In [1]:
```python
import matplotlib.pyplot as plt
import tensorflow as tf
from keras.backend.tensorflow_backend import set_session
import keras
import sys, time, os, warnings
import numpy as np
import pandas as pd
from collections import Counter
warnings.filterwarnings("ignore")
print("python {}".format(sys.version))
print("keras version {}".format(keras.__version__)); del keras
print("tensorflow version {}".format(tf.__version__))
config = tf.ConfigProto()
config.gpu_options.per_process_gpu_memory_fraction = 0.95
config.gpu_options.visible_device_list = "0"
set_session(tf.Session(config=config))

def set_seed(sd=123):
    from numpy.random import seed
    from tensorflow import set_random_seed
    import random as rn
    ## numpy random seed
    seed(sd)
    ## core python's random number
    rn.seed(sd)
    ## tensor flow's random number
    set_random_seed(sd)
```

```
Using TensorFlow backend.

python 3.7.6 (default, Jan  8 2020, 19:59:22)
[GCC 7.3.0]
keras version 2.3.1
tensorflow version 1.15.0
```

In [2]:
```python
## The location of the Flickr8K_ photos
dir_Flickr_jpg = "./Flicker8k_Dataset/"
## The location of the caption file
dir_Flickr_text = "./Flickr8k.token.txt"

jpgs = os.listdir(dir_Flickr_jpg)
print("The number of jpg flies in Flicker8k: {}".format(len(jpgs)))
```

```
The number of jpg flies in Flicker8k: 8091
```

In [3]:
```python
## read in the Flickr caption data
file = open(dir_Flickr_text,'r')
text = file.read()
file.close()


datatxt = []
for line in text.split('\n'):
    col = line.split('\t')
    if len(col) == 1:
        continue
    w = col[0].split("#")
    datatxt.append(w + [col[1].lower()])

df_txt = pd.DataFrame(datatxt,columns=["filename","index","caption"
])


uni_filenames = np.unique(df_txt.filename.values)
print("The number of unique file names : {}".format(len(uni_filenam
es)))
print("The distribution of the number of captions for each image:")
Counter(Counter(df_txt.filename.values).values())
```

```
The number of unique file names : 8092
The distribution of the number of captions for each image:
```

Out[3]: Counter({5: 8092})

In [4]:
```python
from keras.preprocessing.image import load_img, img_to_array

npic = 10
npix = 224
target_size = (npix,npix,3)

count = 1
fig = plt.figure(figsize=(10,20))
for jpgfnm in uni_filenames[:npic]:
    filename = dir_Flickr_jpg + '/' + jpgfnm
    captions = list(df_txt["caption"].loc[df_txt["filename"]==jpgfn
m].values)
    image_load = load_img(filename, target_size=target_size)

    ax = fig.add_subplot(npic,2,count,xticks=[],yticks=[])
    ax.imshow(image_load)
    count += 1

    ax = fig.add_subplot(npic,2,count)
    plt.axis('off')
    ax.plot()
    ax.set_xlim(0,1)
    ax.set_ylim(0,len(captions))
    for i, caption in enumerate(captions):
        ax.text(0,i,caption,fontsize=20)
    count += 1
plt.show()
```

a little girl in a pink dress going into a wooden cabin .
a little girl climbing the stairs to her playhouse .
a little girl climbing into a wooden playhouse .
a girl going into a wooden building .
a child in a pink dress is climbing up a set of stairs in an entry way .

two dogs on pavement moving toward each other .
two dogs of different breeds looking at each other on the road .
a black dog and a white dog with brown spots are staring at each other in the street .
a black dog and a tri-colored dog playing with each other on the road .
a black dog and a spotted dog are fighting

young girl with pigtails painting outside in the grass .
there is a girl with pigtails sitting in front of a rainbow painting .
a small girl in the grass plays with fingerpaints in front of a white canvas with a rainbow on it .
a little girl is sitting in front of a large painted rainbow .
a little girl covered in paint sits in front of a painted rainbow with her hands in a bowl .

man laying on bench holding leash of dog sitting on ground
a shirtless man lies on a park bench with his dog .
a man sleeping on a bench outside with a white and black dog sitting next to him .
a man lays on the bench to which a white dog is also tied .
a man lays on a bench while his dog sits by him .

the man with pierced ears is wearing glasses and an orange hat .
a man with glasses is wearing a beer can crocheted hat .
a man with gauges and glasses is wearing a blitz hat .
a man wears an orange hat and glasses .
a man in an orange hat starring at something .

the small child climbs on a red ropes on a playground .
a small child grips onto the red ropes at the playground .
a little girl in pink climbs a rope bridge at the park .
a little girl climbing on red roping .
a child playing on a rope net .

a dog runs on the green grass near a wooden fence .
a boston terrier is running on lush green grass in front of a white fence .
a boston terrier is running in the grass .
a black and white dog is running through the grass .
a black and white dog is running in a grassy garden surrounded by a white fence .

white dog with brown ears standing near water with head turned to one side .
white dog playing with a red ball on the shore near the water .
dog with orange ball at feet , stands on shore shaking off water
a white dog shakes on the edge of a beach with an orange ball .
a dog shakes its head near the shore , a red ball next to it .

smiling boy in white shirt and blue jeans in front of rock wall with man in overalls behind him .
a young child is walking on a stone paved street with a metal pole and a man behind him .
a young boy runs aross the street .
a little boy is standing on the street while a man in overalls is working on a stone wall .
a boy smiles in front of a stony wall in a city .

the black dog jumped the tree stump .
a mottled black and grey dog in a blue collar jumping over a fallen tree .
a large black dog leaps a fallen log .
a grey dog is leaping over a fallen tree .
a black dog leaps over a log .

In [5]:
```python
def df_word(df_txt):
    vocabulary = []
    for i in range(len(df_txt)):
        temp=df_txt.iloc[i,2]
        vocabulary.extend(temp.split())
    print('Vocabulary Size: %d' % len(set(vocabulary)))
    ct = Counter(vocabulary)
    dfword = pd.DataFrame({"word":list(ct.keys()),"count":list(ct.values())})
    dfword = dfword.sort_values("count",ascending=False)
    dfword = dfword.reset_index()[["word","count"]]
    return(dfword)
dfword = df_word(df_txt)
dfword.head(3)
```

Vocabulary Size: 8918

Out[5]:

	word	count
0	a	62989
1	.	36581
2	in	18975

In [6]:
```python
topn = 50

def plthist(dfsub, title="The top 50 most frequently appearing words"):
    plt.figure(figsize=(20,3))
    plt.bar(dfsub.index,dfsub["count"])
    plt.yticks(fontsize=20)
    plt.xticks(dfsub.index,dfsub["word"],rotation=90,fontsize=20)
    plt.title(title,fontsize=20)
    plt.show()

plthist(dfword.iloc[:topn,:],
        title="The top 50 most frequently appearing words")
plthist(dfword.iloc[-topn:,:],
        title="The least 50 most frequently appearing words")
```
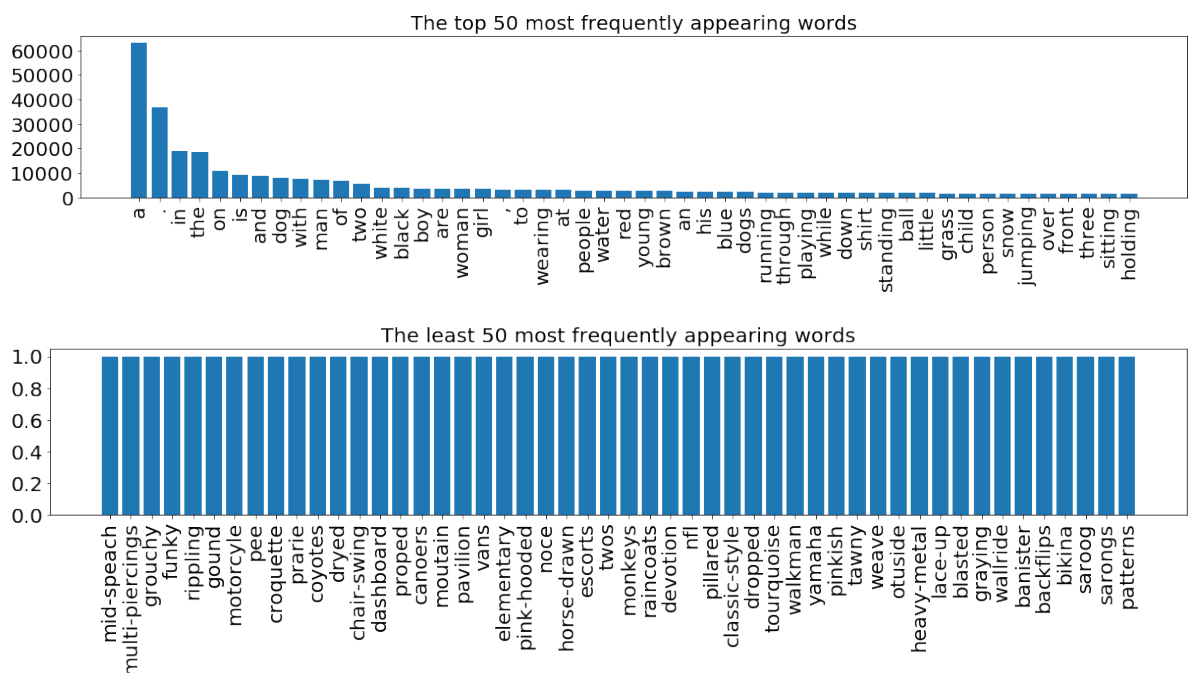

In [7]:
```python
from copy import copy
def add_start_end_seq_token(captions):
    caps = []
    for txt in captions:
        txt = 'startseq ' + txt + ' endseq'
        caps.append(txt)
    return(caps)
df_txt0 = copy(df_txt)
df_txt0["caption"] = add_start_end_seq_token(df_txt["caption"])
df_txt0.head(5)
del df_txt
```

In [9]:
```python
from keras.applications import DenseNet121

model = DenseNet121(include_top= True,weights="imagenet")
model.summary()
```

Model: "densenet121"

_____

_____
Layer (type)   Output Shape   Param #   C
onnected to
==
================================
input_2 (InputLayer)   (None, 224, 224, 3)   0

_____
zero_padding2d_3 (ZeroPadding2D (None, 230, 230, 3)   0   i
nput_2[0][0]

_____
conv1/conv (Conv2D)   (None, 112, 112, 64) 9408   z
ero_padding2d_3[0][0]

_____
conv1/bn (BatchNormalization)   (None, 112, 112, 64) 256   c
onv1/conv[0][0]

_____
conv1/relu (Activation)   (None, 112, 112, 64) 0   c
onv1/bn[0][0]

_____
zero_padding2d_4 (ZeroPadding2D (None, 114, 114, 64) 0   c
onv1/relu[0][0]

_____
pool1 (MaxPooling2D)   (None, 56, 56, 64)   0   z
ero_padding2d_4[0][0]

_____
conv2_block1_0_bn (BatchNormali (None, 56, 56, 64)   256   p
ool1[0][0]

_____
conv2_block1_0_relu (Activation (None, 56, 56, 64)   0   c
onv2_block1_0_bn[0][0]

_____
conv2_block1_1_conv (Conv2D)   (None, 56, 56, 128)   8192   c
onv2_block1_0_relu[0][0]

_____
conv2_block1_1_bn (BatchNormali (None, 56, 56, 128)   512   c
onv2_block1_1_conv[0][0]

_____

conv2_block1_1_relu (Activation (None, 56, 56, 128)   0   c
onv2_block1_1_bn[0][0]

_____

conv2_block1_2_conv (Conv2D)   (None, 56, 56, 32)   36864   c
onv2_block1_1_relu[0][0]

_____

conv2_block1_concat (Concatenat (None, 56, 56, 96)   0   p
ool1[0][0]
                                                                  c
onv2_block1_2_conv[0][0]

_____

conv2_block2_0_bn (BatchNormali (None, 56, 56, 96)   384   c
onv2_block1_concat[0][0]

_____

conv2_block2_0_relu (Activation (None, 56, 56, 96)   0   c
onv2_block2_0_bn[0][0]

_____

conv2_block2_1_conv (Conv2D)   (None, 56, 56, 128)   12288   c
onv2_block2_0_relu[0][0]

_____

conv2_block2_1_bn (BatchNormali (None, 56, 56, 128)   512   c
onv2_block2_1_conv[0][0]

_____

conv2_block2_1_relu (Activation (None, 56, 56, 128)   0   c
onv2_block2_1_bn[0][0]

_____

conv2_block2_2_conv (Conv2D)   (None, 56, 56, 32)   36864   c
onv2_block2_1_relu[0][0]

_____

conv2_block2_concat (Concatenat (None, 56, 56, 128)   0   c
onv2_block1_concat[0][0]
                                                                  c
onv2_block2_2_conv[0][0]

_____

conv2_block3_0_bn (BatchNormali (None, 56, 56, 128)   512   c
onv2_block2_concat[0][0]

_____

conv2_block3_0_relu (Activation (None, 56, 56, 128)   0   c
onv2_block3_0_bn[0][0]

_____

conv2_block3_1_conv (Conv2D)   (None, 56, 56, 128)   16384   c

onv2_block3_0_relu[0][0]

_____

conv2_block3_1_bn (BatchNormali (None, 56, 56, 128) 512   c
onv2_block3_1_conv[0][0]

_____

conv2_block3_1_relu (Activation (None, 56, 56, 128) 0   c
onv2_block3_1_bn[0][0]

_____

conv2_block3_2_conv (Conv2D)   (None, 56, 56, 32) 36864   c
onv2_block3_1_relu[0][0]

_____

conv2_block3_concat (Concatenat (None, 56, 56, 160) 0   c
onv2_block2_concat[0][0]
                                                                 c
onv2_block3_2_conv[0][0]

_____

conv2_block4_0_bn (BatchNormali (None, 56, 56, 160) 640   c
onv2_block3_concat[0][0]

_____

conv2_block4_0_relu (Activation (None, 56, 56, 160) 0   c
onv2_block4_0_bn[0][0]

_____

conv2_block4_1_conv (Conv2D)   (None, 56, 56, 128) 20480   c
onv2_block4_0_relu[0][0]

_____

conv2_block4_1_bn (BatchNormali (None, 56, 56, 128) 512   c
onv2_block4_1_conv[0][0]

_____

conv2_block4_1_relu (Activation (None, 56, 56, 128) 0   c
onv2_block4_1_bn[0][0]

_____

conv2_block4_2_conv (Conv2D)   (None, 56, 56, 32) 36864   c
onv2_block4_1_relu[0][0]

_____

conv2_block4_concat (Concatenat (None, 56, 56, 192) 0   c
onv2_block3_concat[0][0]
                                                                 c
onv2_block4_2_conv[0][0]

_____

conv2_block5_0_bn (BatchNormali (None, 56, 56, 192) 768   c
onv2_block4_concat[0][0]

conv2_block5_0_relu (Activation onv2_block5_0_bn[0][0]	(None, 56, 56, 192)	0	c
conv2_block5_1_conv (Conv2D) onv2_block5_0_relu[0][0]	(None, 56, 56, 128)	24576	c
conv2_block5_1_bn (BatchNormali onv2_block5_1_conv[0][0]	(None, 56, 56, 128)	512	c
conv2_block5_1_relu (Activation onv2_block5_1_bn[0][0]	(None, 56, 56, 128)	0	c
conv2_block5_2_conv (Conv2D) onv2_block5_1_relu[0][0]	(None, 56, 56, 32)	36864	c
conv2_block5_concat (Concatenat onv2_block4_concat[0][0]	(None, 56, 56, 224)	0	c
onv2_block5_2_conv[0][0]			c
conv2_block6_0_bn (BatchNormali onv2_block5_concat[0][0]	(None, 56, 56, 224)	896	c
conv2_block6_0_relu (Activation onv2_block6_0_bn[0][0]	(None, 56, 56, 224)	0	c
conv2_block6_1_conv (Conv2D) onv2_block6_0_relu[0][0]	(None, 56, 56, 128)	28672	c
conv2_block6_1_bn (BatchNormali onv2_block6_1_conv[0][0]	(None, 56, 56, 128)	512	c
conv2_block6_1_relu (Activation onv2_block6_1_bn[0][0]	(None, 56, 56, 128)	0	c
conv2_block6_2_conv (Conv2D) onv2_block6_1_relu[0][0]	(None, 56, 56, 32)	36864	c
conv2_block6_concat (Concatenat	(None, 56, 56, 256)	0	c

onv2_block5_concat[0][0]

c

onv2_block6_2_conv[0][0]

_____

pool2_bn (BatchNormalization)   (None, 56, 56, 256)   1024   c
onv2_block6_concat[0][0]

_____

pool2_relu (Activation)   (None, 56, 56, 256)   0   p
ool2_bn[0][0]

_____

pool2_conv (Conv2D)   (None, 56, 56, 128)   32768   p
ool2_relu[0][0]

_____

pool2_pool (AveragePooling2D)   (None, 28, 28, 128)   0   p
ool2_conv[0][0]

_____

conv3_block1_0_bn (BatchNormali (None, 28, 28, 128)   512   p
ool2_pool[0][0]

_____

conv3_block1_0_relu (Activation (None, 28, 28, 128)   0   c
onv3_block1_0_bn[0][0]

_____

conv3_block1_1_conv (Conv2D)   (None, 28, 28, 128)   16384   c
onv3_block1_0_relu[0][0]

_____

conv3_block1_1_bn (BatchNormali (None, 28, 28, 128)   512   c
onv3_block1_1_conv[0][0]

_____

conv3_block1_1_relu (Activation (None, 28, 28, 128)   0   c
onv3_block1_1_bn[0][0]

_____

conv3_block1_2_conv (Conv2D)   (None, 28, 28, 32)   36864   c
onv3_block1_1_relu[0][0]

