

CarStyle

October 1, 2024

```
[1]: import tensorflow as tf
import os
import cv2
import math
import json
import numpy as np
from matplotlib import pyplot as plt
from keras.applications import DenseNet169
from keras.models import Model
from keras.layers import Dense, GlobalAveragePooling2D
from keras.metrics import Precision, Recall, SparseCategoricalAccuracy

[2]: print("Num GPUs Available: ", len(tf.config.list_physical_devices('GPU')))
gpus = tf.config.experimental.list_physical_devices('GPU')
if gpus:
    try:
        for gpu in gpus:
            tf.config.experimental.set_memory_growth(gpu, True)
        logical_gpus = tf.config.experimental.list_logical_devices('GPU')
        print(len(gpus), "Physical GPUs,", len(logical_gpus), "Logical GPUs")
    except RuntimeError as e:
        print(e)
```

```
Num GPUs Available:  1
1 Physical GPUs, 1 Logical GPUs
```

```
[3]: base_dir = 'Styles'
train_dir = os.path.join(base_dir, 'train')
val_dir = os.path.join(base_dir, 'valid')
test_dir = os.path.join(base_dir, 'test')

img_size = (224, 224)
batch_size = 32

train_data = tf.keras.utils.image_dataset_from_directory(
    train_dir,
    image_size=img_size,
    batch_size=batch_size,
```

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        label_mode='int',
        interpolation='bilinear'
    )

    val_data = tf.keras.utils.image_dataset_from_directory(
        val_dir,
        image_size=img_size,
        batch_size=batch_size,
        label_mode='int',
        interpolation='bilinear'
    )

    test_data = tf.keras.utils.image_dataset_from_directory(
        test_dir,
        image_size=img_size,
        batch_size=batch_size,
        label_mode='int',
        interpolation='bilinear'
    )

```

Found 5350 files belonging to 7 classes.
 Found 1397 files belonging to 7 classes.
 Found 802 files belonging to 7 classes.

```

[4]: class_names = train_data.class_names
    print("Class names test:", class_names)

    with open('CarStyle map.json', 'w') as f:
        json.dump(class_names, f)

    data_iterator = train_data.as_numpy_iterator()

```

Class names test: ['Convertible', 'Coupe', 'Hatchback', 'Pick-Up', 'SUV', 'Sedan', 'VAN']

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[5]: batch = data_iterator.next()
    num_classes = len(class_names)

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[6]: ncols = 4
    nrows = math.ceil(num_classes / ncols)
    fig, ax = plt.subplots(nrows=nrows, ncols=ncols, figsize=(20, 20))

    if nrows == 1:
        ax = ax.flatten()
    elif ncols == 1:
        ax = ax.flatten()

    plotted = set()

```

```

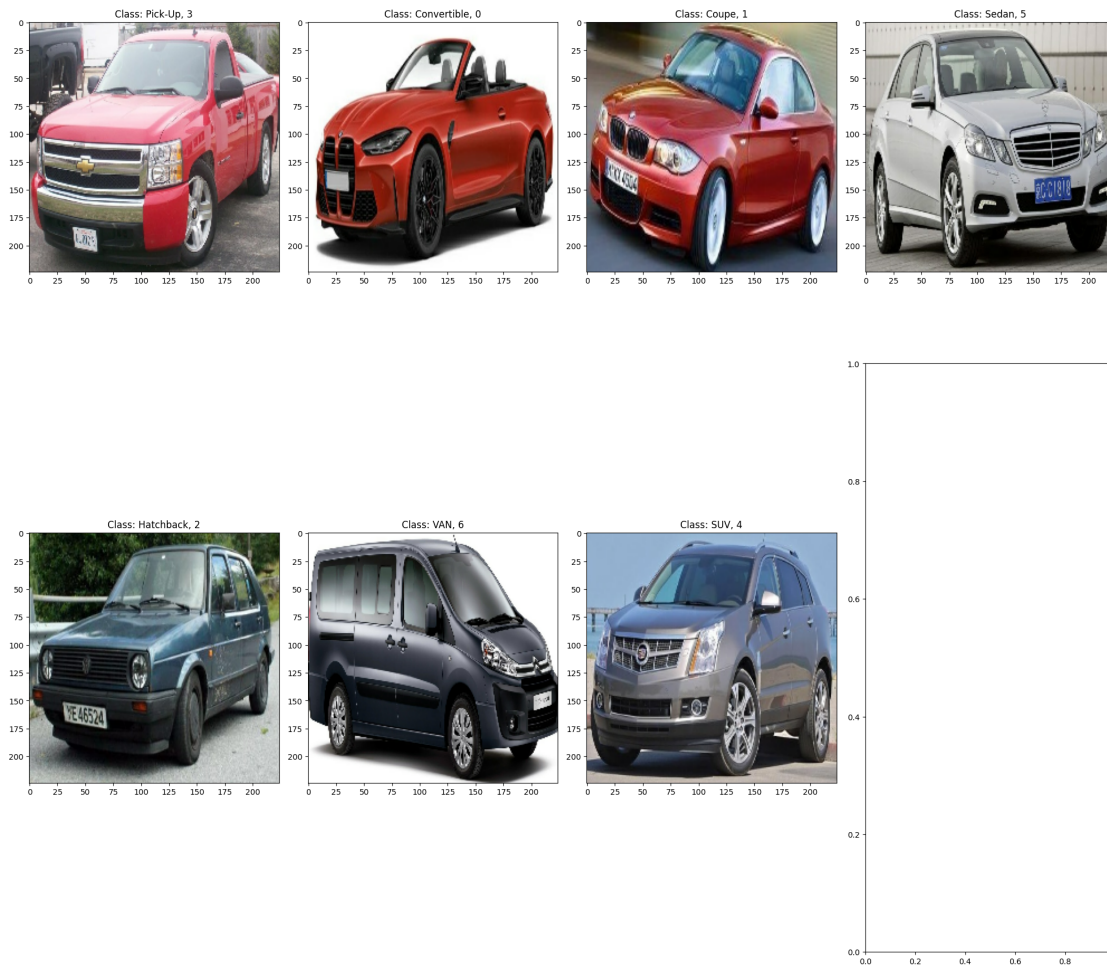
count = 0
while count < num_classes:
    batch = next(data_iterator)

    for idx, img in enumerate(batch[0]):
        label = batch[1][idx]
        if label not in plotted:
            ax_idx = count if nrows == 1 or ncols == 1 else (count // ncols,
↪count % ncols)
            ax[ax_idx].imshow(img.astype(int))
            ax[ax_idx].title.set_text(f"Class: {class_names[label]}, {label}")
            plotted.add(label)
            count += 1

    if count == num_classes:
        break

plt.tight_layout()
plt.show()

```



```
[7]: base_model = DenseNet169(
      weights='imagenet',
      include_top=False,
      input_shape=(224, 224, 3)
    )
    base_model.summary()
```

Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/densenet/densenet169_weights_tf_dim_ordering_tf_kernels_notop.h5
51877672/51877672 [=====] - 1s 0us/step
Model: "densenet169"

```
-----
-----
Layer (type)                Output Shape              Param #   Connected to
=====
input_1 (InputLayer)        [(None, 224, 224, 3) 0   []
                                )]

zero_padding2d (ZeroPadding2D) (None, 230, 230, 3) 0
['input_1[0][0]']

conv1/conv (Conv2D)         (None, 112, 112, 64) 9408
['zero_padding2d[0][0]']
                                )

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

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

zero_padding2d_1 (ZeroPadding2D) (None, 114, 114, 64) 0
['conv1/relu[0][0]']
                                )

pool1 (MaxPooling2D)        (None, 56, 56, 64) 0
['zero_padding2d_1[0][0]']

conv2_block1_0_bn (BatchNormalization) (None, 56, 56, 64) 256
['pool1[0][0]']

conv2_block1_0_relu (Activation) (None, 56, 56, 64) 0
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['conv2_block1_0_bn[0][0]']
n)

conv2_block1_1_conv (Conv2D) (None, 56, 56, 128) 8192
['conv2_block1_0_relu[0][0]']

conv2_block1_1_bn (BatchNormal (None, 56, 56, 128) 512
['conv2_block1_1_conv[0][0]']
ization)

conv2_block1_1_relu (Activatio (None, 56, 56, 128) 0
['conv2_block1_1_bn[0][0]']
n)

conv2_block1_2_conv (Conv2D) (None, 56, 56, 32) 36864
['conv2_block1_1_relu[0][0]']

conv2_block1_concat (Concatena (None, 56, 56, 96) 0 ['pool1[0][0]',
te)
'conv2_block1_2_conv[0][0]']

conv2_block2_0_bn (BatchNormal (None, 56, 56, 96) 384
['conv2_block1_concat[0][0]']
ization)

conv2_block2_0_relu (Activatio (None, 56, 56, 96) 0
['conv2_block2_0_bn[0][0]']
n)

conv2_block2_1_conv (Conv2D) (None, 56, 56, 128) 12288
['conv2_block2_0_relu[0][0]']

conv2_block2_1_bn (BatchNormal (None, 56, 56, 128) 512
['conv2_block2_1_conv[0][0]']
ization)

conv2_block2_1_relu (Activatio (None, 56, 56, 128) 0
['conv2_block2_1_bn[0][0]']
n)

conv2_block2_2_conv (Conv2D) (None, 56, 56, 32) 36864
['conv2_block2_1_relu[0][0]']

conv2_block2_concat (Concatena (None, 56, 56, 128) 0
['conv2_block1_concat[0][0]',
te)
'conv2_block2_2_conv[0][0]']

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conv2_block3_0_bn (BatchNormal (None, 56, 56, 128) 512
['conv2_block2_concat[0][0] '
ization)

conv2_block3_0_relu (Activatio (None, 56, 56, 128) 0
['conv2_block3_0_bn[0][0] '
n)

conv2_block3_1_conv (Conv2D) (None, 56, 56, 128) 16384
['conv2_block3_0_relu[0][0] '

conv2_block3_1_bn (BatchNormal (None, 56, 56, 128) 512
['conv2_block3_1_conv[0][0] '
ization)

conv2_block3_1_relu (Activatio (None, 56, 56, 128) 0
['conv2_block3_1_bn[0][0] '
n)

conv2_block3_2_conv (Conv2D) (None, 56, 56, 32) 36864
['conv2_block3_1_relu[0][0] '

conv2_block3_concat (Concatena (None, 56, 56, 160) 0
['conv2_block2_concat[0][0] ',
te)
'conv2_block3_2_conv[0][0] '

conv2_block4_0_bn (BatchNormal (None, 56, 56, 160) 640
['conv2_block3_concat[0][0] '
ization)

conv2_block4_0_relu (Activatio (None, 56, 56, 160) 0
['conv2_block4_0_bn[0][0] '
n)

conv2_block4_1_conv (Conv2D) (None, 56, 56, 128) 20480
['conv2_block4_0_relu[0][0] '

conv2_block4_1_bn (BatchNormal (None, 56, 56, 128) 512
['conv2_block4_1_conv[0][0] '
ization)

conv2_block4_1_relu (Activatio (None, 56, 56, 128) 0
['conv2_block4_1_bn[0][0] '
n)

conv2_block4_2_conv (Conv2D) (None, 56, 56, 32) 36864
['conv2_block4_1_relu[0][0] '

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conv2_block4_concat (Concatenation) (None, 56, 56, 192) 0
['conv2_block3_concat[0][0]',
 te)
'conv2_block4_2_conv[0][0]']

conv2_block5_0_bn (BatchNormalization) (None, 56, 56, 192) 768
['conv2_block4_concat[0][0]']
ization)

conv2_block5_0_relu (Activation) (None, 56, 56, 192) 0
['conv2_block5_0_bn[0][0]']
n)

conv2_block5_1_conv (Conv2D) (None, 56, 56, 128) 24576
['conv2_block5_0_relu[0][0]']

conv2_block5_1_bn (BatchNormalization) (None, 56, 56, 128) 512
['conv2_block5_1_conv[0][0]']
ization)

conv2_block5_1_relu (Activation) (None, 56, 56, 128) 0
['conv2_block5_1_bn[0][0]']
n)

conv2_block5_2_conv (Conv2D) (None, 56, 56, 32) 36864
['conv2_block5_1_relu[0][0]']

conv2_block5_concat (Concatenation) (None, 56, 56, 224) 0
['conv2_block4_concat[0][0]',
 te)
'conv2_block5_2_conv[0][0]']

conv2_block6_0_bn (BatchNormalization) (None, 56, 56, 224) 896
['conv2_block5_concat[0][0]']
ization)

conv2_block6_0_relu (Activation) (None, 56, 56, 224) 0
['conv2_block6_0_bn[0][0]']
n)

conv2_block6_1_conv (Conv2D) (None, 56, 56, 128) 28672
['conv2_block6_0_relu[0][0]']

conv2_block6_1_bn (BatchNormalization) (None, 56, 56, 128) 512
['conv2_block6_1_conv[0][0]']
ization)

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conv2_block6_1_relu (Activation) (None, 56, 56, 128) 0
['conv2_block6_1_bn[0][0]']
n)

conv2_block6_2_conv (Conv2D) (None, 56, 56, 32) 36864
['conv2_block6_1_relu[0][0]']

conv2_block6_concat (Concatenation) (None, 56, 56, 256) 0
['conv2_block5_concat[0][0]',
te)
'conv2_block6_2_conv[0][0]']

pool2_bn (BatchNormalization) (None, 56, 56, 256) 1024
['conv2_block6_concat[0][0]']

pool2_relu (Activation) (None, 56, 56, 256) 0
['pool2_bn[0][0]']

pool2_conv (Conv2D) (None, 56, 56, 128) 32768
['pool2_relu[0][0]']

pool2_pool (AveragePooling2D) (None, 28, 28, 128) 0
['pool2_conv[0][0]']

conv3_block1_0_bn (BatchNormalization) (None, 28, 28, 128) 512
['pool2_pool[0][0]']
ization)

conv3_block1_0_relu (Activation) (None, 28, 28, 128) 0
['conv3_block1_0_bn[0][0]']
n)

conv3_block1_1_conv (Conv2D) (None, 28, 28, 128) 16384
['conv3_block1_0_relu[0][0]']

conv3_block1_1_bn (BatchNormalization) (None, 28, 28, 128) 512
['conv3_block1_1_conv[0][0]']
ization)

conv3_block1_1_relu (Activation) (None, 28, 28, 128) 0
['conv3_block1_1_bn[0][0]']
n)

conv3_block1_2_conv (Conv2D) (None, 28, 28, 32) 36864
['conv3_block1_1_relu[0][0]']

conv3_block1_concat (Concatenation) (None, 28, 28, 160) 0
['pool2_pool[0][0]',

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te)
'conv3_block1_2_conv[0][0]']

conv3_block2_0_bn (BatchNormal (None, 28, 28, 160) 640
['conv3_block1_concat[0][0]']
ization)

conv3_block2_0_relu (Activatio (None, 28, 28, 160) 0
['conv3_block2_0_bn[0][0]']
n)

conv3_block2_1_conv (Conv2D) (None, 28, 28, 128) 20480
['conv3_block2_0_relu[0][0]']

conv3_block2_1_bn (BatchNormal (None, 28, 28, 128) 512
['conv3_block2_1_conv[0][0]']
ization)

conv3_block2_1_relu (Activatio (None, 28, 28, 128) 0
['conv3_block2_1_bn[0][0]']
n)

conv3_block2_2_conv (Conv2D) (None, 28, 28, 32) 36864
['conv3_block2_1_relu[0][0]']

conv3_block2_concat (Concatena (None, 28, 28, 192) 0
['conv3_block1_concat[0][0]'],
te)
'conv3_block2_2_conv[0][0]']

conv3_block3_0_bn (BatchNormal (None, 28, 28, 192) 768
['conv3_block2_concat[0][0]']
ization)

conv3_block3_0_relu (Activatio (None, 28, 28, 192) 0
['conv3_block3_0_bn[0][0]']
n)

conv3_block3_1_conv (Conv2D) (None, 28, 28, 128) 24576
['conv3_block3_0_relu[0][0]']

conv3_block3_1_bn (BatchNormal (None, 28, 28, 128) 512
['conv3_block3_1_conv[0][0]']
ization)

conv3_block3_1_relu (Activatio (None, 28, 28, 128) 0
['conv3_block3_1_bn[0][0]']
n)

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conv3_block3_2_conv (Conv2D)    (None, 28, 28, 32)    36864
['conv3_block3_1_relu[0][0]']

conv3_block3_concat (Concatena (None, 28, 28, 224)    0
['conv3_block2_concat[0][0]',
te)
'conv3_block3_2_conv[0][0]']

conv3_block4_0_bn (BatchNormal (None, 28, 28, 224)    896
['conv3_block3_concat[0][0]']
ization)

conv3_block4_0_relu (Activatio (None, 28, 28, 224)    0
['conv3_block4_0_bn[0][0]']
n)

conv3_block4_1_conv (Conv2D)    (None, 28, 28, 128)   28672
['conv3_block4_0_relu[0][0]']

conv3_block4_1_bn (BatchNormal (None, 28, 28, 128)   512
['conv3_block4_1_conv[0][0]']
ization)

conv3_block4_1_relu (Activatio (None, 28, 28, 128)    0
['conv3_block4_1_bn[0][0]']
n)

conv3_block4_2_conv (Conv2D)    (None, 28, 28, 32)    36864
['conv3_block4_1_relu[0][0]']

conv3_block4_concat (Concatena (None, 28, 28, 256)    0
['conv3_block3_concat[0][0]',
te)
'conv3_block4_2_conv[0][0]']

conv3_block5_0_bn (BatchNormal (None, 28, 28, 256)   1024
['conv3_block4_concat[0][0]']
ization)

conv3_block5_0_relu (Activatio (None, 28, 28, 256)    0
['conv3_block5_0_bn[0][0]']
n)

conv3_block5_1_conv (Conv2D)    (None, 28, 28, 128)   32768
['conv3_block5_0_relu[0][0]']

conv3_block5_1_bn (BatchNormal (None, 28, 28, 128)   512

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['conv3_block5_1_conv[0][0]']
ization)

conv3_block5_1_relu (Activation) (None, 28, 28, 128) 0
['conv3_block5_1_bn[0][0]']
n)

conv3_block5_2_conv (Conv2D) (None, 28, 28, 32) 36864
['conv3_block5_1_relu[0][0]']

conv3_block5_concat (Concatenation) (None, 28, 28, 288) 0
['conv3_block4_concat[0][0]',
te)
'conv3_block5_2_conv[0][0]']

conv3_block6_0_bn (BatchNormalization) (None, 28, 28, 288) 1152
['conv3_block5_concat[0][0]']
ization)

conv3_block6_0_relu (Activation) (None, 28, 28, 288) 0
['conv3_block6_0_bn[0][0]']
n)

conv3_block6_1_conv (Conv2D) (None, 28, 28, 128) 36864
['conv3_block6_0_relu[0][0]']

conv3_block6_1_bn (BatchNormalization) (None, 28, 28, 128) 512
['conv3_block6_1_conv[0][0]']
ization)

conv3_block6_1_relu (Activation) (None, 28, 28, 128) 0
['conv3_block6_1_bn[0][0]']
n)

conv3_block6_2_conv (Conv2D) (None, 28, 28, 32) 36864
['conv3_block6_1_relu[0][0]']

conv3_block6_concat (Concatenation) (None, 28, 28, 320) 0
['conv3_block5_concat[0][0]',
te)
'conv3_block6_2_conv[0][0]']

conv3_block7_0_bn (BatchNormalization) (None, 28, 28, 320) 1280
['conv3_block6_concat[0][0]']
ization)

conv3_block7_0_relu (Activation) (None, 28, 28, 320) 0
['conv3_block7_0_bn[0][0]']

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n)

conv3_block7_1_conv (Conv2D) (None, 28, 28, 128) 40960
['conv3_block7_0_relu[0][0]']

conv3_block7_1_bn (BatchNormal (None, 28, 28, 128) 512
['conv3_block7_1_conv[0][0]']
ization)

conv3_block7_1_relu (Activatio (None, 28, 28, 128) 0
['conv3_block7_1_bn[0][0]']
n)

conv3_block7_2_conv (Conv2D) (None, 28, 28, 32) 36864
['conv3_block7_1_relu[0][0]']

conv3_block7_concat (Concatena (None, 28, 28, 352) 0
['conv3_block6_concat[0][0] ',
te)
'conv3_block7_2_conv[0][0]']

conv3_block8_0_bn (BatchNormal (None, 28, 28, 352) 1408
['conv3_block7_concat[0][0]']
ization)

conv3_block8_0_relu (Activatio (None, 28, 28, 352) 0
['conv3_block8_0_bn[0][0]']
n)

conv3_block8_1_conv (Conv2D) (None, 28, 28, 128) 45056
['conv3_block8_0_relu[0][0]']

conv3_block8_1_bn (BatchNormal (None, 28, 28, 128) 512
['conv3_block8_1_conv[0][0]']
ization)

conv3_block8_1_relu (Activatio (None, 28, 28, 128) 0
['conv3_block8_1_bn[0][0]']
n)

conv3_block8_2_conv (Conv2D) (None, 28, 28, 32) 36864
['conv3_block8_1_relu[0][0]']

conv3_block8_concat (Concatena (None, 28, 28, 384) 0
['conv3_block7_concat[0][0] ',
te)
'conv3_block8_2_conv[0][0]']

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conv3_block9_0_bn (BatchNormal (None, 28, 28, 384) 1536
['conv3_block8_concat[0][0]']
ization)

conv3_block9_0_relu (Activatio (None, 28, 28, 384) 0
['conv3_block9_0_bn[0][0]']
n)

conv3_block9_1_conv (Conv2D) (None, 28, 28, 128) 49152
['conv3_block9_0_relu[0][0]']

conv3_block9_1_bn (BatchNormal (None, 28, 28, 128) 512
['conv3_block9_1_conv[0][0]']
ization)

conv3_block9_1_relu (Activatio (None, 28, 28, 128) 0
['conv3_block9_1_bn[0][0]']
n)

conv3_block9_2_conv (Conv2D) (None, 28, 28, 32) 36864
['conv3_block9_1_relu[0][0]']

conv3_block9_concat (Concatena (None, 28, 28, 416) 0
['conv3_block8_concat[0][0]',
te)
'conv3_block9_2_conv[0][0]']

conv3_block10_0_bn (BatchNorma (None, 28, 28, 416) 1664
['conv3_block9_concat[0][0]']
lization)

conv3_block10_0_relu (Activati (None, 28, 28, 416) 0
['conv3_block10_0_bn[0][0]']
on)

conv3_block10_1_conv (Conv2D) (None, 28, 28, 128) 53248
['conv3_block10_0_relu[0][0]']

conv3_block10_1_bn (BatchNorma (None, 28, 28, 128) 512
['conv3_block10_1_conv[0][0]']
lization)

conv3_block10_1_relu (Activati (None, 28, 28, 128) 0
['conv3_block10_1_bn[0][0]']
on)

conv3_block10_2_conv (Conv2D) (None, 28, 28, 32) 36864
['conv3_block10_1_relu[0][0]']

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conv3_block10_concat (Concaten (None, 28, 28, 448) 0
['conv3_block9_concat[0][0]',
ate)
'conv3_block10_2_conv[0][0]']

conv3_block11_0_bn (BatchNorma (None, 28, 28, 448) 1792
['conv3_block10_concat[0][0]']
lization)

conv3_block11_0_relu (Activati (None, 28, 28, 448) 0
['conv3_block11_0_bn[0][0]']
on)

conv3_block11_1_conv (Conv2D) (None, 28, 28, 128) 57344
['conv3_block11_0_relu[0][0]']

conv3_block11_1_bn (BatchNorma (None, 28, 28, 128) 512
['conv3_block11_1_conv[0][0]']
lization)

conv3_block11_1_relu (Activati (None, 28, 28, 128) 0
['conv3_block11_1_bn[0][0]']
on)

conv3_block11_2_conv (Conv2D) (None, 28, 28, 32) 36864
['conv3_block11_1_relu[0][0]']

conv3_block11_concat (Concaten (None, 28, 28, 480) 0
['conv3_block10_concat[0][0]',
ate)
'conv3_block11_2_conv[0][0]']

conv3_block12_0_bn (BatchNorma (None, 28, 28, 480) 1920
['conv3_block11_concat[0][0]']
lization)

conv3_block12_0_relu (Activati (None, 28, 28, 480) 0
['conv3_block12_0_bn[0][0]']
on)

conv3_block12_1_conv (Conv2D) (None, 28, 28, 128) 61440
['conv3_block12_0_relu[0][0]']

conv3_block12_1_bn (BatchNorma (None, 28, 28, 128) 512
['conv3_block12_1_conv[0][0]']
lization)

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```

conv3_block12_1_relu (Activation) (None, 28, 28, 128) 0
['conv3_block12_1_bn[0][0]']
on)

conv3_block12_2_conv (Conv2D) (None, 28, 28, 32) 36864
['conv3_block12_1_relu[0][0]']

conv3_block12_concat (Concatenation) (None, 28, 28, 512) 0
['conv3_block11_concat[0][0]',
ate)
['conv3_block12_2_conv[0][0]']

pool3_bn (BatchNormalization) (None, 28, 28, 512) 2048
['conv3_block12_concat[0][0]']

pool3_relu (Activation) (None, 28, 28, 512) 0
['pool3_bn[0][0]']

pool3_conv (Conv2D) (None, 28, 28, 256) 131072
['pool3_relu[0][0]']

pool3_pool (AveragePooling2D) (None, 14, 14, 256) 0
['pool3_conv[0][0]']

conv4_block1_0_bn (BatchNormalization) (None, 14, 14, 256) 1024
['pool3_pool[0][0]']
ization)

conv4_block1_0_relu (Activation) (None, 14, 14, 256) 0
['conv4_block1_0_bn[0][0]']
n)

conv4_block1_1_conv (Conv2D) (None, 14, 14, 128) 32768
['conv4_block1_0_relu[0][0]']

conv4_block1_1_bn (BatchNormalization) (None, 14, 14, 128) 512
['conv4_block1_1_conv[0][0]']
ization)

conv4_block1_1_relu (Activation) (None, 14, 14, 128) 0
['conv4_block1_1_bn[0][0]']
n)

conv4_block1_2_conv (Conv2D) (None, 14, 14, 32) 36864
['conv4_block1_1_relu[0][0]']

conv4_block1_concat (Concatenation) (None, 14, 14, 288) 0
['pool3_pool[0][0]',

