, 2, 288)
864 conv2d_160[0][0]

batch_normalization_163 (BatchN (None, 2, 2, 320)
960 conv2d_163[0][0]

activation_158 (Activation) (None, 2, 2, 384)
0 batch_normalization_158[0][0]

activation_160 (Activation) (None, 2, 2, 288)
0 batch_normalization_160[0][0]

activation_163 (Activation) (None, 2, 2, 320)
0 batch_normalization_163[0][0]

max_pooling2d_4 (MaxPooling2D) (None, 2, 2, 1088)
0 block17_20_ac[0][0]

mixed_7a (Concatenate) (None, 2, 2, 2080)
0 activation_158[0][0]

activation_160[0][0]

activation_163[0][0]

max_pooling2d_4[0][0]

```
conv2d_165 (Conv2D)           (None, 2, 2, 192)
399360      mixed_7a[0][0]
-----  

batch_normalization_165 (BatchN (None, 2, 2, 192)
576          conv2d_165[0][0]
-----  

activation_165 (Activation)   (None, 2, 2, 192)
0            batch_normalization_165[0][0]
-----  

conv2d_166 (Conv2D)           (None, 2, 2, 224)
129024      activation_165[0][0]
-----  

batch_normalization_166 (BatchN (None, 2, 2, 224)
672          conv2d_166[0][0]
-----  

activation_166 (Activation)   (None, 2, 2, 224)
0            batch_normalization_166[0][0]
-----  

conv2d_164 (Conv2D)           (None, 2, 2, 192)
399360      mixed_7a[0][0]
-----  

conv2d_167 (Conv2D)           (None, 2, 2, 256)
172032      activation_166[0][0]
-----  

batch_normalization_164 (BatchN (None, 2, 2, 192)
576          conv2d_164[0][0]
-----  

batch_normalization_167 (BatchN (None, 2, 2, 256)
768          conv2d_167[0][0]
-----  

activation_164 (Activation)   (None, 2, 2, 192)
0            batch_normalization_164[0][0]
-----  

activation_167 (Activation)   (None, 2, 2, 256)
0            batch_normalization_167[0][0]
-----  

block8_1_mixed (Concatenate)  (None, 2, 2, 448)
0            activation_164[0][0]
-----  

activation_167[0][0]
-----  

block8_1_conv (Conv2D)         (None, 2, 2, 2080)
933920      block8_1_mixed[0][0]
-----  

block8_1 (Lambda)              (None, 2, 2, 2080)
```

```
          0           mixed_7a[0][0]

          block8_1_conv[0][0]
-----
-----
```

block8_1_ac (Activation) (None, 2, 2, 2080)
0 block8_1[0][0]

```
-----
```

conv2d_169 (Conv2D) (None, 2, 2, 192)
399360 block8_1_ac[0][0]

```
-----
```

batch_normalization_169 (BatchN (None, 2, 2, 192)
576 conv2d_169[0][0]

```
-----
```

activation_169 (Activation) (None, 2, 2, 192)
0 batch_normalization_169[0][0]

```
-----
```

conv2d_170 (Conv2D) (None, 2, 2, 224)
129024 activation_169[0][0]

```
-----
```

batch_normalization_170 (BatchN (None, 2, 2, 224)
672 conv2d_170[0][0]

```
-----
```

activation_170 (Activation) (None, 2, 2, 224)
0 batch_normalization_170[0][0]

```
-----
```

conv2d_168 (Conv2D) (None, 2, 2, 192)
399360 block8_1_ac[0][0]

```
-----
```

conv2d_171 (Conv2D) (None, 2, 2, 256)
172032 activation_170[0][0]

```
-----
```

batch_normalization_168 (BatchN (None, 2, 2, 192)
576 conv2d_168[0][0]

```
-----
```

batch_normalization_171 (BatchN (None, 2, 2, 256)
768 conv2d_171[0][0]

```
-----
```

activation_168 (Activation) (None, 2, 2, 192)
0 batch_normalization_168[0][0]

```
-----
```

activation_171 (Activation) (None, 2, 2, 256)
0 batch_normalization_171[0][0]

```
-----
```

block8_2_mixed (Concatenate) (None, 2, 2, 448)
0 activation_168[0][0]

activation_171[0][0]

block8_2_conv (Conv2D) (None, 2, 2, 2080)
933920 block8_2_mixed[0][0]

block8_2 (Lambda) (None, 2, 2, 2080)
0 block8_1_ac[0][0]

block8_2_conv[0][0]

block8_2_ac (Activation) (None, 2, 2, 2080)
0 block8_2[0][0]

conv2d_173 (Conv2D) (None, 2, 2, 192)
399360 block8_2_ac[0][0]

batch_normalization_173 (BatchN (None, 2, 2, 192)
576 conv2d_173[0][0]

activation_173 (Activation) (None, 2, 2, 192)
0 batch_normalization_173[0][0]

conv2d_174 (Conv2D) (None, 2, 2, 224)
129024 activation_173[0][0]

batch_normalization_174 (BatchN (None, 2, 2, 224)
672 conv2d_174[0][0]

activation_174 (Activation) (None, 2, 2, 224)
0 batch_normalization_174[0][0]

conv2d_172 (Conv2D) (None, 2, 2, 192)
399360 block8_2_ac[0][0]

conv2d_175 (Conv2D) (None, 2, 2, 256)
172032 activation_174[0][0]

batch_normalization_172 (BatchN (None, 2, 2, 192)
576 conv2d_172[0][0]

batch_normalization_175 (BatchN (None, 2, 2, 256)
768 conv2d_175[0][0]