_____

conv3_block1_concat (Concatenat (None, 28, 28, 160)   0   p
ool2_pool[0][0]
                                                                   c
onv3_block1_2_conv[0][0]

_____

conv3_block2_0_bn (BatchNormali (None, 28, 28, 160)   640   c
onv3_block1_concat[0][0]

conv3_block2_0_relu (Activation onv3_block2_0_bn[0][0]	(None, 28, 28, 160)	0	c
conv3_block2_1_conv (Conv2D) onv3_block2_0_relu[0][0]	(None, 28, 28, 128)	20480	c
conv3_block2_1_bn (BatchNormali onv3_block2_1_conv[0][0]	(None, 28, 28, 128)	512	c
conv3_block2_1_relu (Activation onv3_block2_1_bn[0][0]	(None, 28, 28, 128)	0	c
conv3_block2_2_conv (Conv2D) onv3_block2_1_relu[0][0]	(None, 28, 28, 32)	36864	c
conv3_block2_concat (Concatenat onv3_block1_concat[0][0]	(None, 28, 28, 192)	0	c
onv3_block2_2_conv[0][0]			c
conv3_block3_0_bn (BatchNormali onv3_block2_concat[0][0]	(None, 28, 28, 192)	768	c
conv3_block3_0_relu (Activation onv3_block3_0_bn[0][0]	(None, 28, 28, 192)	0	c
conv3_block3_1_conv (Conv2D) onv3_block3_0_relu[0][0]	(None, 28, 28, 128)	24576	c
conv3_block3_1_bn (BatchNormali onv3_block3_1_conv[0][0]	(None, 28, 28, 128)	512	c
conv3_block3_1_relu (Activation onv3_block3_1_bn[0][0]	(None, 28, 28, 128)	0	c
conv3_block3_2_conv (Conv2D) onv3_block3_1_relu[0][0]	(None, 28, 28, 32)	36864	c
conv3_block3_concat (Concatenat	(None, 28, 28, 224)	0	c

onv3_block2_concat[0][0]

c

onv3_block3_2_conv[0][0]

___

conv3_block4_0_bn (BatchNormali (None, 28, 28, 224)   896   c
onv3_block3_concat[0][0]

___

conv3_block4_0_relu (Activation (None, 28, 28, 224)   0   c
onv3_block4_0_bn[0][0]

___

conv3_block4_1_conv (Conv2D)   (None, 28, 28, 128)   28672   c
onv3_block4_0_relu[0][0]

___

conv3_block4_1_bn (BatchNormali (None, 28, 28, 128)   512   c
onv3_block4_1_conv[0][0]

___

conv3_block4_1_relu (Activation (None, 28, 28, 128)   0   c
onv3_block4_1_bn[0][0]

___

conv3_block4_2_conv (Conv2D)   (None, 28, 28, 32)   36864   c
onv3_block4_1_relu[0][0]

___

conv3_block4_concat (Concatenat (None, 28, 28, 256)   0   c
onv3_block3_concat[0][0]

c

onv3_block4_2_conv[0][0]

___

conv3_block5_0_bn (BatchNormali (None, 28, 28, 256)   1024   c
onv3_block4_concat[0][0]

___

conv3_block5_0_relu (Activation (None, 28, 28, 256)   0   c
onv3_block5_0_bn[0][0]

___

conv3_block5_1_conv (Conv2D)   (None, 28, 28, 128)   32768   c
onv3_block5_0_relu[0][0]

___

conv3_block5_1_bn (BatchNormali (None, 28, 28, 128)   512   c
onv3_block5_1_conv[0][0]

___

conv3_block5_1_relu (Activation (None, 28, 28, 128)   0   c
onv3_block5_1_bn[0][0]

conv3_block5_2_conv (Conv2D) onv3_block5_1_relu[0][0]	(None, 28, 28, 32)	36864	c
conv3_block5_concat (Concatenat onv3_block4_concat[0][0]	(None, 28, 28, 288)	0	c
onv3_block5_2_conv[0][0]			c
conv3_block6_0_bn (BatchNormali onv3_block5_concat[0][0]	(None, 28, 28, 288)	1152	c
conv3_block6_0_relu (Activation onv3_block6_0_bn[0][0]	(None, 28, 28, 288)	0	c
conv3_block6_1_conv (Conv2D) onv3_block6_0_relu[0][0]	(None, 28, 28, 128)	36864	c
conv3_block6_1_bn (BatchNormali onv3_block6_1_conv[0][0]	(None, 28, 28, 128)	512	c
conv3_block6_1_relu (Activation onv3_block6_1_bn[0][0]	(None, 28, 28, 128)	0	c
conv3_block6_2_conv (Conv2D) onv3_block6_1_relu[0][0]	(None, 28, 28, 32)	36864	c
conv3_block6_concat (Concatenat onv3_block5_concat[0][0]	(None, 28, 28, 320)	0	c
onv3_block6_2_conv[0][0]			c
conv3_block7_0_bn (BatchNormali onv3_block6_concat[0][0]	(None, 28, 28, 320)	1280	c
conv3_block7_0_relu (Activation onv3_block7_0_bn[0][0]	(None, 28, 28, 320)	0	c
conv3_block7_1_conv (Conv2D) onv3_block7_0_relu[0][0]	(None, 28, 28, 128)	40960	c

conv3_block7_1_bn (BatchNormali onv3_block7_1_conv[0][0]	(None, 28, 28, 128)	512	c
conv3_block7_1_relu (Activation onv3_block7_1_bn[0][0]	(None, 28, 28, 128)	0	c
conv3_block7_2_conv (Conv2D) onv3_block7_1_relu[0][0]	(None, 28, 28, 32)	36864	c
conv3_block7_concat (Concatenat onv3_block6_concat[0][0] onv3_block7_2_conv[0][0]	(None, 28, 28, 352)	0	c c
conv3_block8_0_bn (BatchNormali onv3_block7_concat[0][0]	(None, 28, 28, 352)	1408	c
conv3_block8_0_relu (Activation onv3_block8_0_bn[0][0]	(None, 28, 28, 352)	0	c
conv3_block8_1_conv (Conv2D) onv3_block8_0_relu[0][0]	(None, 28, 28, 128)	45056	c
conv3_block8_1_bn (BatchNormali onv3_block8_1_conv[0][0]	(None, 28, 28, 128)	512	c
conv3_block8_1_relu (Activation onv3_block8_1_bn[0][0]	(None, 28, 28, 128)	0	c
conv3_block8_2_conv (Conv2D) onv3_block8_1_relu[0][0]	(None, 28, 28, 32)	36864	c
conv3_block8_concat (Concatenat onv3_block7_concat[0][0] onv3_block8_2_conv[0][0]	(None, 28, 28, 384)	0	c c
conv3_block9_0_bn (BatchNormali onv3_block8_concat[0][0]	(None, 28, 28, 384)	1536	c

```
conv3_block9_0_relu (Activation (None, 28, 28, 384)  0          c
onv3_block9_0_bn[0][0]


conv3_block9_1_conv (Conv2D)    (None, 28, 28, 128)  49152      c
onv3_block9_0_relu[0][0]


conv3_block9_1_bn (BatchNormali (None, 28, 28, 128)  512        c
onv3_block9_1_conv[0][0]


conv3_block9_1_relu (Activation (None, 28, 28, 128)  0          c
onv3_block9_1_bn[0][0]


conv3_block9_2_conv (Conv2D)    (None, 28, 28, 32)   36864      c
onv3_block9_1_relu[0][0]


conv3_block9_concat (Concatenat (None, 28, 28, 416)  0          c
onv3_block8_concat[0][0]
                                                                c
onv3_block9_2_conv[0][0]


conv3_block10_0_bn (BatchNormal (None, 28, 28, 416)  1664       c
onv3_block9_concat[0][0]


conv3_block10_0_relu (Activatio (None, 28, 28, 416)  0          c
onv3_block10_0_bn[0][0]


conv3_block10_1_conv (Conv2D)   (None, 28, 28, 128)  53248      c
onv3_block10_0_relu[0][0]


conv3_block10_1_bn (BatchNormal (None, 28, 28, 128)  512        c
onv3_block10_1_conv[0][0]


conv3_block10_1_relu (Activatio (None, 28, 28, 128)  0          c
onv3_block10_1_bn[0][0]


conv3_block10_2_conv (Conv2D)   (None, 28, 28, 32)   36864      c
onv3_block10_1_relu[0][0]


conv3_block10_concat (Concatena (None, 28, 28, 448)  0          c
onv3_block9_concat[0][0]
                                                                c
```

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                                                  onv3_block10_2_conv[0][0]
_____

_____
conv3_block11_0_bn (BatchNormal (None, 28, 28, 448)  1792          c
onv3_block10_concat[0][0]
_____
conv3_block11_0_relu (Activatio (None, 28, 28, 448)  0             c
onv3_block11_0_bn[0][0]
_____
conv3_block11_1_conv (Conv2D)   (None, 28, 28, 128)  57344         c
onv3_block11_0_relu[0][0]
_____
conv3_block11_1_bn (BatchNormal (None, 28, 28, 128)  512           c
onv3_block11_1_conv[0][0]
_____
conv3_block11_1_relu (Activatio (None, 28, 28, 128)  0             c
onv3_block11_1_bn[0][0]
_____
conv3_block11_2_conv (Conv2D)   (None, 28, 28, 32)   36864         c
onv3_block11_1_relu[0][0]
_____
conv3_block11_concat (Concatena (None, 28, 28, 480)  0             c
onv3_block10_concat[0][0]
                                                                                 c
onv3_block11_2_conv[0][0]
_____
conv3_block12_0_bn (BatchNormal (None, 28, 28, 480)  1920          c
onv3_block11_concat[0][0]
_____
conv3_block12_0_relu (Activatio (None, 28, 28, 480)  0             c
onv3_block12_0_bn[0][0]
_____
conv3_block12_1_conv (Conv2D)   (None, 28, 28, 128)  61440         c
onv3_block12_0_relu[0][0]
_____
conv3_block12_1_bn (BatchNormal (None, 28, 28, 128)  512           c
onv3_block12_1_conv[0][0]
_____
conv3_block12_1_relu (Activatio (None, 28, 28, 128)  0             c
onv3_block12_1_bn[0][0]
_____

_____
```

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conv3_block12_2_conv (Conv2D)    (None, 28, 28, 32)    36864        c
onv3_block12_1_relu[0][0]
_____

conv3_block12_concat (Concatena  (None, 28, 28, 512)   0            c
onv3_block11_concat[0][0]
                                                                    c
onv3_block12_2_conv[0][0]
_____

pool3_bn (BatchNormalization)    (None, 28, 28, 512)   2048         c
onv3_block12_concat[0][0]
_____

pool3_relu (Activation)          (None, 28, 28, 512)   0            p
ool3_bn[0][0]
_____

pool3_conv (Conv2D)              (None, 28, 28, 256)   131072       p
ool3_relu[0][0]
_____

pool3_pool (AveragePooling2D)    (None, 14, 14, 256)   0            p
ool3_conv[0][0]
_____

conv4_block1_0_bn (BatchNormali  (None, 14, 14, 256)   1024         p
ool3_pool[0][0]
_____

conv4_block1_0_relu (Activation  (None, 14, 14, 256)   0            c
onv4_block1_0_bn[0][0]
_____

conv4_block1_1_conv (Conv2D)     (None, 14, 14, 128)   32768        c
onv4_block1_0_relu[0][0]
_____

conv4_block1_1_bn (BatchNormali  (None, 14, 14, 128)   512          c
onv4_block1_1_conv[0][0]
_____

conv4_block1_1_relu (Activation  (None, 14, 14, 128)   0            c
onv4_block1_1_bn[0][0]
_____

conv4_block1_2_conv (Conv2D)     (None, 14, 14, 32)    36864        c
onv4_block1_1_relu[0][0]
_____

conv4_block1_concat (Concatenat  (None, 14, 14, 288)   0            p
ool3_pool[0][0]
                                                                    c
```

onv4_block1_2_conv[0][0]

_____

_____
conv4_block2_0_bn (BatchNormali (None, 14, 14, 288) 1152   c
onv4_block1_concat[0][0]

_____
conv4_block2_0_relu (Activation (None, 14, 14, 288) 0   c
onv4_block2_0_bn[0][0]

_____
conv4_block2_1_conv (Conv2D)   (None, 14, 14, 128) 36864   c
onv4_block2_0_relu[0][0]

_____
conv4_block2_1_bn (BatchNormali (None, 14, 14, 128) 512   c
onv4_block2_1_conv[0][0]

_____
conv4_block2_1_relu (Activation (None, 14, 14, 128) 0   c
onv4_block2_1_bn[0][0]

_____
conv4_block2_2_conv (Conv2D)   (None, 14, 14, 32)   36864   c
onv4_block2_1_relu[0][0]

_____
conv4_block2_concat (Concatenat (None, 14, 14, 320) 0   c
onv4_block1_concat[0][0]
                                                                  c
onv4_block2_2_conv[0][0]

_____
conv4_block3_0_bn (BatchNormali (None, 14, 14, 320) 1280   c
onv4_block2_concat[0][0]

_____
conv4_block3_0_relu (Activation (None, 14, 14, 320) 0   c
onv4_block3_0_bn[0][0]

_____
conv4_block3_1_conv (Conv2D)   (None, 14, 14, 128) 40960   c
onv4_block3_0_relu[0][0]

_____
conv4_block3_1_bn (BatchNormali (None, 14, 14, 128) 512   c
onv4_block3_1_conv[0][0]

_____
conv4_block3_1_relu (Activation (None, 14, 14, 128) 0   c
onv4_block3_1_bn[0][0]

_____

_____

conv4_block3_2_conv (Conv2D)   (None, 14, 14, 32)   36864   c
onv4_block3_1_relu[0][0]

conv4_block3_concat (Concatenat (None, 14, 14, 352)   0   c
onv4_block2_concat[0][0]
                                                                       c
onv4_block3_2_conv[0][0]

conv4_block4_0_bn (BatchNormali (None, 14, 14, 352)   1408   c
onv4_block3_concat[0][0]

conv4_block4_0_relu (Activation (None, 14, 14, 352)   0   c
onv4_block4_0_bn[0][0]

conv4_block4_1_conv (Conv2D)   (None, 14, 14, 128)   45056   c
onv4_block4_0_relu[0][0]

conv4_block4_1_bn (BatchNormali (None, 14, 14, 128)   512   c
onv4_block4_1_conv[0][0]

conv4_block4_1_relu (Activation (None, 14, 14, 128)   0   c
onv4_block4_1_bn[0][0]

conv4_block4_2_conv (Conv2D)   (None, 14, 14, 32)   36864   c
onv4_block4_1_relu[0][0]

conv4_block4_concat (Concatenat (None, 14, 14, 384)   0   c
onv4_block3_concat[0][0]
                                                                       c
onv4_block4_2_conv[0][0]

conv4_block5_0_bn (BatchNormali (None, 14, 14, 384)   1536   c
onv4_block4_concat[0][0]

conv4_block5_0_relu (Activation (None, 14, 14, 384)   0   c
onv4_block5_0_bn[0][0]

conv4_block5_1_conv (Conv2D)   (None, 14, 14, 128)   49152   c
onv4_block5_0_relu[0][0]

conv4_block5_1_bn (BatchNormali (None, 14, 14, 128)   512   c

onv4_block5_1_conv[0][0]

conv4_block5_1_relu (Activation (None, 14, 14, 128)   0   c
onv4_block5_1_bn[0][0]

conv4_block5_2_conv (Conv2D)   (None, 14, 14, 32)   36864   c
onv4_block5_1_relu[0][0]

conv4_block5_concat (Concatenat (None, 14, 14, 416)   0   c
onv4_block4_concat[0][0]
                                                                       c
onv4_block5_2_conv[0][0]

conv4_block6_0_bn (BatchNormali (None, 14, 14, 416)   1664   c
onv4_block5_concat[0][0]

conv4_block6_0_relu (Activation (None, 14, 14, 416)   0   c
onv4_block6_0_bn[0][0]

conv4_block6_1_conv (Conv2D)   (None, 14, 14, 128)   53248   c
onv4_block6_0_relu[0][0]

conv4_block6_1_bn (BatchNormali (None, 14, 14, 128)   512   c
onv4_block6_1_conv[0][0]

conv4_block6_1_relu (Activation (None, 14, 14, 128)   0   c
onv4_block6_1_bn[0][0]

conv4_block6_2_conv (Conv2D)   (None, 14, 14, 32)   36864   c
onv4_block6_1_relu[0][0]

conv4_block6_concat (Concatenat (None, 14, 14, 448)   0   c
onv4_block5_concat[0][0]
                                                                       c
onv4_block6_2_conv[0][0]

conv4_block7_0_bn (BatchNormali (None, 14, 14, 448)   1792   c
onv4_block6_concat[0][0]

conv4_block7_0_relu (Activation (None, 14, 14, 448)   0   c
onv4_block7_0_bn[0][0]

conv4_block7_1_conv (Conv2D)	(None, 14, 14, 128)	57344	c
onv4_block7_0_relu[0][0]			
conv4_block7_1_bn (BatchNormali	(None, 14, 14, 128)	512	c
onv4_block7_1_conv[0][0]			
conv4_block7_1_relu (Activation	(None, 14, 14, 128)	0	c
onv4_block7_1_bn[0][0]			
conv4_block7_2_conv (Conv2D)	(None, 14, 14, 32)	36864	c
onv4_block7_1_relu[0][0]			
conv4_block7_concat (Concatenat	(None, 14, 14, 480)	0	c
onv4_block6_concat[0][0]			
			c
onv4_block7_2_conv[0][0]			
conv4_block8_0_bn (BatchNormali	(None, 14, 14, 480)	1920	c
onv4_block7_concat[0][0]			
conv4_block8_0_relu (Activation	(None, 14, 14, 480)	0	c
onv4_block8_0_bn[0][0]			
conv4_block8_1_conv (Conv2D)	(None, 14, 14, 128)	61440	c
onv4_block8_0_relu[0][0]			
conv4_block8_1_bn (BatchNormali	(None, 14, 14, 128)	512	c
onv4_block8_1_conv[0][0]			
conv4_block8_1_relu (Activation	(None, 14, 14, 128)	0	c
onv4_block8_1_bn[0][0]			
conv4_block8_2_conv (Conv2D)	(None, 14, 14, 32)	36864	c
onv4_block8_1_relu[0][0]			
conv4_block8_concat (Concatenat	(None, 14, 14, 512)	0	c
onv4_block7_concat[0][0]			
			c
onv4_block8_2_conv[0][0]			