```

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te)
'conv4_block1_2_conv[0][0]']

conv4_block2_0_bn (BatchNormal (None, 14, 14, 288) 1152
['conv4_block1_concat[0][0]']
ization)

conv4_block2_0_relu (Activatio (None, 14, 14, 288) 0
['conv4_block2_0_bn[0][0]']
n)

conv4_block2_1_conv (Conv2D) (None, 14, 14, 128) 36864
['conv4_block2_0_relu[0][0]']

conv4_block2_1_bn (BatchNormal (None, 14, 14, 128) 512
['conv4_block2_1_conv[0][0]']
ization)

conv4_block2_1_relu (Activatio (None, 14, 14, 128) 0
['conv4_block2_1_bn[0][0]']
n)

conv4_block2_2_conv (Conv2D) (None, 14, 14, 32) 36864
['conv4_block2_1_relu[0][0]']

conv4_block2_concat (Concatena (None, 14, 14, 320) 0
['conv4_block1_concat[0][0]'],
te)
'conv4_block2_2_conv[0][0]']

conv4_block3_0_bn (BatchNormal (None, 14, 14, 320) 1280
['conv4_block2_concat[0][0]']
ization)

conv4_block3_0_relu (Activatio (None, 14, 14, 320) 0
['conv4_block3_0_bn[0][0]']
n)

conv4_block3_1_conv (Conv2D) (None, 14, 14, 128) 40960
['conv4_block3_0_relu[0][0]']

conv4_block3_1_bn (BatchNormal (None, 14, 14, 128) 512
['conv4_block3_1_conv[0][0]']
ization)