activation_172 (Activation) (None, 2, 2, 192)
0 batch_normalization_172[0][0]

```
activation_175 (Activation)      (None, 2, 2, 256)
    0           batch_normalization_175[0][0]

block8_3_mixed (Concatenate)    (None, 2, 2, 448)
    0           activation_172[0][0]

                                activation_175[0][0]

block8_3_conv (Conv2D)          (None, 2, 2, 2080)
    933920     block8_3_mixed[0][0]

block8_3 (Lambda)              (None, 2, 2, 2080)
    0           block8_2_ac[0][0]

                                block8_3_conv[0][0]

block8_3_ac (Activation)       (None, 2, 2, 2080)
    0           block8_3[0][0]

conv2d_177 (Conv2D)            (None, 2, 2, 192)
    399360     block8_3_ac[0][0]

batch_normalization_177 (BatchN (None, 2, 2, 192)
    576         conv2d_177[0][0]

activation_177 (Activation)    (None, 2, 2, 192)
    0           batch_normalization_177[0][0]

conv2d_178 (Conv2D)            (None, 2, 2, 224)
    129024     activation_177[0][0]

batch_normalization_178 (BatchN (None, 2, 2, 224)
    672         conv2d_178[0][0]

activation_178 (Activation)    (None, 2, 2, 224)
    0           batch_normalization_178[0][0]

conv2d_176 (Conv2D)            (None, 2, 2, 192)
    399360     block8_3_ac[0][0]

conv2d_179 (Conv2D)            (None, 2, 2, 256)
    172032     activation_178[0][0]

batch_normalization_176 (BatchN (None, 2, 2, 192)
    576         conv2d_176[0][0]
```

```
-----  
batch_normalization_179 (BatchN (None, 2, 2, 256)  
    768          conv2d_179[0][0]  
  
-----  
activation_176 (Activation)      (None, 2, 2, 192)  
    0          batch_normalization_176[0][0]  
  
-----  
activation_179 (Activation)      (None, 2, 2, 256)  
    0          batch_normalization_179[0][0]  
  
-----  
block8_4_mixed (Concatenate)    (None, 2, 2, 448)  
    0          activation_176[0][0]  
  
            activation_179[0][0]  
  
-----  
block8_4_conv (Conv2D)          (None, 2, 2, 2080)  
    933920      block8_4_mixed[0][0]  
  
-----  
block8_4 (Lambda)              (None, 2, 2, 2080)  
    0          block8_3_ac[0][0]  
  
            block8_4_conv[0][0]  
  
-----  
block8_4_ac (Activation)       (None, 2, 2, 2080)  
    0          block8_4[0][0]  
  
-----  
conv2d_181 (Conv2D)           (None, 2, 2, 192)  
    399360      block8_4_ac[0][0]  
  
-----  
batch_normalization_181 (BatchN (None, 2, 2, 192)  
    576          conv2d_181[0][0]  
  
-----  
activation_181 (Activation)     (None, 2, 2, 192)  
    0          batch_normalization_181[0][0]  
  
-----  
conv2d_182 (Conv2D)           (None, 2, 2, 224)  
    129024      activation_181[0][0]  
  
-----  
batch_normalization_182 (BatchN (None, 2, 2, 224)  
    672          conv2d_182[0][0]  
  
-----  
activation_182 (Activation)     (None, 2, 2, 224)  
    0          batch_normalization_182[0][0]  
  
-----  
conv2d_180 (Conv2D)           (None, 2, 2, 192)  
    399360      block8_4_ac[0][0]
```

```
-----  
conv2d_183 (Conv2D)           (None, 2, 2, 256)  
172032      activation_182[0][0]  
-----  
batch_normalization_180 (BatchN (None, 2, 2, 192)  
576          conv2d_180[0][0]  
-----  
batch_normalization_183 (BatchN (None, 2, 2, 256)  
768          conv2d_183[0][0]  
-----  
activation_180 (Activation)   (None, 2, 2, 192)  
0            batch_normalization_180[0][0]  
-----  
activation_183 (Activation)   (None, 2, 2, 256)  
0            batch_normalization_183[0][0]  
-----  
block8_5_mixed (Concatenate) (None, 2, 2, 448)  
0            activation_180[0][0]  
                               activation_183[0][0]  
-----  
block8_5_conv (Conv2D)        (None, 2, 2, 2080)  
933920      block8_5_mixed[0][0]  
-----  
block8_5 (Lambda)            (None, 2, 2, 2080)  
0            block8_4_ac[0][0]  
                               block8_5_conv[0][0]  
-----  
block8_5_ac (Activation)    (None, 2, 2, 2080)  
0            block8_5[0][0]  
-----  
conv2d_185 (Conv2D)         (None, 2, 2, 192)  
399360      block8_5_ac[0][0]  
-----  
batch_normalization_185 (BatchN (None, 2, 2, 192)  
576          conv2d_185[0][0]  
-----  
activation_185 (Activation)  (None, 2, 2, 192)  
0            batch_normalization_185[0][0]  
-----  
conv2d_186 (Conv2D)         (None, 2, 2, 224)  
129024      activation_185[0][0]  
-----  
batch_normalization_186 (BatchN (None, 2, 2, 224)  
672          conv2d_186[0][0]
```

```
-----  
activation_186 (Activation)      (None, 2, 2, 224)  
0          batch_normalization_186[0][0]  
-----  
conv2d_184 (Conv2D)           (None, 2, 2, 192)  
399360      block8_5_ac[0][0]  
-----  
conv2d_187 (Conv2D)           (None, 2, 2, 256)  
172032      activation_186[0][0]  
-----  
batch_normalization_184 (BatchN (None, 2, 2, 192)  
576          conv2d_184[0][0]  
-----  
batch_normalization_187 (BatchN (None, 2, 2, 256)  
768          conv2d_187[0][0]  
-----  
activation_184 (Activation)    (None, 2, 2, 192)  
0          batch_normalization_184[0][0]  
-----  
activation_187 (Activation)    (None, 2, 2, 256)  
0          batch_normalization_187[0][0]  
-----  
block8_6_mixed (Concatenate)  (None, 2, 2, 448)  
0          activation_184[0][0]  
activation_187[0][0]  
-----  
block8_6_conv (Conv2D)         (None, 2, 2, 2080)  
933920      block8_6_mixed[0][0]  
-----  
block8_6 (Lambda)             (None, 2, 2, 2080)  
0          block8_5_ac[0][0]  
block8_6_conv[0][0]  
-----  
block8_6_ac (Activation)     (None, 2, 2, 2080)  
0          block8_6[0][0]  
-----  
conv2d_189 (Conv2D)           (None, 2, 2, 192)  
399360      block8_6_ac[0][0]  
-----  
batch_normalization_189 (BatchN (None, 2, 2, 192)  
576          conv2d_189[0][0]  
-----  
activation_189 (Activation)    (None, 2, 2, 192)  
0          batch_normalization_189[0][0]
```