conv4_block9_0_bn (BatchNormali onv4_block8_concat[0][0]	(None, 14, 14, 512)	2048	c
conv4_block9_0_relu (Activation onv4_block9_0_bn[0][0]	(None, 14, 14, 512)	0	c
conv4_block9_1_conv (Conv2D) onv4_block9_0_relu[0][0]	(None, 14, 14, 128)	65536	c
conv4_block9_1_bn (BatchNormali onv4_block9_1_conv[0][0]	(None, 14, 14, 128)	512	c
conv4_block9_1_relu (Activation onv4_block9_1_bn[0][0]	(None, 14, 14, 128)	0	c
conv4_block9_2_conv (Conv2D) onv4_block9_1_relu[0][0]	(None, 14, 14, 32)	36864	c
conv4_block9_concat (Concatenat onv4_block8_concat[0][0] onv4_block9_2_conv[0][0]	(None, 14, 14, 544)	0	c c
conv4_block10_0_bn (BatchNormal onv4_block9_concat[0][0]	(None, 14, 14, 544)	2176	c
conv4_block10_0_relu (Activatio onv4_block10_0_bn[0][0]	(None, 14, 14, 544)	0	c
conv4_block10_1_conv (Conv2D) onv4_block10_0_relu[0][0]	(None, 14, 14, 128)	69632	c
conv4_block10_1_bn (BatchNormal onv4_block10_1_conv[0][0]	(None, 14, 14, 128)	512	c
conv4_block10_1_relu (Activatio onv4_block10_1_bn[0][0]	(None, 14, 14, 128)	0	c
conv4_block10_2_conv (Conv2D) onv4_block10_1_relu[0][0]	(None, 14, 14, 32)	36864	c

conv4_block10_concat (Concatena (None, 14, 14, 576)   0   c
onv4_block9_concat[0][0]
                                                                  c

onv4_block10_2_conv[0][0]

conv4_block11_0_bn (BatchNormal (None, 14, 14, 576)   2304   c
onv4_block10_concat[0][0]

conv4_block11_0_relu (Activatio (None, 14, 14, 576)   0   c
onv4_block11_0_bn[0][0]

conv4_block11_1_conv (Conv2D)   (None, 14, 14, 128)   73728   c
onv4_block11_0_relu[0][0]

conv4_block11_1_bn (BatchNormal (None, 14, 14, 128)   512   c
onv4_block11_1_conv[0][0]

conv4_block11_1_relu (Activatio (None, 14, 14, 128)   0   c
onv4_block11_1_bn[0][0]

conv4_block11_2_conv (Conv2D)   (None, 14, 14, 32)   36864   c
onv4_block11_1_relu[0][0]

conv4_block11_concat (Concatena (None, 14, 14, 608)   0   c
onv4_block10_concat[0][0]
                                                                  c

onv4_block11_2_conv[0][0]

conv4_block12_0_bn (BatchNormal (None, 14, 14, 608)   2432   c
onv4_block11_concat[0][0]

conv4_block12_0_relu (Activatio (None, 14, 14, 608)   0   c
onv4_block12_0_bn[0][0]

conv4_block12_1_conv (Conv2D)   (None, 14, 14, 128)   77824   c
onv4_block12_0_relu[0][0]

conv4_block12_1_bn (BatchNormal (None, 14, 14, 128)   512   c
onv4_block12_1_conv[0][0]

conv4_block12_1_relu (Activatio onv4_block12_1_bn[0][0]	(None, 14, 14, 128)	0	c
conv4_block12_2_conv (Conv2D) onv4_block12_1_relu[0][0]	(None, 14, 14, 32)	36864	c
conv4_block12_concat (Concatena onv4_block11_concat[0][0] onv4_block12_2_conv[0][0]	(None, 14, 14, 640)	0	c c
conv4_block13_0_bn (BatchNormal onv4_block12_concat[0][0]	(None, 14, 14, 640)	2560	c
conv4_block13_0_relu (Activatio onv4_block13_0_bn[0][0]	(None, 14, 14, 640)	0	c
conv4_block13_1_conv (Conv2D) onv4_block13_0_relu[0][0]	(None, 14, 14, 128)	81920	c
conv4_block13_1_bn (BatchNormal onv4_block13_1_conv[0][0]	(None, 14, 14, 128)	512	c
conv4_block13_1_relu (Activatio onv4_block13_1_bn[0][0]	(None, 14, 14, 128)	0	c
conv4_block13_2_conv (Conv2D) onv4_block13_1_relu[0][0]	(None, 14, 14, 32)	36864	c
conv4_block13_concat (Concatena onv4_block12_concat[0][0] onv4_block13_2_conv[0][0]	(None, 14, 14, 672)	0	c c
conv4_block14_0_bn (BatchNormal onv4_block13_concat[0][0]	(None, 14, 14, 672)	2688	c
conv4_block14_0_relu (Activatio onv4_block14_0_bn[0][0]	(None, 14, 14, 672)	0	c

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conv4_block14_1_conv (Conv2D)    (None, 14, 14, 128)   86016       c
onv4_block14_0_relu[0][0]
_____

conv4_block14_1_bn (BatchNormal  (None, 14, 14, 128)   512         c
onv4_block14_1_conv[0][0]
_____

conv4_block14_1_relu (Activatio  (None, 14, 14, 128)   0           c
onv4_block14_1_bn[0][0]
_____

conv4_block14_2_conv (Conv2D)    (None, 14, 14, 32)    36864       c
onv4_block14_1_relu[0][0]
_____

conv4_block14_concat (Concatena  (None, 14, 14, 704)   0           c
onv4_block13_concat[0][0]
                                                                   c
onv4_block14_2_conv[0][0]
_____

conv4_block15_0_bn (BatchNormal  (None, 14, 14, 704)   2816        c
onv4_block14_concat[0][0]
_____

conv4_block15_0_relu (Activatio  (None, 14, 14, 704)   0           c
onv4_block15_0_bn[0][0]
_____

conv4_block15_1_conv (Conv2D)    (None, 14, 14, 128)   90112       c
onv4_block15_0_relu[0][0]
_____

conv4_block15_1_bn (BatchNormal  (None, 14, 14, 128)   512         c
onv4_block15_1_conv[0][0]
_____

conv4_block15_1_relu (Activatio  (None, 14, 14, 128)   0           c
onv4_block15_1_bn[0][0]
_____

conv4_block15_2_conv (Conv2D)    (None, 14, 14, 32)    36864       c
onv4_block15_1_relu[0][0]
_____

conv4_block15_concat (Concatena  (None, 14, 14, 736)   0           c
onv4_block14_concat[0][0]
                                                                   c
onv4_block15_2_conv[0][0]
_____

conv4_block16_0_bn (BatchNormal  (None, 14, 14, 736)   2944        c
```

onv4_block15_concat[0][0]

conv4_block16_0_relu (Activatio (None, 14, 14, 736)   0   c
onv4_block16_0_bn[0][0]

conv4_block16_1_conv (Conv2D)   (None, 14, 14, 128)   94208   c
onv4_block16_0_relu[0][0]

conv4_block16_1_bn (BatchNormal (None, 14, 14, 128)   512   c
onv4_block16_1_conv[0][0]

conv4_block16_1_relu (Activatio (None, 14, 14, 128)   0   c
onv4_block16_1_bn[0][0]

conv4_block16_2_conv (Conv2D)   (None, 14, 14, 32)   36864   c
onv4_block16_1_relu[0][0]

conv4_block16_concat (Concatena (None, 14, 14, 768)   0   c
onv4_block15_concat[0][0]
                                                                      c
onv4_block16_2_conv[0][0]

conv4_block17_0_bn (BatchNormal (None, 14, 14, 768)   3072   c
onv4_block16_concat[0][0]

conv4_block17_0_relu (Activatio (None, 14, 14, 768)   0   c
onv4_block17_0_bn[0][0]

conv4_block17_1_conv (Conv2D)   (None, 14, 14, 128)   98304   c
onv4_block17_0_relu[0][0]

conv4_block17_1_bn (BatchNormal (None, 14, 14, 128)   512   c
onv4_block17_1_conv[0][0]

conv4_block17_1_relu (Activatio (None, 14, 14, 128)   0   c
onv4_block17_1_bn[0][0]

conv4_block17_2_conv (Conv2D)   (None, 14, 14, 32)   36864   c
onv4_block17_1_relu[0][0]

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conv4_block17_concat (Concatena (None, 14, 14, 800)   0           c
onv4_block16_concat[0][0]
                                                                  c
onv4_block17_2_conv[0][0]
_____

conv4_block18_0_bn (BatchNormal (None, 14, 14, 800)   3200        c
onv4_block17_concat[0][0]
_____

conv4_block18_0_relu (Activatio (None, 14, 14, 800)   0           c
onv4_block18_0_bn[0][0]
_____

conv4_block18_1_conv (Conv2D)   (None, 14, 14, 128)   102400      c
onv4_block18_0_relu[0][0]
_____

conv4_block18_1_bn (BatchNormal (None, 14, 14, 128)   512         c
onv4_block18_1_conv[0][0]
_____

conv4_block18_1_relu (Activatio (None, 14, 14, 128)   0           c
onv4_block18_1_bn[0][0]
_____

conv4_block18_2_conv (Conv2D)   (None, 14, 14, 32)    36864       c
onv4_block18_1_relu[0][0]
_____

conv4_block18_concat (Concatena (None, 14, 14, 832)   0           c
onv4_block17_concat[0][0]
                                                                  c
onv4_block18_2_conv[0][0]
_____

conv4_block19_0_bn (BatchNormal (None, 14, 14, 832)   3328        c
onv4_block18_concat[0][0]
_____

conv4_block19_0_relu (Activatio (None, 14, 14, 832)   0           c
onv4_block19_0_bn[0][0]
_____

conv4_block19_1_conv (Conv2D)   (None, 14, 14, 128)   106496      c
onv4_block19_0_relu[0][0]
_____

conv4_block19_1_bn (BatchNormal (None, 14, 14, 128)   512         c
onv4_block19_1_conv[0][0]
_____

conv4_block19_1_relu (Activatio (None, 14, 14, 128)   0           c
```

onv4_block19_1_bn[0][0]

conv4_block19_2_conv (Conv2D)   (None, 14, 14, 32)   36864   c
onv4_block19_1_relu[0][0]

conv4_block19_concat (Concatena (None, 14, 14, 864)   0   c
onv4_block18_concat[0][0]
                                                                    c
onv4_block19_2_conv[0][0]

conv4_block20_0_bn (BatchNormal (None, 14, 14, 864)   3456   c
onv4_block19_concat[0][0]

conv4_block20_0_relu (Activatio (None, 14, 14, 864)   0   c
onv4_block20_0_bn[0][0]

conv4_block20_1_conv (Conv2D)   (None, 14, 14, 128)   110592   c
onv4_block20_0_relu[0][0]

conv4_block20_1_bn (BatchNormal (None, 14, 14, 128)   512   c
onv4_block20_1_conv[0][0]

conv4_block20_1_relu (Activatio (None, 14, 14, 128)   0   c
onv4_block20_1_bn[0][0]

conv4_block20_2_conv (Conv2D)   (None, 14, 14, 32)   36864   c
onv4_block20_1_relu[0][0]

conv4_block20_concat (Concatena (None, 14, 14, 896)   0   c
onv4_block19_concat[0][0]
                                                                    c
onv4_block20_2_conv[0][0]

conv4_block21_0_bn (BatchNormal (None, 14, 14, 896)   3584   c
onv4_block20_concat[0][0]

conv4_block21_0_relu (Activatio (None, 14, 14, 896)   0   c
onv4_block21_0_bn[0][0]

conv4_block21_1_conv (Conv2D)   (None, 14, 14, 128)   114688   c
onv4_block21_0_relu[0][0]

conv4_block21_1_bn (BatchNormal (None, 14, 14, 128)   512   c
onv4_block21_1_conv[0][0]

conv4_block21_1_relu (Activatio (None, 14, 14, 128)   0   c
onv4_block21_1_bn[0][0]

conv4_block21_2_conv (Conv2D)   (None, 14, 14, 32)   36864   c
onv4_block21_1_relu[0][0]

conv4_block21_concat (Concatena (None, 14, 14, 928)   0   c
onv4_block20_concat[0][0]
                                                                     c
onv4_block21_2_conv[0][0]

conv4_block22_0_bn (BatchNormal (None, 14, 14, 928)   3712   c
onv4_block21_concat[0][0]

conv4_block22_0_relu (Activatio (None, 14, 14, 928)   0   c
onv4_block22_0_bn[0][0]

conv4_block22_1_conv (Conv2D)   (None, 14, 14, 128)   118784   c
onv4_block22_0_relu[0][0]

conv4_block22_1_bn (BatchNormal (None, 14, 14, 128)   512   c
onv4_block22_1_conv[0][0]

conv4_block22_1_relu (Activatio (None, 14, 14, 128)   0   c
onv4_block22_1_bn[0][0]

conv4_block22_2_conv (Conv2D)   (None, 14, 14, 32)   36864   c
onv4_block22_1_relu[0][0]

conv4_block22_concat (Concatena (None, 14, 14, 960)   0   c
onv4_block21_concat[0][0]
                                                                     c
onv4_block22_2_conv[0][0]

conv4_block23_0_bn (BatchNormal (None, 14, 14, 960)   3840   c
onv4_block22_concat[0][0]

```
conv4_block23_0_relu (Activatio   (None, 14, 14, 960)   0              c
onv4_block23_0_bn[0][0]
```

```
conv4_block23_1_conv (Conv2D)     (None, 14, 14, 128)   122880         c
onv4_block23_0_relu[0][0]
```

```
conv4_block23_1_bn (BatchNormal   (None, 14, 14, 128)   512            c
onv4_block23_1_conv[0][0]
```

```
conv4_block23_1_relu (Activatio   (None, 14, 14, 128)   0              c
onv4_block23_1_bn[0][0]
```

```
conv4_block23_2_conv (Conv2D)     (None, 14, 14, 32)    36864          c
onv4_block23_1_relu[0][0]
```

```
conv4_block23_concat (Concatena   (None, 14, 14, 992)   0              c
onv4_block22_concat[0][0]
                                                                       c
onv4_block23_2_conv[0][0]
```

```
conv4_block24_0_bn (BatchNormal   (None, 14, 14, 992)   3968           c
onv4_block23_concat[0][0]
```

```
conv4_block24_0_relu (Activatio   (None, 14, 14, 992)   0              c
onv4_block24_0_bn[0][0]
```

```
conv4_block24_1_conv (Conv2D)     (None, 14, 14, 128)   126976         c
onv4_block24_0_relu[0][0]
```

```
conv4_block24_1_bn (BatchNormal   (None, 14, 14, 128)   512            c
onv4_block24_1_conv[0][0]
```

```
conv4_block24_1_relu (Activatio   (None, 14, 14, 128)   0              c
onv4_block24_1_bn[0][0]
```

```
conv4_block24_2_conv (Conv2D)     (None, 14, 14, 32)    36864          c
onv4_block24_1_relu[0][0]
```

```
conv4_block24_concat (Concatena   (None, 14, 14, 1024)  0              c
onv4_block23_concat[0][0]
```

			c
onv4_block24_2_conv[0][0]			
pool4_bn (BatchNormalization)	(None, 14, 14, 1024)	4096	c
onv4_block24_concat[0][0]			
pool4_relu (Activation)	(None, 14, 14, 1024)	0	p
ool4_bn[0][0]			
pool4_conv (Conv2D)	(None, 14, 14, 512)	524288	p
ool4_relu[0][0]			
pool4_pool (AveragePooling2D)	(None, 7, 7, 512)	0	p
ool4_conv[0][0]			
conv5_block1_0_bn (BatchNormali	(None, 7, 7, 512)	2048	p
ool4_pool[0][0]			
conv5_block1_0_relu (Activation	(None, 7, 7, 512)	0	c
onv5_block1_0_bn[0][0]			
conv5_block1_1_conv (Conv2D)	(None, 7, 7, 128)	65536	c
onv5_block1_0_relu[0][0]			
conv5_block1_1_bn (BatchNormali	(None, 7, 7, 128)	512	c
onv5_block1_1_conv[0][0]			
conv5_block1_1_relu (Activation	(None, 7, 7, 128)	0	c
onv5_block1_1_bn[0][0]			
conv5_block1_2_conv (Conv2D)	(None, 7, 7, 32)	36864	c
onv5_block1_1_relu[0][0]			
conv5_block1_concat (Concatenat	(None, 7, 7, 544)	0	p
ool4_pool[0][0]			
			c
onv5_block1_2_conv[0][0]			
conv5_block2_0_bn (BatchNormali	(None, 7, 7, 544)	2176	c
onv5_block1_concat[0][0]			

conv5_block2_0_relu (Activation onv5_block2_0_bn[0][0]	(None, 7, 7, 544)	0	c
conv5_block2_1_conv (Conv2D) onv5_block2_0_relu[0][0]	(None, 7, 7, 128)	69632	c
conv5_block2_1_bn (BatchNormali onv5_block2_1_conv[0][0]	(None, 7, 7, 128)	512	c
conv5_block2_1_relu (Activation onv5_block2_1_bn[0][0]	(None, 7, 7, 128)	0	c
conv5_block2_2_conv (Conv2D) onv5_block2_1_relu[0][0]	(None, 7, 7, 32)	36864	c
conv5_block2_concat (Concatenat onv5_block1_concat[0][0]	(None, 7, 7, 576)	0	c
onv5_block2_2_conv[0][0]			c
conv5_block3_0_bn (BatchNormali onv5_block2_concat[0][0]	(None, 7, 7, 576)	2304	c
conv5_block3_0_relu (Activation onv5_block3_0_bn[0][0]	(None, 7, 7, 576)	0	c
conv5_block3_1_conv (Conv2D) onv5_block3_0_relu[0][0]	(None, 7, 7, 128)	73728	c
conv5_block3_1_bn (BatchNormali onv5_block3_1_conv[0][0]	(None, 7, 7, 128)	512	c
conv5_block3_1_relu (Activation onv5_block3_1_bn[0][0]	(None, 7, 7, 128)	0	c
conv5_block3_2_conv (Conv2D) onv5_block3_1_relu[0][0]	(None, 7, 7, 32)	36864	c
conv5_block3_concat (Concatenat onv5_block2_concat[0][0]	(None, 7, 7, 608)	0	c

c
onv5_block3_2_conv[0][0]