conv4_block3_1_relu (Activatio (None, 14, 14, 128) 0
['conv4_block3_1_bn[0][0]']
n)

```



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conv4_block3_2_conv (Conv2D)      (None, 14, 14, 32)    36864
['conv4_block3_1_relu[0][0]']

conv4_block3_concat (Concatenation) (None, 14, 14, 352)   0
['conv4_block2_concat[0][0]',
 te)
'conv4_block3_2_conv[0][0]']

conv4_block4_0_bn (BatchNormalization) (None, 14, 14, 352)  1408
['conv4_block3_concat[0][0]']
ization)

conv4_block4_0_relu (Activation) (None, 14, 14, 352)   0
['conv4_block4_0_bn[0][0]']
n)

conv4_block4_1_conv (Conv2D)      (None, 14, 14, 128)  45056
['conv4_block4_0_relu[0][0]']

conv4_block4_1_bn (BatchNormalization) (None, 14, 14, 128)  512
['conv4_block4_1_conv[0][0]']
ization)

conv4_block4_1_relu (Activation) (None, 14, 14, 128)   0
['conv4_block4_1_bn[0][0]']
n)

conv4_block4_2_conv (Conv2D)      (None, 14, 14, 32)    36864
['conv4_block4_1_relu[0][0]']

conv4_block4_concat (Concatenation) (None, 14, 14, 384)   0
['conv4_block3_concat[0][0]',
 te)
'conv4_block4_2_conv[0][0]']

conv4_block5_0_bn (BatchNormalization) (None, 14, 14, 384)  1536
['conv4_block4_concat[0][0]']
ization)

conv4_block5_0_relu (Activation) (None, 14, 14, 384)   0
['conv4_block5_0_bn[0][0]']
n)

conv4_block5_1_conv (Conv2D)      (None, 14, 14, 128)  49152
['conv4_block5_0_relu[0][0]']

conv4_block5_1_bn (BatchNormalization) (None, 14, 14, 128)  512

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['conv4_block5_1_conv[0][0]']
ization)

conv4_block5_1_relu (Activation) (None, 14, 14, 128) 0
['conv4_block5_1_bn[0][0]']
n)

conv4_block5_2_conv (Conv2D) (None, 14, 14, 32) 36864
['conv4_block5_1_relu[0][0]']

conv4_block5_concat (Concatenation) (None, 14, 14, 416) 0
['conv4_block4_concat[0][0]',
te)
'conv4_block5_2_conv[0][0]']

conv4_block6_0_bn (BatchNormalization) (None, 14, 14, 416) 1664
['conv4_block5_concat[0][0]']
ization)

conv4_block6_0_relu (Activation) (None, 14, 14, 416) 0
['conv4_block6_0_bn[0][0]']
n)

conv4_block6_1_conv (Conv2D) (None, 14, 14, 128) 53248
['conv4_block6_0_relu[0][0]']

conv4_block6_1_bn (BatchNormalization) (None, 14, 14, 128) 512
['conv4_block6_1_conv[0][0]']
ization)

conv4_block6_1_relu (Activation) (None, 14, 14, 128) 0
['conv4_block6_1_bn[0][0]']
n)

conv4_block6_2_conv (Conv2D) (None, 14, 14, 32) 36864
['conv4_block6_1_relu[0][0]']

conv4_block6_concat (Concatenation) (None, 14, 14, 448) 0
['conv4_block5_concat[0][0]',
te)
'conv4_block6_2_conv[0][0]']

conv4_block7_0_bn (BatchNormalization) (None, 14, 14, 448) 1792
['conv4_block6_concat[0][0]']
ization)

conv4_block7_0_relu (Activation) (None, 14, 14, 448) 0
['conv4_block7_0_bn[0][0]']

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n)

conv4_block7_1_conv (Conv2D)    (None, 14, 14, 128)  57344
['conv4_block7_0_relu[0][0]']

conv4_block7_1_bn (BatchNormal  (None, 14, 14, 128)  512
['conv4_block7_1_conv[0][0]']
ization)

conv4_block7_1_relu (Activatio  (None, 14, 14, 128)  0
['conv4_block7_1_bn[0][0]']
n)

conv4_block7_2_conv (Conv2D)    (None, 14, 14, 32)   36864
['conv4_block7_1_relu[0][0]']

conv4_block7_concat (Concatena  (None, 14, 14, 480)  0
['conv4_block6_concat[0][0]',
te)
'conv4_block7_2_conv[0][0]']

conv4_block8_0_bn (BatchNormal  (None, 14, 14, 480)  1920
['conv4_block7_concat[0][0]']
ization)

conv4_block8_0_relu (Activatio  (None, 14, 14, 480)  0
['conv4_block8_0_bn[0][0]']
n)

conv4_block8_1_conv (Conv2D)    (None, 14, 14, 128)  61440
['conv4_block8_0_relu[0][0]']

conv4_block8_1_bn (BatchNormal  (None, 14, 14, 128)  512
['conv4_block8_1_conv[0][0]']
ization)

conv4_block8_1_relu (Activatio  (None, 14, 14, 128)  0
['conv4_block8_1_bn[0][0]']
n)

conv4_block8_2_conv (Conv2D)    (None, 14, 14, 32)   36864
['conv4_block8_1_relu[0][0]']

conv4_block8_concat (Concatena  (None, 14, 14, 512)  0
['conv4_block7_concat[0][0]',
te)
'conv4_block8_2_conv[0][0]']

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conv4_block9_0_bn (BatchNormal (None, 14, 14, 512) 2048
['conv4_block8_concat[0][0]']
ization)

conv4_block9_0_relu (Activatio (None, 14, 14, 512) 0
['conv4_block9_0_bn[0][0]']
n)

conv4_block9_1_conv (Conv2D) (None, 14, 14, 128) 65536
['conv4_block9_0_relu[0][0]']

conv4_block9_1_bn (BatchNormal (None, 14, 14, 128) 512
['conv4_block9_1_conv[0][0]']
ization)

conv4_block9_1_relu (Activatio (None, 14, 14, 128) 0
['conv4_block9_1_bn[0][0]']
n)

conv4_block9_2_conv (Conv2D) (None, 14, 14, 32) 36864
['conv4_block9_1_relu[0][0]']

conv4_block9_concat (Concatena (None, 14, 14, 544) 0
['conv4_block8_concat[0][0]',
te)
'conv4_block9_2_conv[0][0]']

conv4_block10_0_bn (BatchNorma (None, 14, 14, 544) 2176
['conv4_block9_concat[0][0]']
lization)

conv4_block10_0_relu (Activati (None, 14, 14, 544) 0
['conv4_block10_0_bn[0][0]']
on)

conv4_block10_1_conv (Conv2D) (None, 14, 14, 128) 69632
['conv4_block10_0_relu[0][0]']

conv4_block10_1_bn (BatchNorma (None, 14, 14, 128) 512
['conv4_block10_1_conv[0][0]']
lization)

conv4_block10_1_relu (Activati (None, 14, 14, 128) 0
['conv4_block10_1_bn[0][0]']
on)

conv4_block10_2_conv (Conv2D) (None, 14, 14, 32) 36864
['conv4_block10_1_relu[0][0]']

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conv4_block10_concat (Concaten (None, 14, 14, 576) 0
['conv4_block9_concat[0][0]',
ate)
'conv4_block10_2_conv[0][0]']

conv4_block11_0_bn (BatchNorma (None, 14, 14, 576) 2304
['conv4_block10_concat[0][0]']
lization)

conv4_block11_0_relu (Activati (None, 14, 14, 576) 0
['conv4_block11_0_bn[0][0]']
on)

conv4_block11_1_conv (Conv2D) (None, 14, 14, 128) 73728
['conv4_block11_0_relu[0][0]']

conv4_block11_1_bn (BatchNorma (None, 14, 14, 128) 512
['conv4_block11_1_conv[0][0]']
lization)

conv4_block11_1_relu (Activati (None, 14, 14, 128) 0
['conv4_block11_1_bn[0][0]']
on)

conv4_block11_2_conv (Conv2D) (None, 14, 14, 32) 36864
['conv4_block11_1_relu[0][0]']

conv4_block11_concat (Concaten (None, 14, 14, 608) 0
['conv4_block10_concat[0][0]',
ate)
'conv4_block11_2_conv[0][0]']

conv4_block12_0_bn (BatchNorma (None, 14, 14, 608) 2432
['conv4_block11_concat[0][0]']
lization)

conv4_block12_0_relu (Activati (None, 14, 14, 608) 0
['conv4_block12_0_bn[0][0]']
on)

conv4_block12_1_conv (Conv2D) (None, 14, 14, 128) 77824
['conv4_block12_0_relu[0][0]']

conv4_block12_1_bn (BatchNorma (None, 14, 14, 128) 512
['conv4_block12_1_conv[0][0]']
lization)

```

```

conv4_block12_1_relu (Activation) (None, 14, 14, 128) 0
['conv4_block12_1_bn[0][0]']
on)

conv4_block12_2_conv (Conv2D) (None, 14, 14, 32) 36864
['conv4_block12_1_relu[0][0]']

conv4_block12_concat (Concatenation) (None, 14, 14, 640) 0
['conv4_block11_concat[0][0]',
ate)
'conv4_block12_2_conv[0][0]']

conv4_block13_0_bn (BatchNormalization) (None, 14, 14, 640) 2560
['conv4_block12_concat[0][0]']
lization)

conv4_block13_0_relu (Activation) (None, 14, 14, 640) 0
['conv4_block13_0_bn[0][0]']
on)

conv4_block13_1_conv (Conv2D) (None, 14, 14, 128) 81920
['conv4_block13_0_relu[0][0]']

conv4_block13_1_bn (BatchNormalization) (None, 14, 14, 128) 512
['conv4_block13_1_conv[0][0]']
lization)

conv4_block13_1_relu (Activation) (None, 14, 14, 128) 0
['conv4_block13_1_bn[0][0]']
on)

conv4_block13_2_conv (Conv2D) (None, 14, 14, 32) 36864
['conv4_block13_1_relu[0][0]']

conv4_block13_concat (Concatenation) (None, 14, 14, 672) 0
['conv4_block12_concat[0][0]',
ate)
'conv4_block13_2_conv[0][0]']

conv4_block14_0_bn (BatchNormalization) (None, 14, 14, 672) 2688
['conv4_block13_concat[0][0]']
lization)

conv4_block14_0_relu (Activation) (None, 14, 14, 672) 0
['conv4_block14_0_bn[0][0]']
on)

conv4_block14_1_conv (Conv2D) (None, 14, 14, 128) 86016

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['conv4_block14_0_relu[0][0]']

conv4_block14_1_bn (BatchNorma (None, 14, 14, 128) 512
['conv4_block14_1_conv[0][0]']
lization)

conv4_block14_1_relu (Activati (None, 14, 14, 128) 0
['conv4_block14_1_bn[0][0]']
on)

conv4_block14_2_conv (Conv2D) (None, 14, 14, 32) 36864
['conv4_block14_1_relu[0][0]']

conv4_block14_concat (Concaten (None, 14, 14, 704) 0
['conv4_block13_concat[0][0]',
ate)
'conv4_block14_2_conv[0][0]']

conv4_block15_0_bn (BatchNorma (None, 14, 14, 704) 2816
['conv4_block14_concat[0][0]']
lization)

conv4_block15_0_relu (Activati (None, 14, 14, 704) 0
['conv4_block15_0_bn[0][0]']
on)

conv4_block15_1_conv (Conv2D) (None, 14, 14, 128) 90112
['conv4_block15_0_relu[0][0]']

conv4_block15_1_bn (BatchNorma (None, 14, 14, 128) 512
['conv4_block15_1_conv[0][0]']
lization)

conv4_block15_1_relu (Activati (None, 14, 14, 128) 0
['conv4_block15_1_bn[0][0]']
on)

conv4_block15_2_conv (Conv2D) (None, 14, 14, 32) 36864
['conv4_block15_1_relu[0][0]']

conv4_block15_concat (Concaten (None, 14, 14, 736) 0
['conv4_block14_concat[0][0]',
ate)
'conv4_block15_2_conv[0][0]']

conv4_block16_0_bn (BatchNorma (None, 14, 14, 736) 2944
['conv4_block15_concat[0][0]']
lization)