conv2d_190 (Conv2D) (None, 2, 2, 224)
129024 activation_189[0][0]

batch_normalization_190 (BatchN (None, 2, 2, 224)
672 conv2d_190[0][0]

activation_190 (Activation) (None, 2, 2, 224)
0 batch_normalization_190[0][0]

conv2d_188 (Conv2D) (None, 2, 2, 192)
399360 block8_6_ac[0][0]

conv2d_191 (Conv2D) (None, 2, 2, 256)
172032 activation_190[0][0]

batch_normalization_188 (BatchN (None, 2, 2, 192)
576 conv2d_188[0][0]

batch_normalization_191 (BatchN (None, 2, 2, 256)
768 conv2d_191[0][0]

activation_188 (Activation) (None, 2, 2, 192)
0 batch_normalization_188[0][0]

activation_191 (Activation) (None, 2, 2, 256)
0 batch_normalization_191[0][0]

block8_7_mixed (Concatenate) (None, 2, 2, 448)
0 activation_188[0][0]

activation_191[0][0]

block8_7_conv (Conv2D) (None, 2, 2, 2080)
933920 block8_7_mixed[0][0]

block8_7 (Lambda) (None, 2, 2, 2080)
0 block8_6_ac[0][0]

block8_7_conv[0][0]

block8_7_ac (Activation) (None, 2, 2, 2080)
0 block8_7[0][0]

conv2d_193 (Conv2D) (None, 2, 2, 192)
399360 block8_7_ac[0][0]

```
-----  
batch_normalization_193 (BatchN (None, 2, 2, 192)  
    576          conv2d_193[0][0]  
  
-----  
activation_193 (Activation)      (None, 2, 2, 192)  
    0          batch_normalization_193[0][0]  
  
-----  
conv2d_194 (Conv2D)           (None, 2, 2, 224)  
    129024       activation_193[0][0]  
  
-----  
batch_normalization_194 (BatchN (None, 2, 2, 224)  
    672          conv2d_194[0][0]  
  
-----  
activation_194 (Activation)      (None, 2, 2, 224)  
    0          batch_normalization_194[0][0]  
  
-----  
conv2d_192 (Conv2D)           (None, 2, 2, 192)  
    399360       block8_7_ac[0][0]  
  
-----  
conv2d_195 (Conv2D)           (None, 2, 2, 256)  
    172032       activation_194[0][0]  
  
-----  
batch_normalization_192 (BatchN (None, 2, 2, 192)  
    576          conv2d_192[0][0]  
  
-----  
batch_normalization_195 (BatchN (None, 2, 2, 256)  
    768          conv2d_195[0][0]  
  
-----  
activation_192 (Activation)      (None, 2, 2, 192)  
    0          batch_normalization_192[0][0]  
  
-----  
activation_195 (Activation)      (None, 2, 2, 256)  
    0          batch_normalization_195[0][0]  
  
-----  
block8_8_mixed (Concatenate)    (None, 2, 2, 448)  
    0          activation_192[0][0]  
  
                                activation_195[0][0]  
  
-----  
block8_8_conv (Conv2D)          (None, 2, 2, 2080)  
    933920       block8_8_mixed[0][0]  
  
-----  
block8_8 (Lambda)              (None, 2, 2, 2080)  
    0          block8_7_ac[0][0]  
  
                                block8_8_conv[0][0]
```

```
-----  
      block8_8_ac (Activation)      (None, 2, 2, 2080)  
          0           block8_8[0][0]  
  
-----  
      conv2d_197 (Conv2D)          (None, 2, 2, 192)  
          399360       block8_8_ac[0][0]  
  
-----  
      batch_normalization_197 (BatchN (None, 2, 2, 192)  
          576           conv2d_197[0][0]  
  
-----  
      activation_197 (Activation)    (None, 2, 2, 192)  
          0           batch_normalization_197[0][0]  
  
-----  
      conv2d_198 (Conv2D)          (None, 2, 2, 224)  
          129024       activation_197[0][0]  
  
-----  
      batch_normalization_198 (BatchN (None, 2, 2, 224)  
          672           conv2d_198[0][0]  
  
-----  
      activation_198 (Activation)    (None, 2, 2, 224)  
          0           batch_normalization_198[0][0]  
  
-----  
      conv2d_196 (Conv2D)          (None, 2, 2, 192)  
          399360       block8_8_ac[0][0]  
  
-----  
      conv2d_199 (Conv2D)          (None, 2, 2, 256)  
          172032       activation_198[0][0]  
  
-----  
      batch_normalization_196 (BatchN (None, 2, 2, 192)  
          576           conv2d_196[0][0]  
  
-----  
      batch_normalization_199 (BatchN (None, 2, 2, 256)  
          768           conv2d_199[0][0]  
  
-----  
      activation_196 (Activation)    (None, 2, 2, 192)  
          0           batch_normalization_196[0][0]  
  
-----  
      activation_199 (Activation)    (None, 2, 2, 256)  
          0           batch_normalization_199[0][0]  
  
-----  
      block8_9_mixed (Concatenate)  (None, 2, 2, 448)  
          0           activation_196[0][0]  
  
-----  
          activation_199[0][0]
```

```
-----  
block8_9_conv (Conv2D)           (None, 2, 2, 2080)  
933920      block8_9_mixed[0][0]  
-----  
  
block8_9 (Lambda)              (None, 2, 2, 2080)  
0          block8_8_ac[0][0]  
  
          block8_9_conv[0][0]  
-----  
  
block8_9_ac (Activation)       (None, 2, 2, 2080)  
0          block8_9[0][0]  
-----  
  
conv2d_201 (Conv2D)            (None, 2, 2, 192)  
399360      block8_9_ac[0][0]  
-----  
  
batch_normalization_201 (BatchN (None, 2, 2, 192)  
576        conv2d_201[0][0]  
-----  
  
activation_201 (Activation)    (None, 2, 2, 192)  
0          batch_normalization_201[0][0]  
-----  
  
conv2d_202 (Conv2D)            (None, 2, 2, 224)  
129024      activation_201[0][0]  
-----  
  
batch_normalization_202 (BatchN (None, 2, 2, 224)  
672        conv2d_202[0][0]  
-----  
  
activation_202 (Activation)    (None, 2, 2, 224)  
0          batch_normalization_202[0][0]  
-----  
  
conv2d_200 (Conv2D)            (None, 2, 2, 192)  
399360      block8_9_ac[0][0]  
-----  
  
conv2d_203 (Conv2D)            (None, 2, 2, 256)  
172032      activation_202[0][0]  
-----  
  
batch_normalization_200 (BatchN (None, 2, 2, 192)  
576        conv2d_200[0][0]  
-----  
  
batch_normalization_203 (BatchN (None, 2, 2, 256)  
768        conv2d_203[0][0]  
-----  
  
activation_200 (Activation)    (None, 2, 2, 192)  
0          batch_normalization_200[0][0]  
-----  
  
activation_203 (Activation)    (None, 2, 2, 256)
```

```
          0           batch_normalization_203[0][0]
-----
-----
block8_10_mixed (Concatenate)  (None, 2, 2, 448)
          0           activation_200[0][0]
                         activation_203[0][0]
-----
-----
block8_10_conv (Conv2D)        (None, 2, 2, 2080)
         933920      block8_10_mixed[0][0]
-----
-----
block8_10 (Lambda)            (None, 2, 2, 2080)
          0           block8_9_ac[0][0]
                         block8_10_conv[0][0]
-----
-----
conv_7b (Conv2D)              (None, 2, 2, 1536)
        3194880      block8_10[0][0]
-----
-----
conv_7b_bn (BatchNormalization) (None, 2, 2, 1536)
         4608       conv_7b[0][0]
-----
-----
conv_7b_ac (Activation)       (None, 2, 2, 1536)
          0           conv_7b_bn[0][0]
-----
-----
avg_pool (GlobalAveragePooling2 (None, 1536)
          0           conv_7b_ac[0][0]
-----
-----
dropout_1 (Dropout)           (None, 1536)
          0           avg_pool[0][0]
-----
-----
dense_1 (Dense)               (None, 5004)
        7691148      dropout_1[0][0]
=====
=====
```