___

conv5_block4_0_bn (BatchNormali   (None, 7, 7, 608)   2432   c
onv5_block3_concat[0][0]

___

conv5_block4_0_relu (Activation   (None, 7, 7, 608)   0   c
onv5_block4_0_bn[0][0]

___

conv5_block4_1_conv (Conv2D)   (None, 7, 7, 128)   77824   c
onv5_block4_0_relu[0][0]

___

conv5_block4_1_bn (BatchNormali   (None, 7, 7, 128)   512   c
onv5_block4_1_conv[0][0]

___

conv5_block4_1_relu (Activation   (None, 7, 7, 128)   0   c
onv5_block4_1_bn[0][0]

___

conv5_block4_2_conv (Conv2D)   (None, 7, 7, 32)   36864   c
onv5_block4_1_relu[0][0]

___

conv5_block4_concat (Concatenat   (None, 7, 7, 640)   0   c
onv5_block3_concat[0][0]
                                                                     c
onv5_block4_2_conv[0][0]

___

conv5_block5_0_bn (BatchNormali   (None, 7, 7, 640)   2560   c
onv5_block4_concat[0][0]

___

conv5_block5_0_relu (Activation   (None, 7, 7, 640)   0   c
onv5_block5_0_bn[0][0]

___

conv5_block5_1_conv (Conv2D)   (None, 7, 7, 128)   81920   c
onv5_block5_0_relu[0][0]

___

conv5_block5_1_bn (BatchNormali   (None, 7, 7, 128)   512   c
onv5_block5_1_conv[0][0]

___

conv5_block5_1_relu (Activation   (None, 7, 7, 128)   0   c
onv5_block5_1_bn[0][0]

___

conv5_block5_2_conv (Conv2D) onv5_block5_1_relu[0][0]	(None, 7, 7, 32)	36864	c
conv5_block5_concat (Concatenat onv5_block4_concat[0][0] onv5_block5_2_conv[0][0]	(None, 7, 7, 672)	0	c c
conv5_block6_0_bn (BatchNormali onv5_block5_concat[0][0]	(None, 7, 7, 672)	2688	c
conv5_block6_0_relu (Activation onv5_block6_0_bn[0][0]	(None, 7, 7, 672)	0	c
conv5_block6_1_conv (Conv2D) onv5_block6_0_relu[0][0]	(None, 7, 7, 128)	86016	c
conv5_block6_1_bn (BatchNormali onv5_block6_1_conv[0][0]	(None, 7, 7, 128)	512	c
conv5_block6_1_relu (Activation onv5_block6_1_bn[0][0]	(None, 7, 7, 128)	0	c
conv5_block6_2_conv (Conv2D) onv5_block6_1_relu[0][0]	(None, 7, 7, 32)	36864	c
conv5_block6_concat (Concatenat onv5_block5_concat[0][0] onv5_block6_2_conv[0][0]	(None, 7, 7, 704)	0	c c
conv5_block7_0_bn (BatchNormali onv5_block6_concat[0][0]	(None, 7, 7, 704)	2816	c
conv5_block7_0_relu (Activation onv5_block7_0_bn[0][0]	(None, 7, 7, 704)	0	c
conv5_block7_1_conv (Conv2D) onv5_block7_0_relu[0][0]	(None, 7, 7, 128)	90112	c

```
conv5_block7_1_bn (BatchNormali  (None, 7, 7, 128)    512        c
onv5_block7_1_conv[0][0]
_____

conv5_block7_1_relu (Activation  (None, 7, 7, 128)    0          c
onv5_block7_1_bn[0][0]
_____

conv5_block7_2_conv (Conv2D)     (None, 7, 7, 32)     36864      c
onv5_block7_1_relu[0][0]
_____

conv5_block7_concat (Concatenat  (None, 7, 7, 736)    0          c
onv5_block6_concat[0][0]
                                                                 c
onv5_block7_2_conv[0][0]
_____

conv5_block8_0_bn (BatchNormali  (None, 7, 7, 736)    2944       c
onv5_block7_concat[0][0]
_____

conv5_block8_0_relu (Activation  (None, 7, 7, 736)    0          c
onv5_block8_0_bn[0][0]
_____

conv5_block8_1_conv (Conv2D)     (None, 7, 7, 128)    94208      c
onv5_block8_0_relu[0][0]
_____

conv5_block8_1_bn (BatchNormali  (None, 7, 7, 128)    512        c
onv5_block8_1_conv[0][0]
_____

conv5_block8_1_relu (Activation  (None, 7, 7, 128)    0          c
onv5_block8_1_bn[0][0]
_____

conv5_block8_2_conv (Conv2D)     (None, 7, 7, 32)     36864      c
onv5_block8_1_relu[0][0]
_____

conv5_block8_concat (Concatenat  (None, 7, 7, 768)    0          c
onv5_block7_concat[0][0]
                                                                 c
onv5_block8_2_conv[0][0]
_____

conv5_block9_0_bn (BatchNormali  (None, 7, 7, 768)    3072       c
onv5_block8_concat[0][0]
_____

conv5_block9_0_relu (Activation  (None, 7, 7, 768)    0          c
```

onv5_block9_0_bn[0][0]

conv5_block9_1_conv (Conv2D)   (None, 7, 7, 128)   98304   c
onv5_block9_0_relu[0][0]

conv5_block9_1_bn (BatchNormali   (None, 7, 7, 128)   512   c
onv5_block9_1_conv[0][0]

conv5_block9_1_relu (Activation   (None, 7, 7, 128)   0   c
onv5_block9_1_bn[0][0]

conv5_block9_2_conv (Conv2D)   (None, 7, 7, 32)   36864   c
onv5_block9_1_relu[0][0]

conv5_block9_concat (Concatenat   (None, 7, 7, 800)   0   c
onv5_block8_concat[0][0]
                                                                        c
onv5_block9_2_conv[0][0]

conv5_block10_0_bn (BatchNormal   (None, 7, 7, 800)   3200   c
onv5_block9_concat[0][0]

conv5_block10_0_relu (Activatio   (None, 7, 7, 800)   0   c
onv5_block10_0_bn[0][0]

conv5_block10_1_conv (Conv2D)   (None, 7, 7, 128)   102400   c
onv5_block10_0_relu[0][0]

conv5_block10_1_bn (BatchNormal   (None, 7, 7, 128)   512   c
onv5_block10_1_conv[0][0]

conv5_block10_1_relu (Activatio   (None, 7, 7, 128)   0   c
onv5_block10_1_bn[0][0]

conv5_block10_2_conv (Conv2D)   (None, 7, 7, 32)   36864   c
onv5_block10_1_relu[0][0]

conv5_block10_concat (Concatena   (None, 7, 7, 832)   0   c
onv5_block9_concat[0][0]
                                                                        c
onv5_block10_2_conv[0][0]

conv5_block11_0_bn (BatchNormal	(None, 7, 7, 832)	3328	c
onv5_block10_concat[0][0]			
conv5_block11_0_relu (Activatio	(None, 7, 7, 832)	0	c
onv5_block11_0_bn[0][0]			
conv5_block11_1_conv (Conv2D)	(None, 7, 7, 128)	106496	c
onv5_block11_0_relu[0][0]			
conv5_block11_1_bn (BatchNormal	(None, 7, 7, 128)	512	c
onv5_block11_1_conv[0][0]			
conv5_block11_1_relu (Activatio	(None, 7, 7, 128)	0	c
onv5_block11_1_bn[0][0]			
conv5_block11_2_conv (Conv2D)	(None, 7, 7, 32)	36864	c
onv5_block11_1_relu[0][0]			
conv5_block11_concat (Concatena	(None, 7, 7, 864)	0	c
onv5_block10_concat[0][0]			
			c
onv5_block11_2_conv[0][0]			
conv5_block12_0_bn (BatchNormal	(None, 7, 7, 864)	3456	c
onv5_block11_concat[0][0]			
conv5_block12_0_relu (Activatio	(None, 7, 7, 864)	0	c
onv5_block12_0_bn[0][0]			
conv5_block12_1_conv (Conv2D)	(None, 7, 7, 128)	110592	c
onv5_block12_0_relu[0][0]			
conv5_block12_1_bn (BatchNormal	(None, 7, 7, 128)	512	c
onv5_block12_1_conv[0][0]			
conv5_block12_1_relu (Activatio	(None, 7, 7, 128)	0	c
onv5_block12_1_bn[0][0]			
conv5_block12_2_conv (Conv2D)	(None, 7, 7, 32)	36864	c

onv5_block12_1_relu[0][0]

_____

conv5_block12_concat (Concatena (None, 7, 7, 896)   0   c
onv5_block11_concat[0][0]
                                                                  c
onv5_block12_2_conv[0][0]

_____

conv5_block13_0_bn (BatchNormal (None, 7, 7, 896)   3584   c
onv5_block12_concat[0][0]

_____

conv5_block13_0_relu (Activatio (None, 7, 7, 896)   0   c
onv5_block13_0_bn[0][0]

_____

conv5_block13_1_conv (Conv2D)   (None, 7, 7, 128)   114688   c
onv5_block13_0_relu[0][0]

_____

conv5_block13_1_bn (BatchNormal (None, 7, 7, 128)   512   c
onv5_block13_1_conv[0][0]

_____

conv5_block13_1_relu (Activatio (None, 7, 7, 128)   0   c
onv5_block13_1_bn[0][0]

_____

conv5_block13_2_conv (Conv2D)   (None, 7, 7, 32)   36864   c
onv5_block13_1_relu[0][0]

_____

conv5_block13_concat (Concatena (None, 7, 7, 928)   0   c
onv5_block12_concat[0][0]
                                                                  c
onv5_block13_2_conv[0][0]

_____

conv5_block14_0_bn (BatchNormal (None, 7, 7, 928)   3712   c
onv5_block13_concat[0][0]

_____

conv5_block14_0_relu (Activatio (None, 7, 7, 928)   0   c
onv5_block14_0_bn[0][0]

_____

conv5_block14_1_conv (Conv2D)   (None, 7, 7, 128)   118784   c
onv5_block14_0_relu[0][0]

_____

conv5_block14_1_bn (BatchNormal (None, 7, 7, 128)   512   c
onv5_block14_1_conv[0][0]

```
conv5_block14_1_relu (Activatio   (None, 7, 7, 128)    0              c
onv5_block14_1_bn[0][0]

conv5_block14_2_conv (Conv2D)     (None, 7, 7, 32)     36864          c
onv5_block14_1_relu[0][0]

conv5_block14_concat (Concatena   (None, 7, 7, 960)    0              c
onv5_block13_concat[0][0]
                                                                      c
onv5_block14_2_conv[0][0]

conv5_block15_0_bn (BatchNormal   (None, 7, 7, 960)    3840           c
onv5_block14_concat[0][0]

conv5_block15_0_relu (Activatio   (None, 7, 7, 960)    0              c
onv5_block15_0_bn[0][0]

conv5_block15_1_conv (Conv2D)     (None, 7, 7, 128)    122880         c
onv5_block15_0_relu[0][0]

conv5_block15_1_bn (BatchNormal   (None, 7, 7, 128)    512            c
onv5_block15_1_conv[0][0]

conv5_block15_1_relu (Activatio   (None, 7, 7, 128)    0              c
onv5_block15_1_bn[0][0]

conv5_block15_2_conv (Conv2D)     (None, 7, 7, 32)     36864          c
onv5_block15_1_relu[0][0]

conv5_block15_concat (Concatena   (None, 7, 7, 992)    0              c
onv5_block14_concat[0][0]
                                                                      c
onv5_block15_2_conv[0][0]

conv5_block16_0_bn (BatchNormal   (None, 7, 7, 992)    3968           c
onv5_block15_concat[0][0]

conv5_block16_0_relu (Activatio   (None, 7, 7, 992)    0              c
onv5_block16_0_bn[0][0]
```

```
conv5_block16_1_conv (Conv2D)    (None, 7, 7, 128)    126976         c
onv5_block16_0_relu[0][0]
_____

conv5_block16_1_bn (BatchNormal  (None, 7, 7, 128)    512            c
onv5_block16_1_conv[0][0]
_____

conv5_block16_1_relu (Activatio  (None, 7, 7, 128)    0              c
onv5_block16_1_bn[0][0]
_____

conv5_block16_2_conv (Conv2D)    (None, 7, 7, 32)     36864          c
onv5_block16_1_relu[0][0]
_____

conv5_block16_concat (Concatena  (None, 7, 7, 1024)   0              c
onv5_block15_concat[0][0]
                                                                     c
onv5_block16_2_conv[0][0]
_____

bn (BatchNormalization)          (None, 7, 7, 1024)   4096           c
onv5_block16_concat[0][0]
_____

relu (Activation)                (None, 7, 7, 1024)   0              b
n[0][0]
_____

avg_pool (GlobalAveragePooling2  (None, 1024)         0              r
elu[0][0]
_____

fc1000 (Dense)                   (None, 1000)         1025000        a
vg_pool[0][0]
========================================================================
================================
Total params: 8,062,504
Trainable params: 7,978,856
Non-trainable params: 83,648
_____

_____
```

In [13]:
```python
from keras import models
from keras import layers
model.layers.pop()
model = models.Model(inputs=model.inputs, outputs=model.layers[-2].
output)
model.summary()
```

Model: "model_2"

```
Layer (type)                    Output Shape         Param #      C
onnected to
================================================================
================================
input_2 (InputLayer)            (None, 224, 224, 3)  0


zero_padding2d_3 (ZeroPadding2D (None, 230, 230, 3)  0            i
nput_2[0][0]


conv1/conv (Conv2D)             (None, 112, 112, 64) 9408         z
ero_padding2d_3[0][0]


conv1/bn (BatchNormalization)   (None, 112, 112, 64) 256          c
onv1/conv[0][0]


conv1/relu (Activation)         (None, 112, 112, 64) 0            c
onv1/bn[0][0]


zero_padding2d_4 (ZeroPadding2D (None, 114, 114, 64) 0            c
onv1/relu[0][0]


pool1 (MaxPooling2D)            (None, 56, 56, 64)   0            z
ero_padding2d_4[0][0]


conv2_block1_0_bn (BatchNormali (None, 56, 56, 64)   256          p
ool1[0][0]


conv2_block1_0_relu (Activation (None, 56, 56, 64)   0            c
onv2_block1_0_bn[0][0]


conv2_block1_1_conv (Conv2D)    (None, 56, 56, 128)  8192         c
onv2_block1_0_relu[0][0]


conv2_block1_1_bn (BatchNormali (None, 56, 56, 128)  512          c
onv2_block1_1_conv[0][0]


conv2_block1_1_relu (Activation (None, 56, 56, 128)  0            c
onv2_block1_1_bn[0][0]
```

```
conv2_block1_2_conv (Conv2D)     (None, 56, 56, 32)    36864        c
onv2_block1_1_relu[0][0]
_____

conv2_block1_concat (Concatenat  (None, 56, 56, 96)    0            p
ool1[0][0]
                                                                     c
onv2_block1_2_conv[0][0]
_____

conv2_block2_0_bn (BatchNormali  (None, 56, 56, 96)    384          c
onv2_block1_concat[0][0]
_____

conv2_block2_0_relu (Activation  (None, 56, 56, 96)    0            c
onv2_block2_0_bn[0][0]
_____

conv2_block2_1_conv (Conv2D)     (None, 56, 56, 128)   12288        c
onv2_block2_0_relu[0][0]
_____

conv2_block2_1_bn (BatchNormali  (None, 56, 56, 128)   512          c
onv2_block2_1_conv[0][0]
_____

conv2_block2_1_relu (Activation  (None, 56, 56, 128)   0            c
onv2_block2_1_bn[0][0]
_____

conv2_block2_2_conv (Conv2D)     (None, 56, 56, 32)    36864        c
onv2_block2_1_relu[0][0]
_____

conv2_block2_concat (Concatenat  (None, 56, 56, 128)   0            c
onv2_block1_concat[0][0]
                                                                     c
onv2_block2_2_conv[0][0]
_____

conv2_block3_0_bn (BatchNormali  (None, 56, 56, 128)   512          c
onv2_block2_concat[0][0]
_____

conv2_block3_0_relu (Activation  (None, 56, 56, 128)   0            c
onv2_block3_0_bn[0][0]
_____

conv2_block3_1_conv (Conv2D)     (None, 56, 56, 128)   16384        c
onv2_block3_0_relu[0][0]
_____

conv2_block3_1_bn (BatchNormali  (None, 56, 56, 128)   512          c
```

onv2_block3_1_conv[0][0]