```

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conv4_block16_0_relu (Activati (None, 14, 14, 736) 0
['conv4_block16_0_bn[0][0]']
on)

conv4_block16_1_conv (Conv2D) (None, 14, 14, 128) 94208
['conv4_block16_0_relu[0][0]']

conv4_block16_1_bn (BatchNorma (None, 14, 14, 128) 512
['conv4_block16_1_conv[0][0]']
lization)

conv4_block16_1_relu (Activati (None, 14, 14, 128) 0
['conv4_block16_1_bn[0][0]']
on)

conv4_block16_2_conv (Conv2D) (None, 14, 14, 32) 36864
['conv4_block16_1_relu[0][0]']

conv4_block16_concat (Concaten (None, 14, 14, 768) 0
['conv4_block15_concat[0][0]',
ate)
'conv4_block16_2_conv[0][0]']

conv4_block17_0_bn (BatchNorma (None, 14, 14, 768) 3072
['conv4_block16_concat[0][0]']
lization)

conv4_block17_0_relu (Activati (None, 14, 14, 768) 0
['conv4_block17_0_bn[0][0]']
on)

conv4_block17_1_conv (Conv2D) (None, 14, 14, 128) 98304
['conv4_block17_0_relu[0][0]']

conv4_block17_1_bn (BatchNorma (None, 14, 14, 128) 512
['conv4_block17_1_conv[0][0]']
lization)

conv4_block17_1_relu (Activati (None, 14, 14, 128) 0
['conv4_block17_1_bn[0][0]']
on)

conv4_block17_2_conv (Conv2D) (None, 14, 14, 32) 36864
['conv4_block17_1_relu[0][0]']

conv4_block17_concat (Concaten (None, 14, 14, 800) 0
['conv4_block16_concat[0][0]',

```



```

    ate)
'conv4_block17_2_conv[0][0]']

conv4_block18_0_bn (BatchNorma (None, 14, 14, 800) 3200
['conv4_block17_concat[0][0]']
lization)

conv4_block18_0_relu (Activati (None, 14, 14, 800) 0
['conv4_block18_0_bn[0][0]']
on)

conv4_block18_1_conv (Conv2D) (None, 14, 14, 128) 102400
['conv4_block18_0_relu[0][0]']

conv4_block18_1_bn (BatchNorma (None, 14, 14, 128) 512
['conv4_block18_1_conv[0][0]']
lization)

conv4_block18_1_relu (Activati (None, 14, 14, 128) 0
['conv4_block18_1_bn[0][0]']
on)

conv4_block18_2_conv (Conv2D) (None, 14, 14, 32) 36864
['conv4_block18_1_relu[0][0]']

conv4_block18_concat (Concaten (None, 14, 14, 832) 0
['conv4_block17_concat[0][0]',
ate)
'conv4_block18_2_conv[0][0]']

conv4_block19_0_bn (BatchNorma (None, 14, 14, 832) 3328
['conv4_block18_concat[0][0]']
lization)

conv4_block19_0_relu (Activati (None, 14, 14, 832) 0
['conv4_block19_0_bn[0][0]']
on)

conv4_block19_1_conv (Conv2D) (None, 14, 14, 128) 106496
['conv4_block19_0_relu[0][0]']

conv4_block19_1_bn (BatchNorma (None, 14, 14, 128) 512
['conv4_block19_1_conv[0][0]']
lization)

conv4_block19_1_relu (Activati (None, 14, 14, 128) 0
['conv4_block19_1_bn[0][0]']
on)

```

```

conv4_block19_2_conv (Conv2D) (None, 14, 14, 32) 36864
['conv4_block19_1_relu[0][0]']

conv4_block19_concat (Concaten (None, 14, 14, 864) 0
['conv4_block18_concat[0][0]',
ate)
'conv4_block19_2_conv[0][0]']

conv4_block20_0_bn (BatchNorma (None, 14, 14, 864) 3456
['conv4_block19_concat[0][0]']
lization)

conv4_block20_0_relu (Activati (None, 14, 14, 864) 0
['conv4_block20_0_bn[0][0]']
on)

conv4_block20_1_conv (Conv2D) (None, 14, 14, 128) 110592
['conv4_block20_0_relu[0][0]']

conv4_block20_1_bn (BatchNorma (None, 14, 14, 128) 512
['conv4_block20_1_conv[0][0]']
lization)

conv4_block20_1_relu (Activati (None, 14, 14, 128) 0
['conv4_block20_1_bn[0][0]']
on)

conv4_block20_2_conv (Conv2D) (None, 14, 14, 32) 36864
['conv4_block20_1_relu[0][0]']

conv4_block20_concat (Concaten (None, 14, 14, 896) 0
['conv4_block19_concat[0][0]',
ate)
'conv4_block20_2_conv[0][0]']

conv4_block21_0_bn (BatchNorma (None, 14, 14, 896) 3584
['conv4_block20_concat[0][0]']
lization)

conv4_block21_0_relu (Activati (None, 14, 14, 896) 0
['conv4_block21_0_bn[0][0]']
on)

conv4_block21_1_conv (Conv2D) (None, 14, 14, 128) 114688
['conv4_block21_0_relu[0][0]']

conv4_block21_1_bn (BatchNorma (None, 14, 14, 128) 512

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```

['conv4_block21_1_conv[0][0]']
lization)

conv4_block21_1_relu (Activati (None, 14, 14, 128) 0
['conv4_block21_1_bn[0][0]']
on)

conv4_block21_2_conv (Conv2D) (None, 14, 14, 32) 36864
['conv4_block21_1_relu[0][0]']

conv4_block21_concat (Concaten (None, 14, 14, 928) 0
['conv4_block20_concat[0][0]',
ate)
'conv4_block21_2_conv[0][0]']

conv4_block22_0_bn (BatchNorma (None, 14, 14, 928) 3712
['conv4_block21_concat[0][0]']
lization)

conv4_block22_0_relu (Activati (None, 14, 14, 928) 0
['conv4_block22_0_bn[0][0]']
on)

conv4_block22_1_conv (Conv2D) (None, 14, 14, 128) 118784
['conv4_block22_0_relu[0][0]']

conv4_block22_1_bn (BatchNorma (None, 14, 14, 128) 512
['conv4_block22_1_conv[0][0]']
lization)

conv4_block22_1_relu (Activati (None, 14, 14, 128) 0
['conv4_block22_1_bn[0][0]']
on)

conv4_block22_2_conv (Conv2D) (None, 14, 14, 32) 36864
['conv4_block22_1_relu[0][0]']

conv4_block22_concat (Concaten (None, 14, 14, 960) 0
['conv4_block21_concat[0][0]',
ate)
'conv4_block22_2_conv[0][0]']

conv4_block23_0_bn (BatchNorma (None, 14, 14, 960) 3840
['conv4_block22_concat[0][0]']
lization)

conv4_block23_0_relu (Activati (None, 14, 14, 960) 0
['conv4_block23_0_bn[0][0]']

```

```

on)

conv4_block23_1_conv (Conv2D) (None, 14, 14, 128) 122880
['conv4_block23_0_relu[0][0]']

conv4_block23_1_bn (BatchNormaliza (None, 14, 14, 128) 512
['conv4_block23_1_conv[0][0]']
lization)

conv4_block23_1_relu (Activation) (None, 14, 14, 128) 0
['conv4_block23_1_bn[0][0]']
on)

conv4_block23_2_conv (Conv2D) (None, 14, 14, 32) 36864
['conv4_block23_1_relu[0][0]']

conv4_block23_concat (Concatenatio (None, 14, 14, 992) 0
['conv4_block22_concat[0][0]',
ate)
'conv4_block23_2_conv[0][0]']

conv4_block24_0_bn (BatchNormaliza (None, 14, 14, 992) 3968
['conv4_block23_concat[0][0]']
lization)

conv4_block24_0_relu (Activation) (None, 14, 14, 992) 0
['conv4_block24_0_bn[0][0]']
on)

conv4_block24_1_conv (Conv2D) (None, 14, 14, 128) 126976
['conv4_block24_0_relu[0][0]']

conv4_block24_1_bn (BatchNormaliza (None, 14, 14, 128) 512
['conv4_block24_1_conv[0][0]']
lization)

conv4_block24_1_relu (Activation) (None, 14, 14, 128) 0
['conv4_block24_1_bn[0][0]']
on)

conv4_block24_2_conv (Conv2D) (None, 14, 14, 32) 36864
['conv4_block24_1_relu[0][0]']

conv4_block24_concat (Concatenatio (None, 14, 14, 1024) 0
['conv4_block23_concat[0][0]',
ate)
)
'conv4_block24_2_conv[0][0]']

```