Total params: 62,027,884
Trainable params: 61,967,340
Non-trainable params: 60,544

In [12]:

```
gc.collect()
```

Out[12]:

```
0
```

Load model and weights from disc

In [13]:

```
# from keras.models import load_model

# # returns a compiled model
# # identical to the previous cell
# model = load_model(MODEL)
# print("Loaded model architecture from disk")
# gc.collect()

# model.load_weights(WEIGHTS)
# print("Loaded model weights from disk")
# model.summary()

# gc.collect()
```

Train with ImageDataGenerator and flow_from_dataframe

In [14]:

```
from keras.callbacks import LambdaCallback, ModelCheckpoint

ROTATE = 20
SEED = 28
BATCH_SIZE = 100

gc.collect()

batch_gc_callback = LambdaCallback(
    on_epoch_begin=lambda epoch, logs: gc.collect())

checkpointer = ModelCheckpoint(filepath='weights.hdf5',
                               verbose=1, save_best_only=True)

train_datagen = ImageDataGenerator(
    preprocessing_function=preprocess_input,
    rescale=1./255,
    fill_mode='nearest'
)

train_generator = train_datagen.flow_from_dataframe(
    dataframe=whales_train,
    subset = "training",
    directory=TRAIN_CROPPED_IN,
    x_col="Image",
    y_col="Id",
    has_ext=True,
    seed = SEED,
    color_mode= "rgb",
    target_size=(IMAGE_HEIGHT, IMAGE_WIDTH),
    batch_size=BATCH_SIZE,
    class_mode='categorical')
```

```
gc.collect()
```

```
Found 15697 images belonging to 5004 classes.
```

```
Out[14]:
```

```
56
```

Visualize augmented data

```
In [15]:
```

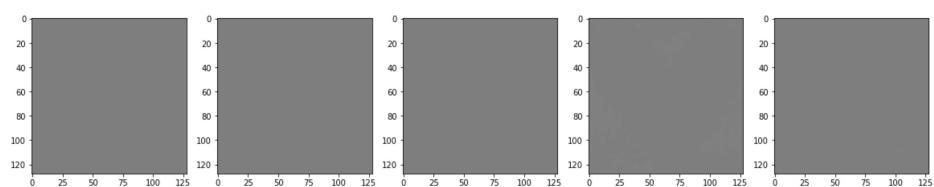
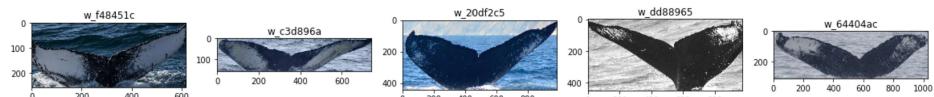
```
from skimage.io import imread
import PIL.Image as pimage

def plot_images(images_names, path):
    fig, m_axs = plt.subplots(1, len(images_names), figsize = (20, 10))
    #show the images and label them
    for ii, c_ax in enumerate(m_axs):
        img = imread(os.path.join(path, images_names[ii][0]))
        c_ax.imshow(img)
        c_ax.set_title(images_names[ii][1])

def plot_loaded_images(images_loaded, labels):
    fig, m_axs = plt.subplots(1, len(images_loaded), figsize = (20, 10))
    #show the images and label them
    for ii, c_ax in enumerate(m_axs):
        img = pimage.fromarray(images_loaded[ii], "RGB")
        c_ax.imshow((images_loaded[ii] + 1) / 2)
    #        c_ax.set_title(labels[ii])

#get the first 5 whale images
images = [(whale_img, whale_label) for (whale_img, whale_label) in zip(whales_train.Image[:5], whales_train.Id[:5])]
plot_images(images, TRAIN_CROPPED_IN)

x_batch, y_batch = next(train_generator)
plot_loaded_images(x_batch[:5], y_batch[:5])
```