_____

conv2_block3_1_relu (Activation (None, 56, 56, 128)   0   c
onv2_block3_1_bn[0][0]

_____

conv2_block3_2_conv (Conv2D)   (None, 56, 56, 32)   36864   c
onv2_block3_1_relu[0][0]

_____

conv2_block3_concat (Concatenat (None, 56, 56, 160)   0   c
onv2_block2_concat[0][0]
                                                                    c
onv2_block3_2_conv[0][0]

_____

conv2_block4_0_bn (BatchNormali (None, 56, 56, 160)   640   c
onv2_block3_concat[0][0]

_____

conv2_block4_0_relu (Activation (None, 56, 56, 160)   0   c
onv2_block4_0_bn[0][0]

_____

conv2_block4_1_conv (Conv2D)   (None, 56, 56, 128)   20480   c
onv2_block4_0_relu[0][0]

_____

conv2_block4_1_bn (BatchNormali (None, 56, 56, 128)   512   c
onv2_block4_1_conv[0][0]

_____

conv2_block4_1_relu (Activation (None, 56, 56, 128)   0   c
onv2_block4_1_bn[0][0]

_____

conv2_block4_2_conv (Conv2D)   (None, 56, 56, 32)   36864   c
onv2_block4_1_relu[0][0]

_____

conv2_block4_concat (Concatenat (None, 56, 56, 192)   0   c
onv2_block3_concat[0][0]
                                                                    c
onv2_block4_2_conv[0][0]

_____

conv2_block5_0_bn (BatchNormali (None, 56, 56, 192)   768   c
onv2_block4_concat[0][0]

_____

conv2_block5_0_relu (Activation (None, 56, 56, 192)   0   c
onv2_block5_0_bn[0][0]

```
conv2_block5_1_conv (Conv2D)    (None, 56, 56, 128)  24576        c
onv2_block5_0_relu[0][0]
_____
conv2_block5_1_bn (BatchNormali (None, 56, 56, 128)  512          c
onv2_block5_1_conv[0][0]
_____
conv2_block5_1_relu (Activation (None, 56, 56, 128)  0            c
onv2_block5_1_bn[0][0]
_____
conv2_block5_2_conv (Conv2D)    (None, 56, 56, 32)   36864        c
onv2_block5_1_relu[0][0]
_____
conv2_block5_concat (Concatenat (None, 56, 56, 224)  0            c
onv2_block4_concat[0][0]
                                                                  c
onv2_block5_2_conv[0][0]
_____
conv2_block6_0_bn (BatchNormali (None, 56, 56, 224)  896          c
onv2_block5_concat[0][0]
_____
conv2_block6_0_relu (Activation (None, 56, 56, 224)  0            c
onv2_block6_0_bn[0][0]
_____
conv2_block6_1_conv (Conv2D)    (None, 56, 56, 128)  28672        c
onv2_block6_0_relu[0][0]
_____
conv2_block6_1_bn (BatchNormali (None, 56, 56, 128)  512          c
onv2_block6_1_conv[0][0]
_____
conv2_block6_1_relu (Activation (None, 56, 56, 128)  0            c
onv2_block6_1_bn[0][0]
_____
conv2_block6_2_conv (Conv2D)    (None, 56, 56, 32)   36864        c
onv2_block6_1_relu[0][0]
_____
conv2_block6_concat (Concatenat (None, 56, 56, 256)  0            c
onv2_block5_concat[0][0]
                                                                  c
onv2_block6_2_conv[0][0]
_____
```

pool2_bn (BatchNormalization)	(None, 56, 56, 256)	1024	c
onv2_block6_concat[0][0]		

| pool2_relu (Activation) | (None, 56, 56, 256) | 0 | p |
| ool2_bn[0][0] | | |

| pool2_conv (Conv2D) | (None, 56, 56, 128) | 32768 | p |
| ool2_relu[0][0] | | |

| pool2_pool (AveragePooling2D) | (None, 28, 28, 128) | 0 | p |
| ool2_conv[0][0] | | |

| conv3_block1_0_bn (BatchNormali | (None, 28, 28, 128) | 512 | p |
| ool2_pool[0][0] | | |

| conv3_block1_0_relu (Activation | (None, 28, 28, 128) | 0 | c |
| onv3_block1_0_bn[0][0] | | |

| conv3_block1_1_conv (Conv2D) | (None, 28, 28, 128) | 16384 | c |
| onv3_block1_0_relu[0][0] | | |

| conv3_block1_1_bn (BatchNormali | (None, 28, 28, 128) | 512 | c |
| onv3_block1_1_conv[0][0] | | |

| conv3_block1_1_relu (Activation | (None, 28, 28, 128) | 0 | c |
| onv3_block1_1_bn[0][0] | | |

| conv3_block1_2_conv (Conv2D) | (None, 28, 28, 32) | 36864 | c |
| onv3_block1_1_relu[0][0] | | |

conv3_block1_concat (Concatenat	(None, 28, 28, 160)	0	p
ool2_pool[0][0]		
			c
onv3_block1_2_conv[0][0]		

| conv3_block2_0_bn (BatchNormali | (None, 28, 28, 160) | 640 | c |
| onv3_block1_concat[0][0] | | |

| conv3_block2_0_relu (Activation | (None, 28, 28, 160) | 0 | c |
| onv3_block2_0_bn[0][0] | | |

```
conv3_block2_1_conv (Conv2D)      (None, 28, 28, 128)   20480         c
onv3_block2_0_relu[0][0]

conv3_block2_1_bn (BatchNormali  (None, 28, 28, 128)   512           c
onv3_block2_1_conv[0][0]

conv3_block2_1_relu (Activation  (None, 28, 28, 128)   0             c
onv3_block2_1_bn[0][0]

conv3_block2_2_conv (Conv2D)      (None, 28, 28, 32)    36864         c
onv3_block2_1_relu[0][0]

conv3_block2_concat (Concatenat  (None, 28, 28, 192)   0             c
onv3_block1_concat[0][0]
                                                                     c
onv3_block2_2_conv[0][0]

conv3_block3_0_bn (BatchNormali  (None, 28, 28, 192)   768           c
onv3_block2_concat[0][0]

conv3_block3_0_relu (Activation  (None, 28, 28, 192)   0             c
onv3_block3_0_bn[0][0]

conv3_block3_1_conv (Conv2D)      (None, 28, 28, 128)   24576         c
onv3_block3_0_relu[0][0]

conv3_block3_1_bn (BatchNormali  (None, 28, 28, 128)   512           c
onv3_block3_1_conv[0][0]

conv3_block3_1_relu (Activation  (None, 28, 28, 128)   0             c
onv3_block3_1_bn[0][0]

conv3_block3_2_conv (Conv2D)      (None, 28, 28, 32)    36864         c
onv3_block3_1_relu[0][0]

conv3_block3_concat (Concatenat  (None, 28, 28, 224)   0             c
onv3_block2_concat[0][0]
                                                                     c
onv3_block3_2_conv[0][0]
```

conv3_block4_0_bn (BatchNormali (None, 28, 28, 224)   896   c
onv3_block3_concat[0][0]

___

conv3_block4_0_relu (Activation (None, 28, 28, 224)   0   c
onv3_block4_0_bn[0][0]

___

conv3_block4_1_conv (Conv2D)   (None, 28, 28, 128)   28672   c
onv3_block4_0_relu[0][0]

___

conv3_block4_1_bn (BatchNormali (None, 28, 28, 128)   512   c
onv3_block4_1_conv[0][0]

___

conv3_block4_1_relu (Activation (None, 28, 28, 128)   0   c
onv3_block4_1_bn[0][0]

___

conv3_block4_2_conv (Conv2D)   (None, 28, 28, 32)   36864   c
onv3_block4_1_relu[0][0]

___

conv3_block4_concat (Concatenat (None, 28, 28, 256)   0   c
onv3_block3_concat[0][0]
                                                                c
onv3_block4_2_conv[0][0]

___

conv3_block5_0_bn (BatchNormali (None, 28, 28, 256)   1024   c
onv3_block4_concat[0][0]

___

conv3_block5_0_relu (Activation (None, 28, 28, 256)   0   c
onv3_block5_0_bn[0][0]

___

conv3_block5_1_conv (Conv2D)   (None, 28, 28, 128)   32768   c
onv3_block5_0_relu[0][0]

___

conv3_block5_1_bn (BatchNormali (None, 28, 28, 128)   512   c
onv3_block5_1_conv[0][0]

___

conv3_block5_1_relu (Activation (None, 28, 28, 128)   0   c
onv3_block5_1_bn[0][0]

___

conv3_block5_2_conv (Conv2D)   (None, 28, 28, 32)   36864   c
onv3_block5_1_relu[0][0]

```
conv3_block5_concat (Concatenat (None, 28, 28, 288)  0          c
onv3_block4_concat[0][0]
                                                                 c
onv3_block5_2_conv[0][0]


conv3_block6_0_bn (BatchNormali (None, 28, 28, 288)  1152       c
onv3_block5_concat[0][0]


conv3_block6_0_relu (Activation (None, 28, 28, 288)  0          c
onv3_block6_0_bn[0][0]


conv3_block6_1_conv (Conv2D)    (None, 28, 28, 128)  36864      c
onv3_block6_0_relu[0][0]


conv3_block6_1_bn (BatchNormali (None, 28, 28, 128)  512        c
onv3_block6_1_conv[0][0]


conv3_block6_1_relu (Activation (None, 28, 28, 128)  0          c
onv3_block6_1_bn[0][0]


conv3_block6_2_conv (Conv2D)    (None, 28, 28, 32)   36864      c
onv3_block6_1_relu[0][0]


conv3_block6_concat (Concatenat (None, 28, 28, 320)  0          c
onv3_block5_concat[0][0]
                                                                 c
onv3_block6_2_conv[0][0]


conv3_block7_0_bn (BatchNormali (None, 28, 28, 320)  1280       c
onv3_block6_concat[0][0]


conv3_block7_0_relu (Activation (None, 28, 28, 320)  0          c
onv3_block7_0_bn[0][0]


conv3_block7_1_conv (Conv2D)    (None, 28, 28, 128)  40960      c
onv3_block7_0_relu[0][0]


conv3_block7_1_bn (BatchNormali (None, 28, 28, 128)  512        c
onv3_block7_1_conv[0][0]
```

conv3_block7_1_relu (Activation onv3_block7_1_bn[0][0]	(None, 28, 28, 128)	0	c
conv3_block7_2_conv (Conv2D) onv3_block7_1_relu[0][0]	(None, 28, 28, 32)	36864	c
conv3_block7_concat (Concatenat onv3_block6_concat[0][0] onv3_block7_2_conv[0][0]	(None, 28, 28, 352)	0	c c
conv3_block8_0_bn (BatchNormali onv3_block7_concat[0][0]	(None, 28, 28, 352)	1408	c
conv3_block8_0_relu (Activation onv3_block8_0_bn[0][0]	(None, 28, 28, 352)	0	c
conv3_block8_1_conv (Conv2D) onv3_block8_0_relu[0][0]	(None, 28, 28, 128)	45056	c
conv3_block8_1_bn (BatchNormali onv3_block8_1_conv[0][0]	(None, 28, 28, 128)	512	c
conv3_block8_1_relu (Activation onv3_block8_1_bn[0][0]	(None, 28, 28, 128)	0	c
conv3_block8_2_conv (Conv2D) onv3_block8_1_relu[0][0]	(None, 28, 28, 32)	36864	c
conv3_block8_concat (Concatenat onv3_block7_concat[0][0] onv3_block8_2_conv[0][0]	(None, 28, 28, 384)	0	c c
conv3_block9_0_bn (BatchNormali onv3_block8_concat[0][0]	(None, 28, 28, 384)	1536	c
conv3_block9_0_relu (Activation onv3_block9_0_bn[0][0]	(None, 28, 28, 384)	0	c

```
conv3_block9_1_conv (Conv2D)      (None, 28, 28, 128)   49152        c
onv3_block9_0_relu[0][0]
_____

conv3_block9_1_bn (BatchNormali   (None, 28, 28, 128)   512          c
onv3_block9_1_conv[0][0]
_____

conv3_block9_1_relu (Activation   (None, 28, 28, 128)   0            c
onv3_block9_1_bn[0][0]
_____

conv3_block9_2_conv (Conv2D)      (None, 28, 28, 32)    36864        c
onv3_block9_1_relu[0][0]
_____

conv3_block9_concat (Concatenat   (None, 28, 28, 416)   0            c
onv3_block8_concat[0][0]
                                                                     c
onv3_block9_2_conv[0][0]
_____

conv3_block10_0_bn (BatchNormal   (None, 28, 28, 416)   1664         c
onv3_block9_concat[0][0]
_____

conv3_block10_0_relu (Activatio   (None, 28, 28, 416)   0            c
onv3_block10_0_bn[0][0]
_____

conv3_block10_1_conv (Conv2D)     (None, 28, 28, 128)   53248        c
onv3_block10_0_relu[0][0]
_____

conv3_block10_1_bn (BatchNormal   (None, 28, 28, 128)   512          c
onv3_block10_1_conv[0][0]
_____

conv3_block10_1_relu (Activatio   (None, 28, 28, 128)   0            c
onv3_block10_1_bn[0][0]
_____

conv3_block10_2_conv (Conv2D)     (None, 28, 28, 32)    36864        c
onv3_block10_1_relu[0][0]
_____

conv3_block10_concat (Concatena   (None, 28, 28, 448)   0            c
onv3_block9_concat[0][0]
                                                                     c
onv3_block10_2_conv[0][0]
_____

conv3_block11_0_bn (BatchNormal   (None, 28, 28, 448)   1792         c
```

```
                                  onv3_block10_concat[0][0]
_____

conv3_block11_0_relu (Activatio (None, 28, 28, 448)  0           c
onv3_block11_0_bn[0][0]
_____

conv3_block11_1_conv (Conv2D)   (None, 28, 28, 128)  57344       c
onv3_block11_0_relu[0][0]
_____

conv3_block11_1_bn (BatchNormal (None, 28, 28, 128)  512         c
onv3_block11_1_conv[0][0]
_____

conv3_block11_1_relu (Activatio (None, 28, 28, 128)  0           c
onv3_block11_1_bn[0][0]
_____

conv3_block11_2_conv (Conv2D)   (None, 28, 28, 32)   36864       c
onv3_block11_1_relu[0][0]
_____

conv3_block11_concat (Concatena (None, 28, 28, 480)  0           c
onv3_block10_concat[0][0]
                                                                 c
onv3_block11_2_conv[0][0]
_____

conv3_block12_0_bn (BatchNormal (None, 28, 28, 480)  1920        c
onv3_block11_concat[0][0]
_____

conv3_block12_0_relu (Activatio (None, 28, 28, 480)  0           c
onv3_block12_0_bn[0][0]
_____

conv3_block12_1_conv (Conv2D)   (None, 28, 28, 128)  61440       c
onv3_block12_0_relu[0][0]
_____

conv3_block12_1_bn (BatchNormal (None, 28, 28, 128)  512         c
onv3_block12_1_conv[0][0]
_____

conv3_block12_1_relu (Activatio (None, 28, 28, 128)  0           c
onv3_block12_1_bn[0][0]
_____

conv3_block12_2_conv (Conv2D)   (None, 28, 28, 32)   36864       c
onv3_block12_1_relu[0][0]
_____
```

```
conv3_block12_concat (Concatena (None, 28, 28, 512)   0         c
onv3_block11_concat[0][0]
                                                                c
onv3_block12_2_conv[0][0]
_____
pool3_bn (BatchNormalization)   (None, 28, 28, 512)   2048      c
onv3_block12_concat[0][0]
_____
pool3_relu (Activation)         (None, 28, 28, 512)   0         p
ool3_bn[0][0]
_____
pool3_conv (Conv2D)             (None, 28, 28, 256)   131072    p
ool3_relu[0][0]
_____
pool3_pool (AveragePooling2D)   (None, 14, 14, 256)   0         p
ool3_conv[0][0]
_____
conv4_block1_0_bn (BatchNormali (None, 14, 14, 256)   1024      p
ool3_pool[0][0]
_____
conv4_block1_0_relu (Activation (None, 14, 14, 256)   0         c
onv4_block1_0_bn[0][0]
_____
conv4_block1_1_conv (Conv2D)    (None, 14, 14, 128)   32768     c
onv4_block1_0_relu[0][0]
_____
conv4_block1_1_bn (BatchNormali (None, 14, 14, 128)   512       c
onv4_block1_1_conv[0][0]
_____
conv4_block1_1_relu (Activation (None, 14, 14, 128)   0         c
onv4_block1_1_bn[0][0]
_____
conv4_block1_2_conv (Conv2D)    (None, 14, 14, 32)    36864     c
onv4_block1_1_relu[0][0]
_____
conv4_block1_concat (Concatenat (None, 14, 14, 288)   0         p
ool3_pool[0][0]
                                                                c
onv4_block1_2_conv[0][0]
_____
conv4_block2_0_bn (BatchNormali (None, 14, 14, 288)   1152      c
```

onv4_block1_concat[0][0]

---

conv4_block2_0_relu (Activation (None, 14, 14, 288)   0   c
onv4_block2_0_bn[0][0]

---

conv4_block2_1_conv (Conv2D)   (None, 14, 14, 128)   36864   c
onv4_block2_0_relu[0][0]

---

conv4_block2_1_bn (BatchNormali (None, 14, 14, 128)   512   c
onv4_block2_1_conv[0][0]

---

conv4_block2_1_relu (Activation (None, 14, 14, 128)   0   c
onv4_block2_1_bn[0][0]

---

conv4_block2_2_conv (Conv2D)   (None, 14, 14, 32)   36864   c
onv4_block2_1_relu[0][0]