```

conv4_block25_0_bn (BatchNorma (None, 14, 14, 1024 4096
['conv4_block24_concat[0][0]']
lization)
)

conv4_block25_0_relu (Activati (None, 14, 14, 1024 0
['conv4_block25_0_bn[0][0]']
on)
)

conv4_block25_1_conv (Conv2D) (None, 14, 14, 128) 131072
['conv4_block25_0_relu[0][0]']

conv4_block25_1_bn (BatchNorma (None, 14, 14, 128) 512
['conv4_block25_1_conv[0][0]']
lization)

conv4_block25_1_relu (Activati (None, 14, 14, 128) 0
['conv4_block25_1_bn[0][0]']
on)

conv4_block25_2_conv (Conv2D) (None, 14, 14, 32) 36864
['conv4_block25_1_relu[0][0]']

conv4_block25_concat (Concaten (None, 14, 14, 1056 0
['conv4_block24_concat[0][0]',
ate)
)
['conv4_block25_2_conv[0][0]']

conv4_block26_0_bn (BatchNorma (None, 14, 14, 1056 4224
['conv4_block25_concat[0][0]']
lization)
)

conv4_block26_0_relu (Activati (None, 14, 14, 1056 0
['conv4_block26_0_bn[0][0]']
on)
)

conv4_block26_1_conv (Conv2D) (None, 14, 14, 128) 135168
['conv4_block26_0_relu[0][0]']

conv4_block26_1_bn (BatchNorma (None, 14, 14, 128) 512
['conv4_block26_1_conv[0][0]']
lization)

conv4_block26_1_relu (Activati (None, 14, 14, 128) 0
['conv4_block26_1_bn[0][0]']
on)

conv4_block26_2_conv (Conv2D) (None, 14, 14, 32) 36864
['conv4_block26_1_relu[0][0]']

```

```

conv4_block26_concat (Concaten (None, 14, 14, 1088 0
['conv4_block25_concat[0][0]',
ate)
)
'conv4_block26_2_conv[0][0]']

conv4_block27_0_bn (BatchNorma (None, 14, 14, 1088 4352
['conv4_block26_concat[0][0]']
lization)
)

conv4_block27_0_relu (Activati (None, 14, 14, 1088 0
['conv4_block27_0_bn[0][0]']
on)
)

conv4_block27_1_conv (Conv2D) (None, 14, 14, 128) 139264
['conv4_block27_0_relu[0][0]']

conv4_block27_1_bn (BatchNorma (None, 14, 14, 128) 512
['conv4_block27_1_conv[0][0]']
lization)

conv4_block27_1_relu (Activati (None, 14, 14, 128) 0
['conv4_block27_1_bn[0][0]']
on)

conv4_block27_2_conv (Conv2D) (None, 14, 14, 32) 36864
['conv4_block27_1_relu[0][0]']

conv4_block27_concat (Concaten (None, 14, 14, 1120 0
['conv4_block26_concat[0][0]',
ate)
)
'conv4_block27_2_conv[0][0]']

conv4_block28_0_bn (BatchNorma (None, 14, 14, 1120 4480
['conv4_block27_concat[0][0]']
lization)
)

conv4_block28_0_relu (Activati (None, 14, 14, 1120 0
['conv4_block28_0_bn[0][0]']
on)
)

conv4_block28_1_conv (Conv2D) (None, 14, 14, 128) 143360
['conv4_block28_0_relu[0][0]']

conv4_block28_1_bn (BatchNorma (None, 14, 14, 128) 512
['conv4_block28_1_conv[0][0]']
lization)

```

```

conv4_block28_1_relu (Activation) (None, 14, 14, 128) 0
['conv4_block28_1_bn[0][0]']
on)

conv4_block28_2_conv (Conv2D) (None, 14, 14, 32) 36864
['conv4_block28_1_relu[0][0]']

conv4_block28_concat (Concatenation) (None, 14, 14, 1152) 0
['conv4_block27_concat[0][0]',
ate)
'conv4_block28_2_conv[0][0]']

conv4_block29_0_bn (BatchNormalization) (None, 14, 14, 1152) 4608
['conv4_block28_concat[0][0]']
lization)

conv4_block29_0_relu (Activation) (None, 14, 14, 1152) 0
['conv4_block29_0_bn[0][0]']
on)

conv4_block29_1_conv (Conv2D) (None, 14, 14, 128) 147456
['conv4_block29_0_relu[0][0]']

conv4_block29_1_bn (BatchNormalization) (None, 14, 14, 128) 512
['conv4_block29_1_conv[0][0]']
lization)

conv4_block29_1_relu (Activation) (None, 14, 14, 128) 0
['conv4_block29_1_bn[0][0]']
on)

conv4_block29_2_conv (Conv2D) (None, 14, 14, 32) 36864
['conv4_block29_1_relu[0][0]']

conv4_block29_concat (Concatenation) (None, 14, 14, 1184) 0
['conv4_block28_concat[0][0]',
ate)
'conv4_block29_2_conv[0][0]']

conv4_block30_0_bn (BatchNormalization) (None, 14, 14, 1184) 4736
['conv4_block29_concat[0][0]']
lization)

conv4_block30_0_relu (Activation) (None, 14, 14, 1184) 0
['conv4_block30_0_bn[0][0]']
on)

conv4_block30_1_conv (Conv2D) (None, 14, 14, 128) 151552

```

```

['conv4_block30_0_relu[0][0]']

conv4_block30_1_bn (BatchNorma (None, 14, 14, 128) 512
['conv4_block30_1_conv[0][0]']
lization)

conv4_block30_1_relu (Activati (None, 14, 14, 128) 0
['conv4_block30_1_bn[0][0]']
on)

conv4_block30_2_conv (Conv2D) (None, 14, 14, 32) 36864
['conv4_block30_1_relu[0][0]']

conv4_block30_concat (Concaten (None, 14, 14, 1216 0
['conv4_block29_concat[0][0]',
ate)
)
'conv4_block30_2_conv[0][0]']

conv4_block31_0_bn (BatchNorma (None, 14, 14, 1216 4864
['conv4_block30_concat[0][0]']
lization)
)

conv4_block31_0_relu (Activati (None, 14, 14, 1216 0
['conv4_block31_0_bn[0][0]']
on)
)

conv4_block31_1_conv (Conv2D) (None, 14, 14, 128) 155648
['conv4_block31_0_relu[0][0]']

conv4_block31_1_bn (BatchNorma (None, 14, 14, 128) 512
['conv4_block31_1_conv[0][0]']
lization)

conv4_block31_1_relu (Activati (None, 14, 14, 128) 0
['conv4_block31_1_bn[0][0]']
on)

conv4_block31_2_conv (Conv2D) (None, 14, 14, 32) 36864
['conv4_block31_1_relu[0][0]']

conv4_block31_concat (Concaten (None, 14, 14, 1248 0
['conv4_block30_concat[0][0]',
ate)
)
'conv4_block31_2_conv[0][0]']

conv4_block32_0_bn (BatchNorma (None, 14, 14, 1248 4992
['conv4_block31_concat[0][0]']
lization)
)

```



```

conv4_block32_0_relu (Activation) (None, 14, 14, 1248) 0
['conv4_block32_0_bn[0][0]']
on)

conv4_block32_1_conv (Conv2D) (None, 14, 14, 128) 159744
['conv4_block32_0_relu[0][0]']

conv4_block32_1_bn (BatchNormalization) (None, 14, 14, 128) 512
['conv4_block32_1_conv[0][0]']
lization)

conv4_block32_1_relu (Activation) (None, 14, 14, 128) 0
['conv4_block32_1_bn[0][0]']
on)

conv4_block32_2_conv (Conv2D) (None, 14, 14, 32) 36864
['conv4_block32_1_relu[0][0]']

conv4_block32_concat (Concatenate) (None, 14, 14, 1280) 0
['conv4_block31_concat[0][0]',
ate)
'conv4_block32_2_conv[0][0]']

pool4_bn (BatchNormalization) (None, 14, 14, 1280) 5120
['conv4_block32_concat[0][0]']
)

pool4_relu (Activation) (None, 14, 14, 1280) 0
['pool4_bn[0][0]']
)

pool4_conv (Conv2D) (None, 14, 14, 640) 819200
['pool4_relu[0][0]']

pool4_pool (AveragePooling2D) (None, 7, 7, 640) 0
['pool4_conv[0][0]']

conv5_block1_0_bn (BatchNormalization) (None, 7, 7, 640) 2560
['pool4_pool[0][0]']
ization)

conv5_block1_0_relu (Activation) (None, 7, 7, 640) 0
['conv5_block1_0_bn[0][0]']
n)

conv5_block1_1_conv (Conv2D) (None, 7, 7, 128) 81920
['conv5_block1_0_relu[0][0]']