Learning rate finder

In [16]:

```
import keras.backend as K
from keras.callbacks import Callback

class LRFinder(Callback):
    ...

    A simple callback for finding the optimal learning rate range for your model + dataset.

    # Usage
    ````python
 lr_finder = LRFinder(min_lr=1e-5,
 max_lr=1e-2,
 steps_per_epoch=np.c
 eil(epoch_size/batch_size),
 epochs=3)
 model.fit(X_train, Y_train, callbacks=[lr
 _finder])

 lr_finder.plot_loss()
 ...

 # Arguments
 min_lr: The lower bound of the learning rate range for the experiment.
 max_lr: The upper bound of the learning rate range for the experiment.
 steps_per_epoch: Number of mini-batches in the dataset. Calculated as `np.ceil(epoch_size/batch_size)` .
 epochs: Number of epochs to run experiment. Usually between 2 and 4 epochs is sufficient.

 # References
 Blog post: jeremyjordan.me/nn-learning-rate
 Original paper: https://arxiv.org/abs/1506.01
186
 ...

 def __init__(self, min_lr=1e-5, max_lr=1e-1, steps_per_epoch=None, epochs=None, beta=.98):
 super().__init__()

 self.min_lr = min_lr
 self.max_lr = max_lr
 self.total_iterations = steps_per_epoch * epochs
 self.iteration = 0
 self.history = {}
 self.beta = beta
 self.lr_mult = (max_lr/min_lr)**(1/steps_per_epoch)

 def clr(self):
 Calculate the learning rate.
 x = self.iteration / self.total_iterations
 return self.min_lr * (self.lr_mult**self.it
 eration)
```

```

 def on_train_begin(self, logs=None):
 '''Initialize the learning rate to the minimum value at the start of training.'''
 self.best_loss = 1e9
 self.avg_loss = 0
 self.losses, self.smoothed_losses, self.lrs
 , self.iterations = [], [], [], []
 logs = logs or {}
 K.set_value(self.model.optimizer.lr, self.m
in_lr)

 def on_epoch_end(self, epoch, logs=None):
 print(" Epoch ended learning rate: " + str(
K.get_value(self.model.optimizer.lr)))

 def on_epoch_begin(self, epoch, logs=None):
 print(" Epoch start learning rate: " + str(
K.get_value(self.model.optimizer.lr)))

 def on_batch_end(self, epoch, logs=None):
 '''Record previous batch statistics and update the learning rate.'''
 logs = logs or {}
 self.iteration += 1

 #addition
 loss = logs.get('loss')
 self.avg_loss = self.beta * self.avg_loss +
(1 - self.beta) * loss
 smoothed_loss = self.avg_loss / (1 - self.b
eta**self.iteration)
 # Check if the loss is not exploding
 if self.iteration>1 and smoothed_loss > sel
f.best_loss * 1.5:
 self.model.stop_training = True
 return
 if smoothed_loss < self.best_loss or self.i
teration==1:
 self.best_loss = smoothed_loss

 lr = self.clr()
 self.losses.append(loss)
 self.smoothed_losses.append(smoothed_loss)
 self.lrs.append(lr)
 self.iterations.append(self.iteration)

 self.history.setdefault('lr', []).append(K.
get_value(self.model.optimizer.lr))
 self.history.setdefault('iterations', []).a
ppend(self.iteration)

 for k, v in logs.items():
 self.history.setdefault(k, []).append(v
)

 K.set_value(self.model.optimizer.lr,lr)

def plot_lr(self):
'''Helper function to quickly inspect the l

```

```

earning rate schedule.'''
```

```

plt.plot(self.history['iterations'], self.h
istory['lr'])
plt.yscale('log')
plt.xlabel('Iteration')
plt.ylabel('Learning rate')
plt.show()
```

```

def plot_lr(self):
 plt.xlabel('Iterations')
 plt.ylabel('Learning rate')
 plt.plot(self.iterations, self.lrs)
 plt.yscale('log')
 plt.show()
```

```

def plot_loss(self):
 '''Helper function to quickly observe the le
arning rate experiment results.'''
 plt.plot(self.history['lr'], self.history[
'loss'])
 plt.xscale('log')
 plt.xlabel('Learning rate')
 plt.ylabel('Loss')
 plt.show()
```

```

def plot(self, n_skip=10):
 plt.ylabel('Loss')
 plt.xlabel('Learning rate (log scale)')
 plt.plot(self.lrs[n_skip:-5], self.losses[n
_skip:-5])
 plt.xscale('log')
```

```

def plot_loss2(self):
 plt.ylabel('Losses')
 plt.xlabel('Iterations')
 plt.plot(self.iterations[10:], self.losses[
10:])
```

```

def plot_smoothed_loss(self, n_skip=6):
 plt.ylabel('Smoothed Losses')
 plt.xlabel('Learning rate (log scale)')
 plt.plot(self.lrs[n_skip:-5], self.smoothed
_losses[n_skip:-5])
 plt.xscale('log')
```

```

def plot_loss_change(self, sma=1, n_skip=20, y_
lim=(-0.01,0.01), should_lim_y = False):
 """
 Plots rate of change of the loss function.
 Parameters:
 sched - learning rate scheduler, an insta
nce of LR_Finder class.
 sma - number of batches for simple moving
 average to smooth out the curve.
 n_skip - number of batches to skip on the
 left.
 y_lim - limits for the y axis.
 """
 derivatives = [0] * (sma + 1)
 for i in range(1 + sma, len(self.lrs)):
 derivatives[i] = (self.losses[i] - self.losses[i - sma]) / sma
 plt.plot(self.iterations[n_skip:-5], derivatives)
 if should_lim_y:
 plt.ylim(y_lim)
```

```

 for i in range(1, sma, len(losses) // s):
 derivative = (self.losses[i] - self.losses[i - sma]) / sma
 derivatives.append(derivative)

 plt.ylabel("d/loss")
 plt.xlabel("learning rate (log scale)")
 plt.plot(self.lrs[n_skip:], derivatives[n_skip:])
 plt.xscale('log')
 if should_lim_y:
 plt.ylim(y_lim)