---

conv4_block2_concat (Concatenat (None, 14, 14, 320)   0   c
onv4_block1_concat[0][0]
                                                                      c
onv4_block2_2_conv[0][0]

---

conv4_block3_0_bn (BatchNormali (None, 14, 14, 320)   1280   c
onv4_block2_concat[0][0]

---

conv4_block3_0_relu (Activation (None, 14, 14, 320)   0   c
onv4_block3_0_bn[0][0]

---

conv4_block3_1_conv (Conv2D)   (None, 14, 14, 128)   40960   c
onv4_block3_0_relu[0][0]

---

conv4_block3_1_bn (BatchNormali (None, 14, 14, 128)   512   c
onv4_block3_1_conv[0][0]

---

conv4_block3_1_relu (Activation (None, 14, 14, 128)   0   c
onv4_block3_1_bn[0][0]

---

conv4_block3_2_conv (Conv2D)   (None, 14, 14, 32)   36864   c
onv4_block3_1_relu[0][0]

```
conv4_block3_concat (Concatenat (None, 14, 14, 352)  0          c
onv4_block2_concat[0][0]
                                                                c
onv4_block3_2_conv[0][0]
_____

_____
conv4_block4_0_bn (BatchNormali (None, 14, 14, 352)  1408       c
onv4_block3_concat[0][0]
_____

_____
conv4_block4_0_relu (Activation (None, 14, 14, 352)  0          c
onv4_block4_0_bn[0][0]
_____

_____
conv4_block4_1_conv (Conv2D)    (None, 14, 14, 128)  45056      c
onv4_block4_0_relu[0][0]
_____

_____
conv4_block4_1_bn (BatchNormali (None, 14, 14, 128)  512        c
onv4_block4_1_conv[0][0]
_____

_____
conv4_block4_1_relu (Activation (None, 14, 14, 128)  0          c
onv4_block4_1_bn[0][0]
_____

_____
conv4_block4_2_conv (Conv2D)    (None, 14, 14, 32)   36864      c
onv4_block4_1_relu[0][0]
_____

_____
conv4_block4_concat (Concatenat (None, 14, 14, 384)  0          c
onv4_block3_concat[0][0]
                                                                c
onv4_block4_2_conv[0][0]
_____

_____
conv4_block5_0_bn (BatchNormali (None, 14, 14, 384)  1536       c
onv4_block4_concat[0][0]
_____

_____
conv4_block5_0_relu (Activation (None, 14, 14, 384)  0          c
onv4_block5_0_bn[0][0]
_____

_____
conv4_block5_1_conv (Conv2D)    (None, 14, 14, 128)  49152      c
onv4_block5_0_relu[0][0]
_____

_____
conv4_block5_1_bn (BatchNormali (None, 14, 14, 128)  512        c
onv4_block5_1_conv[0][0]
_____

_____
conv4_block5_1_relu (Activation (None, 14, 14, 128)  0          c
```

```
                                            onv4_block5_1_bn[0][0]
_____
conv4_block5_2_conv (Conv2D)      (None, 14, 14, 32)    36864       c
onv4_block5_1_relu[0][0]
_____
conv4_block5_concat (Concatenat  (None, 14, 14, 416)   0           c
onv4_block4_concat[0][0]
                                                                    c
onv4_block5_2_conv[0][0]
_____
conv4_block6_0_bn (BatchNormali  (None, 14, 14, 416)   1664        c
onv4_block5_concat[0][0]
_____
conv4_block6_0_relu (Activation  (None, 14, 14, 416)   0           c
onv4_block6_0_bn[0][0]
_____
conv4_block6_1_conv (Conv2D)      (None, 14, 14, 128)   53248       c
onv4_block6_0_relu[0][0]
_____
conv4_block6_1_bn (BatchNormali  (None, 14, 14, 128)   512         c
onv4_block6_1_conv[0][0]
_____
conv4_block6_1_relu (Activation  (None, 14, 14, 128)   0           c
onv4_block6_1_bn[0][0]
_____
conv4_block6_2_conv (Conv2D)      (None, 14, 14, 32)    36864       c
onv4_block6_1_relu[0][0]
_____
conv4_block6_concat (Concatenat  (None, 14, 14, 448)   0           c
onv4_block5_concat[0][0]
                                                                    c
onv4_block6_2_conv[0][0]
_____
conv4_block7_0_bn (BatchNormali  (None, 14, 14, 448)   1792        c
onv4_block6_concat[0][0]
_____
conv4_block7_0_relu (Activation  (None, 14, 14, 448)   0           c
onv4_block7_0_bn[0][0]
_____
conv4_block7_1_conv (Conv2D)      (None, 14, 14, 128)   57344       c
onv4_block7_0_relu[0][0]
```

```
conv4_block7_1_bn (BatchNormali (None, 14, 14, 128)   512          c
onv4_block7_1_conv[0][0]


conv4_block7_1_relu (Activation (None, 14, 14, 128)   0            c
onv4_block7_1_bn[0][0]


conv4_block7_2_conv (Conv2D)    (None, 14, 14, 32)    36864        c
onv4_block7_1_relu[0][0]


conv4_block7_concat (Concatenat (None, 14, 14, 480)   0            c
onv4_block6_concat[0][0]
                                                                   c
onv4_block7_2_conv[0][0]


conv4_block8_0_bn (BatchNormali (None, 14, 14, 480)   1920         c
onv4_block7_concat[0][0]


conv4_block8_0_relu (Activation (None, 14, 14, 480)   0            c
onv4_block8_0_bn[0][0]


conv4_block8_1_conv (Conv2D)    (None, 14, 14, 128)   61440        c
onv4_block8_0_relu[0][0]


conv4_block8_1_bn (BatchNormali (None, 14, 14, 128)   512          c
onv4_block8_1_conv[0][0]


conv4_block8_1_relu (Activation (None, 14, 14, 128)   0            c
onv4_block8_1_bn[0][0]


conv4_block8_2_conv (Conv2D)    (None, 14, 14, 32)    36864        c
onv4_block8_1_relu[0][0]


conv4_block8_concat (Concatenat (None, 14, 14, 512)   0            c
onv4_block7_concat[0][0]
                                                                   c
onv4_block8_2_conv[0][0]


conv4_block9_0_bn (BatchNormali (None, 14, 14, 512)   2048         c
onv4_block8_concat[0][0]
```

conv4_block9_0_relu (Activation	(None, 14, 14, 512)	0	c
onv4_block9_0_bn[0][0]			
conv4_block9_1_conv (Conv2D)	(None, 14, 14, 128)	65536	c
onv4_block9_0_relu[0][0]			
conv4_block9_1_bn (BatchNormali	(None, 14, 14, 128)	512	c
onv4_block9_1_conv[0][0]			
conv4_block9_1_relu (Activation	(None, 14, 14, 128)	0	c
onv4_block9_1_bn[0][0]			
conv4_block9_2_conv (Conv2D)	(None, 14, 14, 32)	36864	c
onv4_block9_1_relu[0][0]			
conv4_block9_concat (Concatenat	(None, 14, 14, 544)	0	c
onv4_block8_concat[0][0]			
			c
onv4_block9_2_conv[0][0]			
conv4_block10_0_bn (BatchNormal	(None, 14, 14, 544)	2176	c
onv4_block9_concat[0][0]			
conv4_block10_0_relu (Activatio	(None, 14, 14, 544)	0	c
onv4_block10_0_bn[0][0]			
conv4_block10_1_conv (Conv2D)	(None, 14, 14, 128)	69632	c
onv4_block10_0_relu[0][0]			
conv4_block10_1_bn (BatchNormal	(None, 14, 14, 128)	512	c
onv4_block10_1_conv[0][0]			
conv4_block10_1_relu (Activatio	(None, 14, 14, 128)	0	c
onv4_block10_1_bn[0][0]			
conv4_block10_2_conv (Conv2D)	(None, 14, 14, 32)	36864	c
onv4_block10_1_relu[0][0]			
conv4_block10_concat (Concatena	(None, 14, 14, 576)	0	c
onv4_block9_concat[0][0]			

```
                                                                                  c
onv4_block10_2_conv[0][0]
_____

_____
conv4_block11_0_bn (BatchNormal (None, 14, 14, 576)  2304        c
onv4_block10_concat[0][0]
_____

_____
conv4_block11_0_relu (Activatio (None, 14, 14, 576)  0           c
onv4_block11_0_bn[0][0]
_____

_____
conv4_block11_1_conv (Conv2D)   (None, 14, 14, 128)  73728       c
onv4_block11_0_relu[0][0]
_____

_____
conv4_block11_1_bn (BatchNormal (None, 14, 14, 128)  512         c
onv4_block11_1_conv[0][0]
_____

_____
conv4_block11_1_relu (Activatio (None, 14, 14, 128)  0           c
onv4_block11_1_bn[0][0]
_____

_____
conv4_block11_2_conv (Conv2D)   (None, 14, 14, 32)   36864       c
onv4_block11_1_relu[0][0]
_____

_____
conv4_block11_concat (Concatena (None, 14, 14, 608)  0           c
onv4_block10_concat[0][0]
                                                                                  c
onv4_block11_2_conv[0][0]
_____

_____
conv4_block12_0_bn (BatchNormal (None, 14, 14, 608)  2432        c
onv4_block11_concat[0][0]
_____

_____
conv4_block12_0_relu (Activatio (None, 14, 14, 608)  0           c
onv4_block12_0_bn[0][0]
_____

_____
conv4_block12_1_conv (Conv2D)   (None, 14, 14, 128)  77824       c
onv4_block12_0_relu[0][0]
_____

_____
conv4_block12_1_bn (BatchNormal (None, 14, 14, 128)  512         c
onv4_block12_1_conv[0][0]
_____

_____
conv4_block12_1_relu (Activatio (None, 14, 14, 128)  0           c
onv4_block12_1_bn[0][0]
_____
```

conv4_block12_2_conv (Conv2D)	(None, 14, 14, 32)	36864	c
onv4_block12_1_relu[0][0]			
conv4_block12_concat (Concatena	(None, 14, 14, 640)	0	c
onv4_block11_concat[0][0]			
			c
onv4_block12_2_conv[0][0]			
conv4_block13_0_bn (BatchNormal	(None, 14, 14, 640)	2560	c
onv4_block12_concat[0][0]			
conv4_block13_0_relu (Activatio	(None, 14, 14, 640)	0	c
onv4_block13_0_bn[0][0]			
conv4_block13_1_conv (Conv2D)	(None, 14, 14, 128)	81920	c
onv4_block13_0_relu[0][0]			
conv4_block13_1_bn (BatchNormal	(None, 14, 14, 128)	512	c
onv4_block13_1_conv[0][0]			
conv4_block13_1_relu (Activatio	(None, 14, 14, 128)	0	c
onv4_block13_1_bn[0][0]			
conv4_block13_2_conv (Conv2D)	(None, 14, 14, 32)	36864	c
onv4_block13_1_relu[0][0]			
conv4_block13_concat (Concatena	(None, 14, 14, 672)	0	c
onv4_block12_concat[0][0]			
			c
onv4_block13_2_conv[0][0]			
conv4_block14_0_bn (BatchNormal	(None, 14, 14, 672)	2688	c
onv4_block13_concat[0][0]			
conv4_block14_0_relu (Activatio	(None, 14, 14, 672)	0	c
onv4_block14_0_bn[0][0]			
conv4_block14_1_conv (Conv2D)	(None, 14, 14, 128)	86016	c
onv4_block14_0_relu[0][0]			

conv4_block14_1_bn (BatchNormal (None, 14, 14, 128)   512   c
onv4_block14_1_conv[0][0]

conv4_block14_1_relu (Activatio (None, 14, 14, 128)   0   c
onv4_block14_1_bn[0][0]

conv4_block14_2_conv (Conv2D)   (None, 14, 14, 32)   36864   c
onv4_block14_1_relu[0][0]

conv4_block14_concat (Concatena (None, 14, 14, 704)   0   c
onv4_block13_concat[0][0]
                                                                 c
onv4_block14_2_conv[0][0]

conv4_block15_0_bn (BatchNormal (None, 14, 14, 704)   2816   c
onv4_block14_concat[0][0]

conv4_block15_0_relu (Activatio (None, 14, 14, 704)   0   c
onv4_block15_0_bn[0][0]

conv4_block15_1_conv (Conv2D)   (None, 14, 14, 128)   90112   c
onv4_block15_0_relu[0][0]

conv4_block15_1_bn (BatchNormal (None, 14, 14, 128)   512   c
onv4_block15_1_conv[0][0]

conv4_block15_1_relu (Activatio (None, 14, 14, 128)   0   c
onv4_block15_1_bn[0][0]

conv4_block15_2_conv (Conv2D)   (None, 14, 14, 32)   36864   c
onv4_block15_1_relu[0][0]

conv4_block15_concat (Concatena (None, 14, 14, 736)   0   c
onv4_block14_concat[0][0]
                                                                 c
onv4_block15_2_conv[0][0]

conv4_block16_0_bn (BatchNormal (None, 14, 14, 736)   2944   c
onv4_block15_concat[0][0]

conv4_block16_0_relu (Activatio (None, 14, 14, 736)   0   c

onv4_block16_0_bn[0][0]

---

conv4_block16_1_conv (Conv2D)   (None, 14, 14, 128)   94208   c
onv4_block16_0_relu[0][0]

---

conv4_block16_1_bn (BatchNormal (None, 14, 14, 128)   512   c
onv4_block16_1_conv[0][0]

---

conv4_block16_1_relu (Activatio (None, 14, 14, 128)   0   c
onv4_block16_1_bn[0][0]

---

conv4_block16_2_conv (Conv2D)   (None, 14, 14, 32)   36864   c
onv4_block16_1_relu[0][0]

---

conv4_block16_concat (Concatena (None, 14, 14, 768)   0   c
onv4_block15_concat[0][0]
                                                                      c
onv4_block16_2_conv[0][0]

---

conv4_block17_0_bn (BatchNormal (None, 14, 14, 768)   3072   c
onv4_block16_concat[0][0]

---

conv4_block17_0_relu (Activatio (None, 14, 14, 768)   0   c
onv4_block17_0_bn[0][0]

---

conv4_block17_1_conv (Conv2D)   (None, 14, 14, 128)   98304   c
onv4_block17_0_relu[0][0]

---

conv4_block17_1_bn (BatchNormal (None, 14, 14, 128)   512   c
onv4_block17_1_conv[0][0]

---

conv4_block17_1_relu (Activatio (None, 14, 14, 128)   0   c
onv4_block17_1_bn[0][0]

---

conv4_block17_2_conv (Conv2D)   (None, 14, 14, 32)   36864   c
onv4_block17_1_relu[0][0]

---

conv4_block17_concat (Concatena (None, 14, 14, 800)   0   c
onv4_block16_concat[0][0]
                                                                      c
onv4_block17_2_conv[0][0]

conv4_block18_0_bn (BatchNormal (None, 14, 14, 800) 3200   c
onv4_block17_concat[0][0]

conv4_block18_0_relu (Activatio (None, 14, 14, 800) 0   c
onv4_block18_0_bn[0][0]

conv4_block18_1_conv (Conv2D)   (None, 14, 14, 128) 102400   c
onv4_block18_0_relu[0][0]

conv4_block18_1_bn (BatchNormal (None, 14, 14, 128) 512   c
onv4_block18_1_conv[0][0]

conv4_block18_1_relu (Activatio (None, 14, 14, 128) 0   c
onv4_block18_1_bn[0][0]

conv4_block18_2_conv (Conv2D)   (None, 14, 14, 32) 36864   c
onv4_block18_1_relu[0][0]

conv4_block18_concat (Concatena (None, 14, 14, 832) 0   c
onv4_block17_concat[0][0]
                                                                  c
onv4_block18_2_conv[0][0]

conv4_block19_0_bn (BatchNormal (None, 14, 14, 832) 3328   c
onv4_block18_concat[0][0]

conv4_block19_0_relu (Activatio (None, 14, 14, 832) 0   c
onv4_block19_0_bn[0][0]

conv4_block19_1_conv (Conv2D)   (None, 14, 14, 128) 106496   c
onv4_block19_0_relu[0][0]

conv4_block19_1_bn (BatchNormal (None, 14, 14, 128) 512   c
onv4_block19_1_conv[0][0]

conv4_block19_1_relu (Activatio (None, 14, 14, 128) 0   c
onv4_block19_1_bn[0][0]

conv4_block19_2_conv (Conv2D)   (None, 14, 14, 32) 36864   c

onv4_block19_1_relu[0][0]

conv4_block19_concat (Concatena   (None, 14, 14, 864)   0   c
onv4_block18_concat[0][0]
                                                                     c
onv4_block19_2_conv[0][0]

conv4_block20_0_bn (BatchNormal   (None, 14, 14, 864)   3456   c
onv4_block19_concat[0][0]

conv4_block20_0_relu (Activatio   (None, 14, 14, 864)   0   c
onv4_block20_0_bn[0][0]

conv4_block20_1_conv (Conv2D)   (None, 14, 14, 128)   110592   c
onv4_block20_0_relu[0][0]

conv4_block20_1_bn (BatchNormal   (None, 14, 14, 128)   512   c
onv4_block20_1_conv[0][0]

conv4_block20_1_relu (Activatio   (None, 14, 14, 128)   0   c
onv4_block20_1_bn[0][0]

conv4_block20_2_conv (Conv2D)   (None, 14, 14, 32)   36864   c
onv4_block20_1_relu[0][0]

conv4_block20_concat (Concatena   (None, 14, 14, 896)   0   c
onv4_block19_concat[0][0]
                                                                     c
onv4_block20_2_conv[0][0]

conv4_block21_0_bn (BatchNormal   (None, 14, 14, 896)   3584   c
onv4_block20_concat[0][0]

conv4_block21_0_relu (Activatio   (None, 14, 14, 896)   0   c
onv4_block21_0_bn[0][0]