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conv5_block1_1_bn (BatchNormal ['conv5_block1_1_conv[0][0]' ization)	(None, 7, 7, 128)	512
conv5_block1_1_relu (Activatio ['conv5_block1_1_bn[0][0]' n)	(None, 7, 7, 128)	0
conv5_block1_2_conv (Conv2D) ['conv5_block1_1_relu[0][0]']	(None, 7, 7, 32)	36864
conv5_block1_concat (Concatena ['pool4_pool[0][0]', te) 'conv5_block1_2_conv[0][0]']	(None, 7, 7, 672)	0
conv5_block2_0_bn (BatchNormal ['conv5_block1_concat[0][0]' ization)	(None, 7, 7, 672)	2688
conv5_block2_0_relu (Activatio ['conv5_block2_0_bn[0][0]' n)	(None, 7, 7, 672)	0
conv5_block2_1_conv (Conv2D) ['conv5_block2_0_relu[0][0]']	(None, 7, 7, 128)	86016
conv5_block2_1_bn (BatchNormal ['conv5_block2_1_conv[0][0]' ization)	(None, 7, 7, 128)	512
conv5_block2_1_relu (Activatio ['conv5_block2_1_bn[0][0]' n)	(None, 7, 7, 128)	0
conv5_block2_2_conv (Conv2D) ['conv5_block2_1_relu[0][0]']	(None, 7, 7, 32)	36864
conv5_block2_concat (Concatena ['conv5_block1_concat[0][0]', te) 'conv5_block2_2_conv[0][0]']	(None, 7, 7, 704)	0
conv5_block3_0_bn (BatchNormal ['conv5_block2_concat[0][0]' ization)	(None, 7, 7, 704)	2816

conv5_block3_0_relu (Activation)	(None, 7, 7, 704)	0
['conv5_block3_0_bn[0][0]']		
conv5_block3_1_conv (Conv2D)	(None, 7, 7, 128)	90112
['conv5_block3_0_relu[0][0]']		
conv5_block3_1_bn (Batch Normalization)	(None, 7, 7, 128)	512
['conv5_block3_1_conv[0][0]']		
conv5_block3_1_relu (Activation)	(None, 7, 7, 128)	0
['conv5_block3_1_bn[0][0]']		
conv5_block3_2_conv (Conv2D)	(None, 7, 7, 32)	36864
['conv5_block3_1_relu[0][0]']		
conv5_block3_concat (Concatenate)	(None, 7, 7, 736)	0
['conv5_block2_concat[0][0]', 'conv5_block3_2_conv[0][0]']		
conv5_block4_0_bn (Batch Normalization)	(None, 7, 7, 736)	2944
['conv5_block3_concat[0][0]']		
conv5_block4_0_relu (Activation)	(None, 7, 7, 736)	0
['conv5_block4_0_bn[0][0]']		
conv5_block4_1_conv (Conv2D)	(None, 7, 7, 128)	94208
['conv5_block4_0_relu[0][0]']		
conv5_block4_1_bn (Batch Normalization)	(None, 7, 7, 128)	512
['conv5_block4_1_conv[0][0]']		
conv5_block4_1_relu (Activation)	(None, 7, 7, 128)	0
['conv5_block4_1_bn[0][0]']		
conv5_block4_2_conv (Conv2D)	(None, 7, 7, 32)	36864
['conv5_block4_1_relu[0][0]']		
conv5_block4_concat (Concatenate)	(None, 7, 7, 768)	0
['conv5_block3_concat[0][0]', 'conv5_block4_2_conv[0][0]']		

```

'conv5_block4_2_conv[0][0]']

conv5_block5_0_bn (BatchNormal (None, 7, 7, 768) 3072
['conv5_block4_concat[0][0]']
ization)

conv5_block5_0_relu (Activatio (None, 7, 7, 768) 0
['conv5_block5_0_bn[0][0]']
n)

conv5_block5_1_conv (Conv2D) (None, 7, 7, 128) 98304
['conv5_block5_0_relu[0][0]']

conv5_block5_1_bn (BatchNormal (None, 7, 7, 128) 512
['conv5_block5_1_conv[0][0]']
ization)

conv5_block5_1_relu (Activatio (None, 7, 7, 128) 0
['conv5_block5_1_bn[0][0]']
n)

conv5_block5_2_conv (Conv2D) (None, 7, 7, 32) 36864
['conv5_block5_1_relu[0][0]']

conv5_block5_concat (Concatena (None, 7, 7, 800) 0
['conv5_block4_concat[0][0]',
te)
'conv5_block5_2_conv[0][0]']

conv5_block6_0_bn (BatchNormal (None, 7, 7, 800) 3200
['conv5_block5_concat[0][0]']
ization)

conv5_block6_0_relu (Activatio (None, 7, 7, 800) 0
['conv5_block6_0_bn[0][0]']
n)

conv5_block6_1_conv (Conv2D) (None, 7, 7, 128) 102400
['conv5_block6_0_relu[0][0]']

conv5_block6_1_bn (BatchNormal (None, 7, 7, 128) 512
['conv5_block6_1_conv[0][0]']
ization)

conv5_block6_1_relu (Activatio (None, 7, 7, 128) 0
['conv5_block6_1_bn[0][0]']
n)

```

conv5_block6_2_conv (Conv2D) ['conv5_block6_1_relu[0][0]']	(None, 7, 7, 32)	36864
conv5_block6_concat (Concatena te) ['conv5_block5_concat[0][0]', 'conv5_block6_2_conv[0][0]']	(None, 7, 7, 832)	0
conv5_block7_0_bn (BatchNormal ization) ['conv5_block6_concat[0][0]']	(None, 7, 7, 832)	3328
conv5_block7_0_relu (Activatio n) ['conv5_block7_0_bn[0][0]']	(None, 7, 7, 832)	0
conv5_block7_1_conv (Conv2D) ['conv5_block7_0_relu[0][0]']	(None, 7, 7, 128)	106496
conv5_block7_1_bn (BatchNormal ization) ['conv5_block7_1_conv[0][0]']	(None, 7, 7, 128)	512
conv5_block7_1_relu (Activatio n) ['conv5_block7_1_bn[0][0]']	(None, 7, 7, 128)	0
conv5_block7_2_conv (Conv2D) ['conv5_block7_1_relu[0][0]']	(None, 7, 7, 32)	36864
conv5_block7_concat (Concatena te) ['conv5_block6_concat[0][0]', 'conv5_block7_2_conv[0][0]']	(None, 7, 7, 864)	0
conv5_block8_0_bn (BatchNormal ization) ['conv5_block7_concat[0][0]']	(None, 7, 7, 864)	3456
conv5_block8_0_relu (Activatio n) ['conv5_block8_0_bn[0][0]']	(None, 7, 7, 864)	0
conv5_block8_1_conv (Conv2D) ['conv5_block8_0_relu[0][0]']	(None, 7, 7, 128)	110592
conv5_block8_1_bn (BatchNormal ization) ['conv5_block8_1_conv[0][0]']	(None, 7, 7, 128)	512

```

ization)

conv5_block8_1_relu (Activation) (None, 7, 7, 128) 0
['conv5_block8_1_bn[0][0]']
n)

conv5_block8_2_conv (Conv2D) (None, 7, 7, 32) 36864
['conv5_block8_1_relu[0][0]']

conv5_block8_concat (Concatenation) (None, 7, 7, 896) 0
['conv5_block7_concat[0][0]',
te)
'conv5_block8_2_conv[0][0]']

conv5_block9_0_bn (BatchNormalization) (None, 7, 7, 896) 3584
['conv5_block8_concat[0][0]']
ization)

conv5_block9_0_relu (Activation) (None, 7, 7, 896) 0
['conv5_block9_0_bn[0][0]']
n)

conv5_block9_1_conv (Conv2D) (None, 7, 7, 128) 114688
['conv5_block9_0_relu[0][0]']

conv5_block9_1_bn (BatchNormalization) (None, 7, 7, 128) 512
['conv5_block9_1_conv[0][0]']
ization)

conv5_block9_1_relu (Activation) (None, 7, 7, 128) 0
['conv5_block9_1_bn[0][0]']
n)

conv5_block9_2_conv (Conv2D) (None, 7, 7, 32) 36864
['conv5_block9_1_relu[0][0]']

conv5_block9_concat (Concatenation) (None, 7, 7, 928) 0
['conv5_block8_concat[0][0]',
te)
'conv5_block9_2_conv[0][0]']

conv5_block10_0_bn (BatchNormalization) (None, 7, 7, 928) 3712
['conv5_block9_concat[0][0]']
lization)

conv5_block10_0_relu (Activation) (None, 7, 7, 928) 0
['conv5_block10_0_bn[0][0]']
on)

```

conv5_block10_1_conv (Conv2D)	(None, 7, 7, 128)	118784
['conv5_block10_0_relu[0][0]']		
conv5_block10_1_bn (Batch Normalization)	(None, 7, 7, 128)	512
['conv5_block10_1_conv[0][0]']		
conv5_block10_1_relu (Activation)	(None, 7, 7, 128)	0
['conv5_block10_1_bn[0][0]']		
conv5_block10_2_conv (Conv2D)	(None, 7, 7, 32)	36864
['conv5_block10_1_relu[0][0]']		
conv5_block10_concat (Concatenate)	(None, 7, 7, 960)	0
['conv5_block9_concat[0][0]', 'conv5_block10_2_conv[0][0]']		
conv5_block11_0_bn (Batch Normalization)	(None, 7, 7, 960)	3840
['conv5_block10_concat[0][0]']		
conv5_block11_0_relu (Activation)	(None, 7, 7, 960)	0
['conv5_block11_0_bn[0][0]']		
conv5_block11_1_conv (Conv2D)	(None, 7, 7, 128)	122880
['conv5_block11_0_relu[0][0]']		
conv5_block11_1_bn (Batch Normalization)	(None, 7, 7, 128)	512
['conv5_block11_1_conv[0][0]']		
conv5_block11_1_relu (Activation)	(None, 7, 7, 128)	0
['conv5_block11_1_bn[0][0]']		
conv5_block11_2_conv (Conv2D)	(None, 7, 7, 32)	36864
['conv5_block11_1_relu[0][0]']		
conv5_block11_concat (Concatenate)	(None, 7, 7, 992)	0
['conv5_block10_concat[0][0]', 'conv5_block11_2_conv[0][0]']		
conv5_block12_0_bn (Batch Normalization)	(None, 7, 7, 992)	3968

```

['conv5_block11_concat[0][0]']
lization)

conv5_block12_0_relu (Activati (None, 7, 7, 992) 0
['conv5_block12_0_bn[0][0]']
on)

conv5_block12_1_conv (Conv2D) (None, 7, 7, 128) 126976
['conv5_block12_0_relu[0][0]']

conv5_block12_1_bn (BatchNorma (None, 7, 7, 128) 512
['conv5_block12_1_conv[0][0]']
lization)

conv5_block12_1_relu (Activati (None, 7, 7, 128) 0
['conv5_block12_1_bn[0][0]']
on)

conv5_block12_2_conv (Conv2D) (None, 7, 7, 32) 36864
['conv5_block12_1_relu[0][0]']

conv5_block12_concat (Concaten (None, 7, 7, 1024) 0
['conv5_block11_concat[0][0]',
ate)
'conv5_block12_2_conv[0][0]']

conv5_block13_0_bn (BatchNorma (None, 7, 7, 1024) 4096
['conv5_block12_concat[0][0]']
lization)

conv5_block13_0_relu (Activati (None, 7, 7, 1024) 0
['conv5_block13_0_bn[0][0]']
on)

conv5_block13_1_conv (Conv2D) (None, 7, 7, 128) 131072
['conv5_block13_0_relu[0][0]']

conv5_block13_1_bn (BatchNorma (None, 7, 7, 128) 512
['conv5_block13_1_conv[0][0]']
lization)

conv5_block13_1_relu (Activati (None, 7, 7, 128) 0
['conv5_block13_1_bn[0][0]']
on)

conv5_block13_2_conv (Conv2D) (None, 7, 7, 32) 36864
['conv5_block13_1_relu[0][0]']