```

## Train

In [17]:

```

fits the model on batches with real-time data augmentation:
STEP_SIZE_TRAIN=train_generator.n//train_generator.batch_size

lr_finder = LRFinder(min_lr=1e-6,
 max_lr=1,
 steps_per_epoch=np.ceil(train_generator.n//train_generator.batch_size),
 epochs=EPOCHS)

Train the loaded model for more epochs
history = model.fit_generator(generator=train_generator,
 steps_per_epoch=STEP_SIZE_TRAIN,
 epochs=EPOCHS,
 callbacks=[batch_gc_callback, lr_finder])

```

Epoch 1/5

```

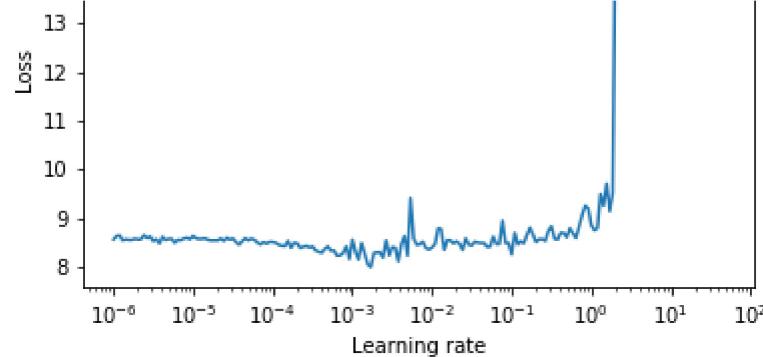
Epoch start learning rate: 1e-06
156/156 [=====] - 276s 2s/step - loss: 8.5178 - acc: 0.0027 - mean_absolute_error: 3.9952e-04 - top_5_accuracy: 0.0128
Epoch ended learning rate: 1.0
Epoch 2/5
Epoch start learning rate: 1.0
45/156 [=====>.....] - ETA: 2:40 - loss: 14.8865 - acc: 6.6667e-04 - mean_absolute_error: 3.9964e-04 - top_5_accuracy: 0.7553 Epoch ended learning rate: 49.238827

```

In [18]:

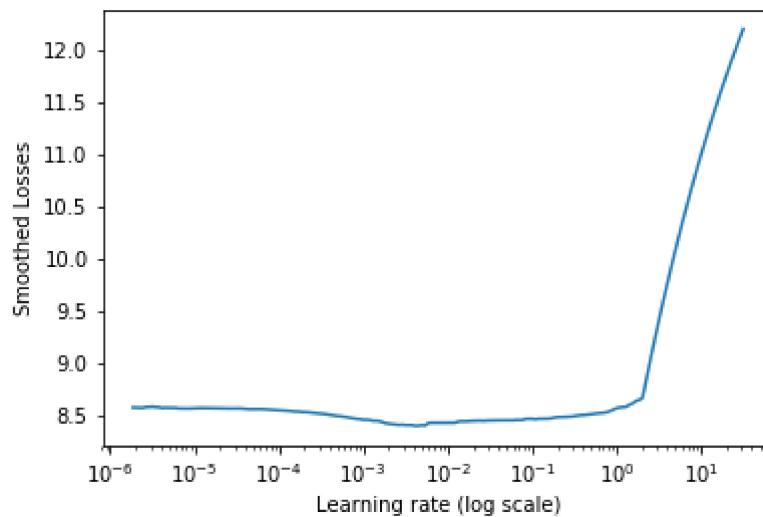
```
lr_finder.plot_loss()
```





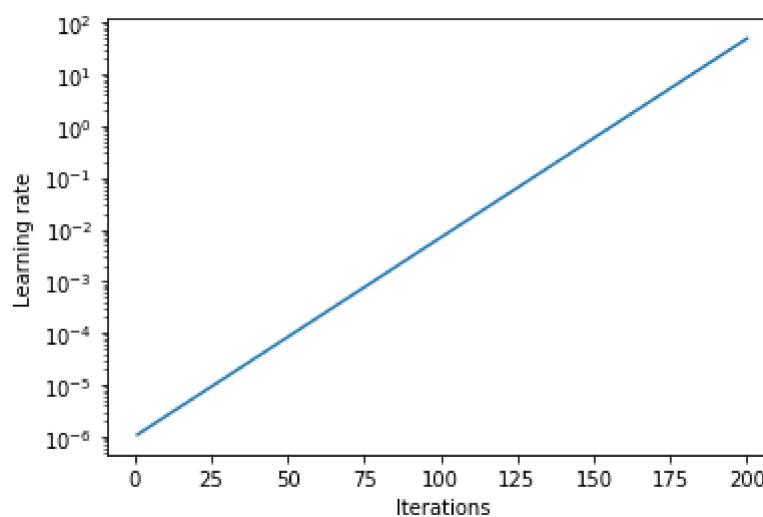
In [19]:

```
lr_finder.plot_smoothed_loss()
```