conv4_block21_1_conv (Conv2D)   (None, 14, 14, 128)   114688   c
onv4_block21_0_relu[0][0]

conv4_block21_1_bn (BatchNormal   (None, 14, 14, 128)   512   c
onv4_block21_1_conv[0][0]

```
conv4_block21_1_relu (Activatio  (None, 14, 14, 128)   0           c
onv4_block21_1_bn[0][0]
```

```
conv4_block21_2_conv (Conv2D)    (None, 14, 14, 32)    36864       c
onv4_block21_1_relu[0][0]
```

```
conv4_block21_concat (Concatena  (None, 14, 14, 928)   0           c
onv4_block20_concat[0][0]
                                                                   c
onv4_block21_2_conv[0][0]
```

```
conv4_block22_0_bn (BatchNormal  (None, 14, 14, 928)   3712        c
onv4_block21_concat[0][0]
```

```
conv4_block22_0_relu (Activatio  (None, 14, 14, 928)   0           c
onv4_block22_0_bn[0][0]
```

```
conv4_block22_1_conv (Conv2D)    (None, 14, 14, 128)   118784      c
onv4_block22_0_relu[0][0]
```

```
conv4_block22_1_bn (BatchNormal  (None, 14, 14, 128)   512         c
onv4_block22_1_conv[0][0]
```

```
conv4_block22_1_relu (Activatio  (None, 14, 14, 128)   0           c
onv4_block22_1_bn[0][0]
```

```
conv4_block22_2_conv (Conv2D)    (None, 14, 14, 32)    36864       c
onv4_block22_1_relu[0][0]
```

```
conv4_block22_concat (Concatena  (None, 14, 14, 960)   0           c
onv4_block21_concat[0][0]
                                                                   c
onv4_block22_2_conv[0][0]
```

```
conv4_block23_0_bn (BatchNormal  (None, 14, 14, 960)   3840        c
onv4_block22_concat[0][0]
```

```
conv4_block23_0_relu (Activatio  (None, 14, 14, 960)   0           c
onv4_block23_0_bn[0][0]
```

```
conv4_block23_1_conv (Conv2D)    (None, 14, 14, 128)   122880        c
onv4_block23_0_relu[0][0]
_____

conv4_block23_1_bn (BatchNormal  (None, 14, 14, 128)   512           c
onv4_block23_1_conv[0][0]
_____

conv4_block23_1_relu (Activatio  (None, 14, 14, 128)   0             c
onv4_block23_1_bn[0][0]
_____

conv4_block23_2_conv (Conv2D)    (None, 14, 14, 32)    36864         c
onv4_block23_1_relu[0][0]
_____

conv4_block23_concat (Concatena  (None, 14, 14, 992)   0             c
onv4_block22_concat[0][0]
                                                                     c
onv4_block23_2_conv[0][0]
_____

conv4_block24_0_bn (BatchNormal  (None, 14, 14, 992)   3968          c
onv4_block23_concat[0][0]
_____

conv4_block24_0_relu (Activatio  (None, 14, 14, 992)   0             c
onv4_block24_0_bn[0][0]
_____

conv4_block24_1_conv (Conv2D)    (None, 14, 14, 128)   126976        c
onv4_block24_0_relu[0][0]
_____

conv4_block24_1_bn (BatchNormal  (None, 14, 14, 128)   512           c
onv4_block24_1_conv[0][0]
_____

conv4_block24_1_relu (Activatio  (None, 14, 14, 128)   0             c
onv4_block24_1_bn[0][0]
_____

conv4_block24_2_conv (Conv2D)    (None, 14, 14, 32)    36864         c
onv4_block24_1_relu[0][0]
_____

conv4_block24_concat (Concatena  (None, 14, 14, 1024)  0             c
onv4_block23_concat[0][0]
                                                                     c
onv4_block24_2_conv[0][0]
_____
```

pool4_bn (BatchNormalization) onv4_block24_concat[0][0]	(None, 14, 14, 1024)	4096	c
pool4_relu (Activation) ool4_bn[0][0]	(None, 14, 14, 1024)	0	p
pool4_conv (Conv2D) ool4_relu[0][0]	(None, 14, 14, 512)	524288	p
pool4_pool (AveragePooling2D) ool4_conv[0][0]	(None, 7, 7, 512)	0	p
conv5_block1_0_bn (BatchNormali ool4_pool[0][0]	(None, 7, 7, 512)	2048	p
conv5_block1_0_relu (Activation onv5_block1_0_bn[0][0]	(None, 7, 7, 512)	0	c
conv5_block1_1_conv (Conv2D) onv5_block1_0_relu[0][0]	(None, 7, 7, 128)	65536	c
conv5_block1_1_bn (BatchNormali onv5_block1_1_conv[0][0]	(None, 7, 7, 128)	512	c
conv5_block1_1_relu (Activation onv5_block1_1_bn[0][0]	(None, 7, 7, 128)	0	c
conv5_block1_2_conv (Conv2D) onv5_block1_1_relu[0][0]	(None, 7, 7, 32)	36864	c
conv5_block1_concat (Concatenat ool4_pool[0][0] onv5_block1_2_conv[0][0]	(None, 7, 7, 544)	0	p c
conv5_block2_0_bn (BatchNormali onv5_block1_concat[0][0]	(None, 7, 7, 544)	2176	c
conv5_block2_0_relu (Activation onv5_block2_0_bn[0][0]	(None, 7, 7, 544)	0	c

conv5_block2_1_conv (Conv2D) onv5_block2_0_relu[0][0]	(None, 7, 7, 128)	69632	c
conv5_block2_1_bn (BatchNormali onv5_block2_1_conv[0][0]	(None, 7, 7, 128)	512	c
conv5_block2_1_relu (Activation onv5_block2_1_bn[0][0]	(None, 7, 7, 128)	0	c
conv5_block2_2_conv (Conv2D) onv5_block2_1_relu[0][0]	(None, 7, 7, 32)	36864	c
conv5_block2_concat (Concatenat onv5_block1_concat[0][0] onv5_block2_2_conv[0][0]	(None, 7, 7, 576)	0	c c
conv5_block3_0_bn (BatchNormali onv5_block2_concat[0][0]	(None, 7, 7, 576)	2304	c
conv5_block3_0_relu (Activation onv5_block3_0_bn[0][0]	(None, 7, 7, 576)	0	c
conv5_block3_1_conv (Conv2D) onv5_block3_0_relu[0][0]	(None, 7, 7, 128)	73728	c
conv5_block3_1_bn (BatchNormali onv5_block3_1_conv[0][0]	(None, 7, 7, 128)	512	c
conv5_block3_1_relu (Activation onv5_block3_1_bn[0][0]	(None, 7, 7, 128)	0	c
conv5_block3_2_conv (Conv2D) onv5_block3_1_relu[0][0]	(None, 7, 7, 32)	36864	c
conv5_block3_concat (Concatenat onv5_block2_concat[0][0] onv5_block3_2_conv[0][0]	(None, 7, 7, 608)	0	c c

```
conv5_block4_0_bn (BatchNormali  (None, 7, 7, 608)    2432        c
onv5_block3_concat[0][0]


conv5_block4_0_relu (Activation  (None, 7, 7, 608)    0           c
onv5_block4_0_bn[0][0]


conv5_block4_1_conv (Conv2D)     (None, 7, 7, 128)    77824       c
onv5_block4_0_relu[0][0]


conv5_block4_1_bn (BatchNormali  (None, 7, 7, 128)    512         c
onv5_block4_1_conv[0][0]


conv5_block4_1_relu (Activation  (None, 7, 7, 128)    0           c
onv5_block4_1_bn[0][0]


conv5_block4_2_conv (Conv2D)     (None, 7, 7, 32)     36864       c
onv5_block4_1_relu[0][0]


conv5_block4_concat (Concatenat  (None, 7, 7, 640)    0           c
onv5_block3_concat[0][0]
                                                                 c
onv5_block4_2_conv[0][0]


conv5_block5_0_bn (BatchNormali  (None, 7, 7, 640)    2560        c
onv5_block4_concat[0][0]


conv5_block5_0_relu (Activation  (None, 7, 7, 640)    0           c
onv5_block5_0_bn[0][0]


conv5_block5_1_conv (Conv2D)     (None, 7, 7, 128)    81920       c
onv5_block5_0_relu[0][0]


conv5_block5_1_bn (BatchNormali  (None, 7, 7, 128)    512         c
onv5_block5_1_conv[0][0]


conv5_block5_1_relu (Activation  (None, 7, 7, 128)    0           c
onv5_block5_1_bn[0][0]


conv5_block5_2_conv (Conv2D)     (None, 7, 7, 32)     36864       c
onv5_block5_1_relu[0][0]
```

```
conv5_block5_concat (Concatenat (None, 7, 7, 672)        0           c
onv5_block4_concat[0][0]
                                                                     c
onv5_block5_2_conv[0][0]
_____

conv5_block6_0_bn (BatchNormali (None, 7, 7, 672)        2688        c
onv5_block5_concat[0][0]
_____

conv5_block6_0_relu (Activation (None, 7, 7, 672)        0           c
onv5_block6_0_bn[0][0]
_____

conv5_block6_1_conv (Conv2D)    (None, 7, 7, 128)        86016       c
onv5_block6_0_relu[0][0]
_____

conv5_block6_1_bn (BatchNormali (None, 7, 7, 128)        512         c
onv5_block6_1_conv[0][0]
_____

conv5_block6_1_relu (Activation (None, 7, 7, 128)        0           c
onv5_block6_1_bn[0][0]
_____

conv5_block6_2_conv (Conv2D)    (None, 7, 7, 32)         36864       c
onv5_block6_1_relu[0][0]
_____

conv5_block6_concat (Concatenat (None, 7, 7, 704)        0           c
onv5_block5_concat[0][0]
                                                                     c
onv5_block6_2_conv[0][0]
_____

conv5_block7_0_bn (BatchNormali (None, 7, 7, 704)        2816        c
onv5_block6_concat[0][0]
_____

conv5_block7_0_relu (Activation (None, 7, 7, 704)        0           c
onv5_block7_0_bn[0][0]
_____

conv5_block7_1_conv (Conv2D)    (None, 7, 7, 128)        90112       c
onv5_block7_0_relu[0][0]
_____

conv5_block7_1_bn (BatchNormali (None, 7, 7, 128)        512         c
onv5_block7_1_conv[0][0]
_____
```

conv5_block7_1_relu (Activation (None, 7, 7, 128)   0   c
onv5_block7_1_bn[0][0]

_____

conv5_block7_2_conv (Conv2D)   (None, 7, 7, 32)   36864   c
onv5_block7_1_relu[0][0]

_____

conv5_block7_concat (Concatenat (None, 7, 7, 736)   0   c
onv5_block6_concat[0][0]
                                                                c
onv5_block7_2_conv[0][0]

_____

conv5_block8_0_bn (BatchNormali (None, 7, 7, 736)   2944   c
onv5_block7_concat[0][0]

_____

conv5_block8_0_relu (Activation (None, 7, 7, 736)   0   c
onv5_block8_0_bn[0][0]

_____

conv5_block8_1_conv (Conv2D)   (None, 7, 7, 128)   94208   c
onv5_block8_0_relu[0][0]

_____

conv5_block8_1_bn (BatchNormali (None, 7, 7, 128)   512   c
onv5_block8_1_conv[0][0]

_____

conv5_block8_1_relu (Activation (None, 7, 7, 128)   0   c
onv5_block8_1_bn[0][0]

_____

conv5_block8_2_conv (Conv2D)   (None, 7, 7, 32)   36864   c
onv5_block8_1_relu[0][0]

_____

conv5_block8_concat (Concatenat (None, 7, 7, 768)   0   c
onv5_block7_concat[0][0]
                                                                c
onv5_block8_2_conv[0][0]

_____

conv5_block9_0_bn (BatchNormali (None, 7, 7, 768)   3072   c
onv5_block8_concat[0][0]

_____

conv5_block9_0_relu (Activation (None, 7, 7, 768)   0   c
onv5_block9_0_bn[0][0]

_____

conv5_block9_1_conv (Conv2D)   (None, 7, 7, 128)   98304   c

```
                                              onv5_block9_0_relu[0][0]
_____
conv5_block9_1_bn (BatchNormali (None, 7, 7, 128)    512         c
onv5_block9_1_conv[0][0]
_____
conv5_block9_1_relu (Activation (None, 7, 7, 128)    0           c
onv5_block9_1_bn[0][0]
_____
conv5_block9_2_conv (Conv2D)    (None, 7, 7, 32)     36864       c
onv5_block9_1_relu[0][0]
_____
conv5_block9_concat (Concatenat (None, 7, 7, 800)    0           c
onv5_block8_concat[0][0]
                                                                 c
onv5_block9_2_conv[0][0]
_____
conv5_block10_0_bn (BatchNormal (None, 7, 7, 800)    3200        c
onv5_block9_concat[0][0]
_____
conv5_block10_0_relu (Activatio (None, 7, 7, 800)    0           c
onv5_block10_0_bn[0][0]
_____
conv5_block10_1_conv (Conv2D)   (None, 7, 7, 128)    102400      c
onv5_block10_0_relu[0][0]
_____
conv5_block10_1_bn (BatchNormal (None, 7, 7, 128)    512         c
onv5_block10_1_conv[0][0]
_____
conv5_block10_1_relu (Activatio (None, 7, 7, 128)    0           c
onv5_block10_1_bn[0][0]
_____
conv5_block10_2_conv (Conv2D)   (None, 7, 7, 32)     36864       c
onv5_block10_1_relu[0][0]
_____
conv5_block10_concat (Concatena (None, 7, 7, 832)    0           c
onv5_block9_concat[0][0]
                                                                 c
onv5_block10_2_conv[0][0]
_____
conv5_block11_0_bn (BatchNormal (None, 7, 7, 832)    3328        c
onv5_block10_concat[0][0]
```

conv5_block11_0_relu (Activatio onv5_block11_0_bn[0][0]	(None, 7, 7, 832)	0		c
conv5_block11_1_conv (Conv2D) onv5_block11_0_relu[0][0]	(None, 7, 7, 128)	106496		c
conv5_block11_1_bn (BatchNormal onv5_block11_1_conv[0][0]	(None, 7, 7, 128)	512		c
conv5_block11_1_relu (Activatio onv5_block11_1_bn[0][0]	(None, 7, 7, 128)	0		c
conv5_block11_2_conv (Conv2D) onv5_block11_1_relu[0][0]	(None, 7, 7, 32)	36864		c
conv5_block11_concat (Concatena onv5_block10_concat[0][0] onv5_block11_2_conv[0][0]	(None, 7, 7, 864)	0		c c
conv5_block12_0_bn (BatchNormal onv5_block11_concat[0][0]	(None, 7, 7, 864)	3456		c
conv5_block12_0_relu (Activatio onv5_block12_0_bn[0][0]	(None, 7, 7, 864)	0		c
conv5_block12_1_conv (Conv2D) onv5_block12_0_relu[0][0]	(None, 7, 7, 128)	110592		c
conv5_block12_1_bn (BatchNormal onv5_block12_1_conv[0][0]	(None, 7, 7, 128)	512		c
conv5_block12_1_relu (Activatio onv5_block12_1_bn[0][0]	(None, 7, 7, 128)	0		c
conv5_block12_2_conv (Conv2D) onv5_block12_1_relu[0][0]	(None, 7, 7, 32)	36864		c
conv5_block12_concat (Concatena	(None, 7, 7, 896)	0		c

```
                                                              onv5_block11_concat[0][0]
                                                                                                                    c
                                                              onv5_block12_2_conv[0][0]
_____

conv5_block13_0_bn (BatchNormal (None, 7, 7, 896)       3584            c
onv5_block12_concat[0][0]
_____

conv5_block13_0_relu (Activatio (None, 7, 7, 896)       0               c
onv5_block13_0_bn[0][0]
_____

conv5_block13_1_conv (Conv2D)   (None, 7, 7, 128)       114688          c
onv5_block13_0_relu[0][0]
_____

conv5_block13_1_bn (BatchNormal (None, 7, 7, 128)       512             c
onv5_block13_1_conv[0][0]
_____

conv5_block13_1_relu (Activatio (None, 7, 7, 128)       0               c
onv5_block13_1_bn[0][0]
_____

conv5_block13_2_conv (Conv2D)   (None, 7, 7, 32)        36864           c
onv5_block13_1_relu[0][0]
_____

conv5_block13_concat (Concatena (None, 7, 7, 928)       0               c
onv5_block12_concat[0][0]
                                                                        c
onv5_block13_2_conv[0][0]
_____

conv5_block14_0_bn (BatchNormal (None, 7, 7, 928)       3712            c
onv5_block13_concat[0][0]
_____

conv5_block14_0_relu (Activatio (None, 7, 7, 928)       0               c
onv5_block14_0_bn[0][0]
_____

conv5_block14_1_conv (Conv2D)   (None, 7, 7, 128)       118784          c
onv5_block14_0_relu[0][0]
_____

conv5_block14_1_bn (BatchNormal (None, 7, 7, 128)       512             c
onv5_block14_1_conv[0][0]
_____

conv5_block14_1_relu (Activatio (None, 7, 7, 128)       0               c
onv5_block14_1_bn[0][0]
```

| conv5_block14_2_conv (Conv2D) onv5_block14_1_relu[0][0] | (None, 7, 7, 32) | 36864 | c |

conv5_block14_concat (Concatena onv5_block13_concat[0][0]	(None, 7, 7, 960)	0	c
			c
onv5_block14_2_conv[0][0]			

| conv5_block15_0_bn (BatchNormal onv5_block14_concat[0][0] | (None, 7, 7, 960) | 3840 | c |

| conv5_block15_0_relu (Activatio onv5_block15_0_bn[0][0] | (None, 7, 7, 960) | 0 | c |

| conv5_block15_1_conv (Conv2D) onv5_block15_0_relu[0][0] | (None, 7, 7, 128) | 122880 | c |

| conv5_block15_1_bn (BatchNormal onv5_block15_1_conv[0][0] | (None, 7, 7, 128) | 512 | c |

| conv5_block15_1_relu (Activatio onv5_block15_1_bn[0][0] | (None, 7, 7, 128) | 0 | c |

| conv5_block15_2_conv (Conv2D) onv5_block15_1_relu[0][0] | (None, 7, 7, 32) | 36864 | c |

conv5_block15_concat (Concatena onv5_block14_concat[0][0]	(None, 7, 7, 992)	0	c
			c
onv5_block15_2_conv[0][0]			

| conv5_block16_0_bn (BatchNormal onv5_block15_concat[0][0] | (None, 7, 7, 992) | 3968 | c |

| conv5_block16_0_relu (Activatio onv5_block16_0_bn[0][0] | (None, 7, 7, 992) | 0 | c |

| conv5_block16_1_conv (Conv2D) onv5_block16_0_relu[0][0] | (None, 7, 7, 128) | 126976 | c |

```
conv5_block16_1_bn (BatchNormal (None, 7, 7, 128)     512          c
onv5_block16_1_conv[0][0]
_____

conv5_block16_1_relu (Activatio (None, 7, 7, 128)     0            c
onv5_block16_1_bn[0][0]
_____

conv5_block16_2_conv (Conv2D)   (None, 7, 7, 32)      36864        c
onv5_block16_1_relu[0][0]
_____

conv5_block16_concat (Concatena (None, 7, 7, 1024)    0            c
onv5_block15_concat[0][0]
                                                                   c
onv5_block16_2_conv[0][0]
================================================================
================================
Total params: 7,033,408
Trainable params: 6,951,808
Non-trainable params: 81,600
_____


_____
```