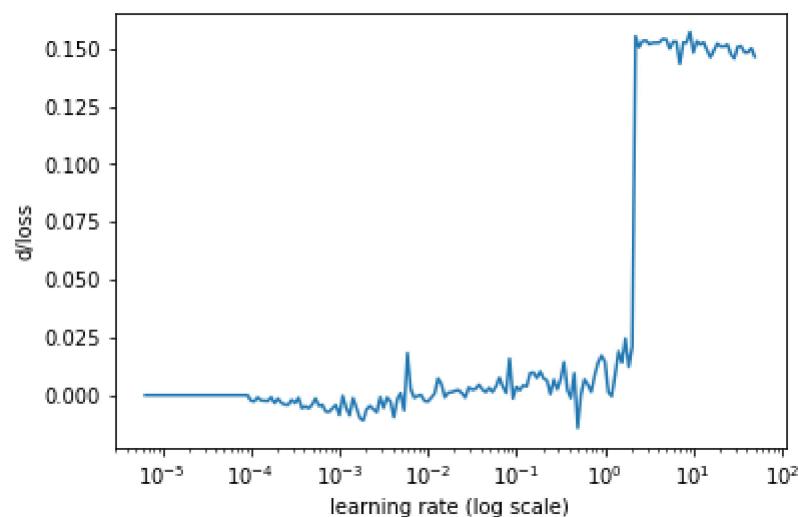
In [20]:

```
lr_finder.plot_lr()
```



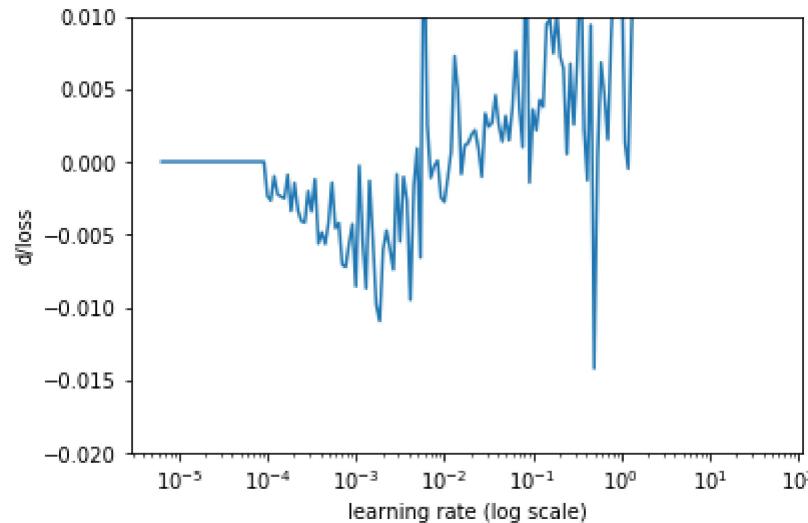
In [21]:

```
lr_finder.plot_loss_change(sma=50)
```



```
In [22]:
```

```
lr_finder.plot_loss_change(sma=50, y_lim=(-0.02,0.01), should_lim_y=True)
```



## Plot train results

```
In [23]:
```

```
def plot_accuracy(history, should_plot_val = False, should_plot_top5 = False):
 acc = history.history['acc']
 l1 = plt.plot(acc, label='acc')

 if should_plot_val:
 val_acc = history.history['val_acc']
 l2 = plt.plot(val_acc, label='val_acc')

 if should_plot_top5:
 top5_acc = history.history['top_5_accuracy']
]
 l3 = plt.plot(top5_acc, label='top_5_accuracy')

 plt.legend(loc=2, fontsize="small")
 plt.title('Model accuracy')
 plt.ylabel('Accuracy')
 plt.xlabel('Epoch')
 plt.show()

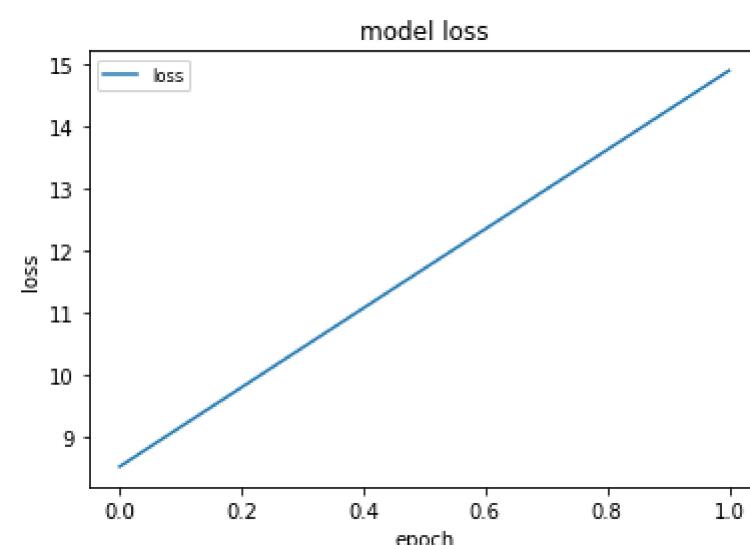
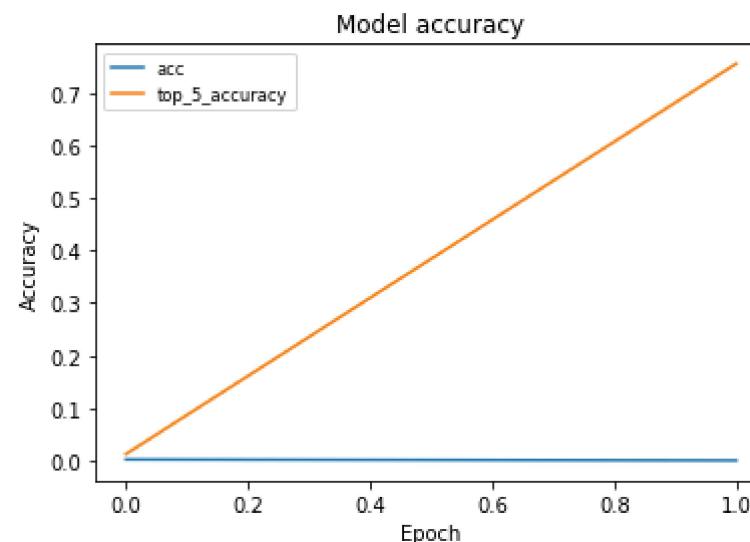
def plot_loss(history, should_plot_val = False):
 loss = history.history['loss']
 l1 = plt.plot(loss, label='loss')

 if should_plot_val:
 val_loss = history.history['val_loss']
 plt.plot(val_loss, label='val_loss')

 plt.legend(loc=2, fontsize="small")
 plt.title('model loss')
 plt.ylabel('loss')
 plt.xlabel('epoch')
 plt.show()
```