In [17]:
```python
model_C = models.Sequential()
model_C.add(model)
model_C.add(layers.Flatten())
model_C.add(layers.Dense(4096, activation='relu'))
model_C.summary()
```

Model: "sequential_6"

Layer (type)	Output Shape	Param #
model_2 (Model)	(None, 7, 7, 1024)	7033408
flatten_4 (Flatten)	(None, 50176)	0
dense_4 (Dense)	(None, 4096)	205524992

```
Total params: 212,558,400
Trainable params: 212,476,800
Non-trainable params: 81,600
```

In [18]:
```python
from keras.preprocessing.image import load_img, img_to_array
from keras.applications.vgg16 import preprocess_input
from collections import OrderedDict

images = OrderedDict()
npix = 224
target_size = (npix,npix,3)
data = np.zeros((len(jpgs),npix,npix,3))
for i,name in enumerate(jpgs):
    # load an image from file
    filename = dir_Flickr_jpg + '/' + name
    image = load_img(filename, target_size=target_size)
    # convert the image pixels to a numpy array
    image = img_to_array(image)
    nimage = preprocess_input(image)

    y_pred = model_C.predict(nimage.reshape( (1,) + nimage.shape[:3
]))
    images[name] = y_pred.flatten()
```

WARNING:tensorflow:From /home/veda18/.conda/envs/keras/lib/python3
.7/site-packages/keras/backend/tensorflow_backend.py:422: The name
tf.global_variables is deprecated. Please use tf.compat.v1.global_
variables instead.

In [19]:
```python
dimages, keepindex = [],[]
df_txt0 = df_txt0.loc[df_txt0["index"].values == "0",: ]
for i, fnm in enumerate(df_txt0.filename):
    if fnm in images.keys():
        dimages.append(images[fnm])
        keepindex.append(i)

fnames = df_txt0["filename"].iloc[keepindex].values
dcaptions = df_txt0["caption"].iloc[keepindex].values
dimages = np.array(dimages)
```

In [20]:
```python
from keras.preprocessing.text import Tokenizer
## the maximum number of words in dictionary
nb_words = 8000
tokenizer = Tokenizer(nb_words=nb_words)
tokenizer.fit_on_texts(dcaptions)
vocab_size = len(tokenizer.word_index) + 1
print("vocabulary size : {}".format(vocab_size))
dtexts = tokenizer.texts_to_sequences(dcaptions)
print(dtexts[:5])
```

```
vocabulary size : 4423
[[2, 1, 39, 4, 1, 67, 145, 8, 125, 51, 1, 413, 10, 370, 4, 25, 235
3, 485, 3], [2, 1, 13, 9, 6, 1, 761, 9, 18, 371, 3], [2, 1, 49, 16
, 152, 4, 558, 102, 4, 43, 10, 1, 559, 1207, 12, 56, 219, 4, 1, 10
88, 3], [2, 1, 11, 630, 7, 1, 153, 28, 24, 9, 102, 47, 113, 3], [2
, 1, 11, 4, 25, 83, 97, 1208, 20, 167, 3]]
```

In [21]:
```python
prop_test, prop_val = 0.2, 0.2

N = len(dtexts)
Ntest, Nval = int(N*prop_test), int(N*prop_val)

def split_test_val_train(dtexts,Ntest,Nval):
    return(dtexts[:Ntest],
           dtexts[Ntest:Ntest+Nval],
           dtexts[Ntest+Nval:])

dt_test,  dt_val, dt_train  = split_test_val_train(dtexts,Ntest,Nval)
di_test,  di_val, di_train  = split_test_val_train(dimages,Ntest,Nval)
fnm_test,fnm_val, fnm_train  = split_test_val_train(fnames,Ntest,Nval)
```

In [22]:
```python
maxlen = np.max([len(text) for text in dtexts])
```

In [23]:
```python
from keras.preprocessing.sequence import pad_sequences
from keras.utils import to_categorical

def preprocessing(dtexts,dimages):
    N = len(dtexts)
    print("# captions/images = {}".format(N))

    assert(N==len(dimages))
    Xtext, Ximage, ytext = [],[],[]
    for text,image in zip(dtexts,dimages):

        for i in range(1,len(text)):
            in_text, out_text = text[:i], text[i]
            in_text = pad_sequences([in_text],maxlen=maxlen).flatte
n()
            out_text = to_categorical(out_text,num_classes = vocab_
size)

            Xtext.append(in_text)
            Ximage.append(image)
            ytext.append(out_text)

    Xtext  = np.array(Xtext)
    Ximage = np.array(Ximage)
    ytext  = np.array(ytext)
    print(" {} {} {}".format(Xtext.shape,Ximage.shape,ytext.shape))
    return(Xtext,Ximage,ytext)


Xtext_train, Ximage_train, ytext_train = preprocessing(dt_train,di_
train)
Xtext_val,  Ximage_val,   ytext_val  = preprocessing(dt_val,di_va
l)
# pre-processing is not necessary for testing data
#Xtext_test,  Ximage_test,  ytext_test  = preprocessing(dt_test,di_
test)
```

```
# captions/images = 4855
 (59087, 35) (59087, 4096) (59087, 4423)
# captions/images = 1618
 (19489, 35) (19489, 4096) (19489, 4423)
```

In [24]:
```python
from keras import layers
print(vocab_size)
## image feature

dim_embedding = 64

input_image = layers.Input(shape=(Ximage_train.shape[1],))
fimage = layers.Dense(256,activation='relu',name="ImageFeature")(in
put_image)
## sequence model
input_txt = layers.Input(shape=(maxlen,))
ftxt = layers.Embedding(vocab_size,dim_embedding, mask_zero=True)(i
nput_txt)
ftxt = layers.LSTM(256,name="CaptionFeature")(ftxt)
## combined model for decoder
decoder = layers.add([ftxt,fimage])
decoder = layers.Dense(256,activation='relu')(decoder)
output = layers.Dense(vocab_size,activation='softmax')(decoder)
model = models.Model(inputs=[input_image, input_txt],outputs=output
)

model.compile(loss='categorical_crossentropy', optimizer='adam')

print(model.summary())
```

```
4423
WARNING:tensorflow:From /home/veda18/.conda/envs/keras/lib/python3
.7/site-packages/tensorflow_core/python/keras/backend.py:3994: whe
re (from tensorflow.python.ops.array_ops) is deprecated and will b
e removed in a future version.
Instructions for updating:
Use tf.where in 2.0, which has the same broadcast rule as np.where
Model: "model_3"
```

Layer (type)	Output Shape	Param #	C
			onnected to
===			
==============================			
input_4 (InputLayer)	(None, 35)	0	
embedding_1 (Embedding)	(None, 35, 64)	283072	i
nput_4[0][0]			
input_3 (InputLayer)	(None, 4096)	0	
CaptionFeature (LSTM)	(None, 256)	328704	e
mbedding_1[0][0]			
ImageFeature (Dense)	(None, 256)	1048832	i
nput_3[0][0]			
add_1 (Add)	(None, 256)	0	C
aptionFeature[0][0]			
			I
mageFeature[0][0]			
dense_5 (Dense)	(None, 256)	65792	a
dd_1[0][0]			
dense_6 (Dense)	(None, 4423)	1136711	d
ense_5[0][0]			
===			
==============================			

```
Total params: 2,863,111
Trainable params: 2,863,111
Non-trainable params: 0
```

None

```
In [25]:  # fit model
          start = time.time()
          hist = model.fit([Ximage_train, Xtext_train], ytext_train,
                           epochs=5, verbose=2,
                           batch_size=64,
                           validation_data=([Ximage_val, Xtext_val], ytext_v
          al))
          end = time.time()
          print("TIME TOOK {:3.2f}MIN".format((end - start )/60))
```

```
Train on 59087 samples, validate on 19489 samples
Epoch 1/5
 - 60s - loss: 4.6411 - val_loss: 4.0539
Epoch 2/5
 - 56s - loss: 3.7947 - val_loss: 3.8304
Epoch 3/5
 - 56s - loss: 3.4610 - val_loss: 3.7849
Epoch 4/5
 - 55s - loss: 3.2302 - val_loss: 3.7417
Epoch 5/5
 - 56s - loss: 3.0389 - val_loss: 3.7598
TIME TOOK 4.79MIN
```
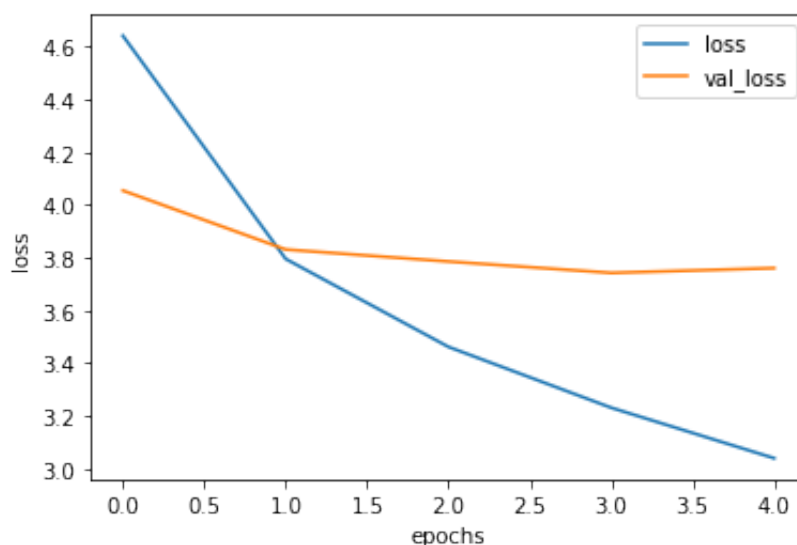
```
In [28]:  print(Ximage_train.shape,Xtext_train.shape,ytext_train.shape)
```

```
(59087, 4096) (59087, 35) (59087, 4423)
```

```
In [29]:  for label in ["loss","val_loss"]:
              plt.plot(hist.history[label],label=label)
          plt.legend()
          plt.xlabel("epochs")
          plt.ylabel("loss")
          plt.show()
```

```
In [30]:  index_word = dict([(index,word) for word, index in tokenizer.word_i
          ndex.items()])
          def predict_caption(image):
              '''
              image.shape = (1,4462)
              '''

              in_text = 'startseq'

              for iword in range(maxlen):
                  sequence = tokenizer.texts_to_sequences([in_text])[0]
                  sequence = pad_sequences([sequence],maxlen)
                  yhat = model.predict([image,sequence],verbose=0)
                  yhat = np.argmax(yhat)
                  newword = index_word[yhat]
                  in_text += " " + newword
                  if newword == "endseq":
                      break
              return(in_text)



          npic = 10
          npix = 224
          target_size = (npix,npix,3)

          count = 1
          fig = plt.figure(figsize=(10,20))
          for jpgfnm, image_feature in zip(fnm_test[:npic],di_test[:npic]):
              ## images
              filename = dir_Flickr_jpg + '/' + jpgfnm
              image_load = load_img(filename, target_size=target_size)
              ax = fig.add_subplot(npic,2,count,xticks=[],yticks=[])
              ax.imshow(image_load)
              count += 1

              ## captions
              caption = predict_caption(image_feature.reshape(1,len(image_fea
          ture)))
              ax = fig.add_subplot(npic,2,count)
              plt.axis('off')
              ax.plot()
              ax.set_xlim(0,1)
              ax.set_ylim(0,1)
              ax.text(0,0.5,caption,fontsize=20)
              count += 1

          plt.show()
```

 startseq a man in a red shirt and a white shirt and a white shirt and a man in a red shirt and a man in a red shirt and a man in a red shirt

 startseq a black dog is running through the water endseq

 startseq a man in a red shirt and a white shirt and a white shirt and a man in a red shirt and a man in a red shirt and a man in a red shirt

 startseq a man in a blue shirt is riding a skateboard on a skateboard endseq

 startseq a man in a red shirt and jeans is riding a skateboard endseq

 startseq a group of people are standing in a red game endseq

 startseq a black dog is running through the water endseq

 startseq a black dog is running through the water endseq

 startseq a man in a red shirt is riding a skateboard in the snow endseq

 startseq a black dog is running through the water endseq

In [34]:
```python
from nltk.translate.bleu_score import sentence_bleu
index_word = dict([(index,word) for word, index in tokenizer.word_i
ndex.items()])


nkeep = 5
pred_good, pred_bad, bleus = [], [], []
count = 0
for jpgfnm, image_feature, tokenized_text in zip(fnm_test,di_test,d
t_test):
    count += 1
    if count % 200 == 0:
        print("  {:4.2f}% is done..".format(100*count/float(len(fnm
_test))))

    caption_true = [ index_word[i] for i in tokenized_text ]
    caption_true = caption_true[1:-1] ## remove startreg, and endre
g
    ## captions
    caption = predict_caption(image_feature.reshape(1,len(image_fea
ture)))
    caption = caption.split()
    caption = caption[1:-1]## remove startreg, and endreg

    bleu = sentence_bleu([caption_true],caption)
    bleus.append(bleu)
    if bleu > 0.6 and len(pred_good) < nkeep:
        pred_good.append((bleu,jpgfnm,caption_true,caption))
    elif bleu < 0.3 and len(pred_bad) < nkeep:
        pred_bad.append((bleu,jpgfnm,caption_true,caption))
```

```
 12.36% is done..
 24.72% is done..
 37.08% is done..
 49.44% is done..
 61.80% is done..
 74.17% is done..
 86.53% is done..
 98.89% is done..
```

In [35]:
```python
print("Mean BLEU {:4.3f}".format(np.mean(bleus)))
```

```
Mean BLEU 0.010
```

```
In [36]: def plot_images(pred_bad):
             def create_str(caption_true):
                 strue = ""
                 for s in caption_true:
                     strue += " " + s
                 return(strue)
             npix = 224
             target_size = (npix,npix,3)
             count = 1
             fig = plt.figure(figsize=(10,20))
             npic = len(pred_bad)
             for pb in pred_bad:
                 bleu,jpgfnm,caption_true,caption = pb
                 ## images
                 filename = dir_Flickr_jpg + '/' + jpgfnm
                 image_load = load_img(filename, target_size=target_size)
                 ax = fig.add_subplot(npic,2,count,xticks=[],yticks=[])
                 ax.imshow(image_load)
                 count += 1

                 caption_true = create_str(caption_true)
                 caption = create_str(caption)

                 ax = fig.add_subplot(npic,2,count)
                 plt.axis('off')
                 ax.plot()
                 ax.set_xlim(0,1)
                 ax.set_ylim(0,1)
                 ax.text(0,0.7,"true:" + caption_true,fontsize=20)
                 ax.text(0,0.4,"pred:" + caption,fontsize=20)
                 ax.text(0,0.1,"BLEU: {}".format(bleu),fontsize=20)
                 count += 1
             plt.show()

         print("Bad Caption")
         plot_images(pred_bad)
         print("Good Caption")
         plot_images(pred_good)
```
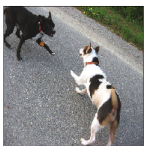
Bad Caption

true: a child in a pink dress is climbing up a set of stairs in an entry way

pred: a man in a red shirt and a white shirt and a white shirt and a man in a red shirt and a man in a red shirt and a man in a red

BLEU: 3.8540425273546335e-155

true: a black dog and a spotted dog are fighting
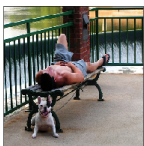
pred: a black dog is running through the water

BLEU: 3.940055059819774e-78

true: a little girl covered in paint sits in front of a painted rainbow with her hands in a bowl

pred: a man in a red shirt and a white shirt and a white shirt and a man in a red shirt and a man in a red shirt and a man in a red

BLEU: 4.033776337840988e-155

true: a man lays on a bench while his dog sits by him

pred: a man in a blue shirt is riding a skateboard on a skateboard

BLEU: 7.098450576376767e-155

true: a man in an orange hat starring at something

pred: a man in a red shirt and jeans is riding a skateboard

BLEU: 3.1712496890592535e-78

Good Caption

true: a black dog is running in the water

pred: a black dog is running in the snow

BLEU: 0.8408964152537145