In [24]:

```
plot_accuracy(history, False, True)
plot_loss(history, False)
```



In [25]:

```
model.save(MODEL_F)
```

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Did you find this Kernel useful?  
Show your appreciation with an upvote

0

## Data

**Data Sources**

- ▼ Humpback Wh...
  - ▀ s: 7960 x 2
  - ▀ t: 25.4k x 2
- ▼ test.zip
  - ▀ 0027089a...
  - ▀ 00313e2d...
  - ▀ 004344c9...

**Humpback Whale Identification**  
Can you identify a whale by its tail?  
Last Updated: 2 months ago

**About this Competition**  
This training data contains thousands of images of humpback whale flukes. Individual whales have been identified by researchers and given an Id . The

	00434e9...
	008a4bc8...
	00ac0fca6...
	00ff45291...
	012dbdb5...
	0169cec0...
	01830c9cf...
	01b1ecf7b....
...	1000+ more
▼	train.zip
	002b4615...
	00600ce1...
	00d64188...
	00eaedfab...
	00fee397...
	010a1f0eb....
	01237f1ce....
	01dcbb420f...
	0202dfb2...
	020ab0f9...
...	1000+ more

challenge is to predict the whale `Id` of images in the test set. What makes this such a challenge is that there are only a few examples for each of 3,000+ whale IDs.

## File descriptions

- **train.zip** - a folder containing the training images
- **train.csv** - maps the training `Image` to the appropriate whale `Id`. Whales that are not predicted to have a label identified in the training data should be labeled as `new_whale`.
- **test.zip** - a folder containing the test images to predict the whale `Id`
- **sample\_submission.csv** - a sample submission file in the correct format

Output Files

New Dataset

New Kernel

Download All



### Output Files

- Model\_InceptionResNetV2.h5
- Weights\_InceptionResNetV2.h5

### About this file

This file was created from a Kernel, it does not have a description.

Model\_InceptionResNetV2.h5



We don't support previews for this file yet

### Run Info

Succeeded	True	Run Time	681.6 seconds
Exit Code	0	Queue Time	0 seconds
Docker Image Name	/python(Dockerfile)	Output Size	0
Timeout Exceeded	False	Used All Space	False
Failure Message			

Download Log

```
Time Line # Log Message
2.8s 1 [NbConvertApp] Converting notebook
 __notebook__.ipynb to notebook
2.9s 2 [NbConvertApp] Executing notebook with kernel:
 python3
7.8s 3 2019-02-01 13:58:53.871822: I
 tensorflow/stream_executor/cuda/cuda_gpu_executor.cc:964]
 successful NUMA node read from SysFS had negative value
 (-1), but there must be at least one NUMA node, so
 returning NUMA node zero
7.8s 4 2019-02-01 13:58:53.877171: I
 tensorflow/core/common_runtime/gpu/gpu_device.cc:1432]
 Found device 0 with properties:
 name: Tesla K80 major: 3 minor: 7
 memoryClockRate(GHz): 0.8235
 pciBusID: 0000:00:04.0
 totalMemory: 11.17GiB freeMemory: 11.10GiB
 2019-02-01 13:58:53.877392: I
 tensorflow/core/common_runtime/gpu/gpu_device.cc:1511]
 Adding visible gpu devices: 0
9.2s 5 2019-02-01 13:58:55.307235: I
 tensorflow/core/common_runtime/gpu/gpu_device.cc:982]
 Device interconnect StreamExecutor with strength 1
 edge matrix:
 2019-02-01 13:58:55.307289: I
 tensorflow/core/common_runtime/gpu/gpu_device.cc:988]
 0
 2019-02-01 13:58:55.307305: I
 tensorflow/core/common_runtime/gpu/gpu_device.cc:1001]
 0: N
9.2s 6 2019-02-01 13:58:55.311449: I
 tensorflow/core/common_runtime/gpu/gpu_device.cc:1115]
 Created TensorFlow device
 (/job:localhost/replica:0/task:0/device:GPU:0 with
 10758 MB memory) -> physical GPU (device: 0, name:
 Tesla K80, pci bus id: 0000:00:04.0, compute
 capability: 3.7)
678.4s 7 [NbConvertApp] Writing 602971 bytes to
 __notebook__.ipynb
680.5s 8 [NbConvertApp] Converting notebook
 __notebook__.ipynb to html
681.1s 9 [NbConvertApp] Support files will be in
 __results__files/
 [NbConvertApp] Making directory __results__files
681.1s 10 [NbConvertApp] Making directory __results__files
 [NbConvertApp] Writing 493447 bytes to
 __results__.html
681.1s 11
681.1s 13 Complete. Exited with code 0.
```

## Comments (0)



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