```



```

conv5_block13_concat (Concaten (None, 7, 7, 1056) 0
['conv5_block12_concat[0][0]',
ate)
'conv5_block13_2_conv[0][0]']

conv5_block14_0_bn (BatchNorma (None, 7, 7, 1056) 4224
['conv5_block13_concat[0][0]']
lization)

conv5_block14_0_relu (Activati (None, 7, 7, 1056) 0
['conv5_block14_0_bn[0][0]']
on)

conv5_block14_1_conv (Conv2D) (None, 7, 7, 128) 135168
['conv5_block14_0_relu[0][0]']

conv5_block14_1_bn (BatchNorma (None, 7, 7, 128) 512
['conv5_block14_1_conv[0][0]']
lization)

conv5_block14_1_relu (Activati (None, 7, 7, 128) 0
['conv5_block14_1_bn[0][0]']
on)

conv5_block14_2_conv (Conv2D) (None, 7, 7, 32) 36864
['conv5_block14_1_relu[0][0]']

conv5_block14_concat (Concaten (None, 7, 7, 1088) 0
['conv5_block13_concat[0][0]',
ate)
'conv5_block14_2_conv[0][0]']

conv5_block15_0_bn (BatchNorma (None, 7, 7, 1088) 4352
['conv5_block14_concat[0][0]']
lization)

conv5_block15_0_relu (Activati (None, 7, 7, 1088) 0
['conv5_block15_0_bn[0][0]']
on)

conv5_block15_1_conv (Conv2D) (None, 7, 7, 128) 139264
['conv5_block15_0_relu[0][0]']

conv5_block15_1_bn (BatchNorma (None, 7, 7, 128) 512
['conv5_block15_1_conv[0][0]']
lization)

conv5_block15_1_relu (Activati (None, 7, 7, 128) 0

```

```

['conv5_block15_1_bn[0][0]']
on)

conv5_block15_2_conv (Conv2D) (None, 7, 7, 32) 36864
['conv5_block15_1_relu[0][0]']

conv5_block15_concat (Concaten (None, 7, 7, 1120) 0
['conv5_block14_concat[0][0]',
ate)
'conv5_block15_2_conv[0][0]']

conv5_block16_0_bn (BatchNorma (None, 7, 7, 1120) 4480
['conv5_block15_concat[0][0]']
lization)

conv5_block16_0_relu (Activati (None, 7, 7, 1120) 0
['conv5_block16_0_bn[0][0]']
on)

conv5_block16_1_conv (Conv2D) (None, 7, 7, 128) 143360
['conv5_block16_0_relu[0][0]']

conv5_block16_1_bn (BatchNorma (None, 7, 7, 128) 512
['conv5_block16_1_conv[0][0]']
lization)

conv5_block16_1_relu (Activati (None, 7, 7, 128) 0
['conv5_block16_1_bn[0][0]']
on)

conv5_block16_2_conv (Conv2D) (None, 7, 7, 32) 36864
['conv5_block16_1_relu[0][0]']

conv5_block16_concat (Concaten (None, 7, 7, 1152) 0
['conv5_block15_concat[0][0]',
ate)
'conv5_block16_2_conv[0][0]']

conv5_block17_0_bn (BatchNorma (None, 7, 7, 1152) 4608
['conv5_block16_concat[0][0]']
lization)

conv5_block17_0_relu (Activati (None, 7, 7, 1152) 0
['conv5_block17_0_bn[0][0]']
on)

conv5_block17_1_conv (Conv2D) (None, 7, 7, 128) 147456
['conv5_block17_0_relu[0][0]']

```

```

conv5_block17_1_bn (BatchNorma (None, 7, 7, 128) 512
['conv5_block17_1_conv[0][0]']
lization)

conv5_block17_1_relu (Activati (None, 7, 7, 128) 0
['conv5_block17_1_bn[0][0]']
on)

conv5_block17_2_conv (Conv2D) (None, 7, 7, 32) 36864
['conv5_block17_1_relu[0][0]']

conv5_block17_concat (Concaten (None, 7, 7, 1184) 0
['conv5_block16_concat[0][0]',
ate)
'conv5_block17_2_conv[0][0]']

conv5_block18_0_bn (BatchNorma (None, 7, 7, 1184) 4736
['conv5_block17_concat[0][0]']
lization)

conv5_block18_0_relu (Activati (None, 7, 7, 1184) 0
['conv5_block18_0_bn[0][0]']
on)

conv5_block18_1_conv (Conv2D) (None, 7, 7, 128) 151552
['conv5_block18_0_relu[0][0]']

conv5_block18_1_bn (BatchNorma (None, 7, 7, 128) 512
['conv5_block18_1_conv[0][0]']
lization)

conv5_block18_1_relu (Activati (None, 7, 7, 128) 0
['conv5_block18_1_bn[0][0]']
on)

conv5_block18_2_conv (Conv2D) (None, 7, 7, 32) 36864
['conv5_block18_1_relu[0][0]']

conv5_block18_concat (Concaten (None, 7, 7, 1216) 0
['conv5_block17_concat[0][0]',
ate)
'conv5_block18_2_conv[0][0]']

conv5_block19_0_bn (BatchNorma (None, 7, 7, 1216) 4864
['conv5_block18_concat[0][0]']
lization)

```

```

conv5_block19_0_relu (Activati (None, 7, 7, 1216) 0
['conv5_block19_0_bn[0][0]']
on)

conv5_block19_1_conv (Conv2D) (None, 7, 7, 128) 155648
['conv5_block19_0_relu[0][0]']

conv5_block19_1_bn (BatchNorma (None, 7, 7, 128) 512
['conv5_block19_1_conv[0][0]']
lization)

conv5_block19_1_relu (Activati (None, 7, 7, 128) 0
['conv5_block19_1_bn[0][0]']
on)

conv5_block19_2_conv (Conv2D) (None, 7, 7, 32) 36864
['conv5_block19_1_relu[0][0]']

conv5_block19_concat (Concaten (None, 7, 7, 1248) 0
['conv5_block18_concat[0][0]',
ate)
'conv5_block19_2_conv[0][0]']

conv5_block20_0_bn (BatchNorma (None, 7, 7, 1248) 4992
['conv5_block19_concat[0][0]']
lization)

conv5_block20_0_relu (Activati (None, 7, 7, 1248) 0
['conv5_block20_0_bn[0][0]']
on)

conv5_block20_1_conv (Conv2D) (None, 7, 7, 128) 159744
['conv5_block20_0_relu[0][0]']

conv5_block20_1_bn (BatchNorma (None, 7, 7, 128) 512
['conv5_block20_1_conv[0][0]']
lization)

conv5_block20_1_relu (Activati (None, 7, 7, 128) 0
['conv5_block20_1_bn[0][0]']
on)

conv5_block20_2_conv (Conv2D) (None, 7, 7, 32) 36864
['conv5_block20_1_relu[0][0]']

conv5_block20_concat (Concaten (None, 7, 7, 1280) 0
['conv5_block19_concat[0][0]',
ate)

```

```

'conv5_block20_2_conv[0][0]']

conv5_block21_0_bn (BatchNorma (None, 7, 7, 1280) 5120
['conv5_block20_concat[0][0]']
lization)

conv5_block21_0_relu (Activati (None, 7, 7, 1280) 0
['conv5_block21_0_bn[0][0]']
on)

conv5_block21_1_conv (Conv2D) (None, 7, 7, 128) 163840
['conv5_block21_0_relu[0][0]']

conv5_block21_1_bn (BatchNorma (None, 7, 7, 128) 512
['conv5_block21_1_conv[0][0]']
lization)

conv5_block21_1_relu (Activati (None, 7, 7, 128) 0
['conv5_block21_1_bn[0][0]']
on)

conv5_block21_2_conv (Conv2D) (None, 7, 7, 32) 36864
['conv5_block21_1_relu[0][0]']

conv5_block21_concat (Concaten (None, 7, 7, 1312) 0
['conv5_block20_concat[0][0]',
ate)
'conv5_block21_2_conv[0][0]']

conv5_block22_0_bn (BatchNorma (None, 7, 7, 1312) 5248
['conv5_block21_concat[0][0]']
lization)

conv5_block22_0_relu (Activati (None, 7, 7, 1312) 0
['conv5_block22_0_bn[0][0]']
on)

conv5_block22_1_conv (Conv2D) (None, 7, 7, 128) 167936
['conv5_block22_0_relu[0][0]']

conv5_block22_1_bn (BatchNorma (None, 7, 7, 128) 512
['conv5_block22_1_conv[0][0]']
lization)

conv5_block22_1_relu (Activati (None, 7, 7, 128) 0
['conv5_block22_1_bn[0][0]']
on)

```

```

conv5_block22_2_conv (Conv2D) (None, 7, 7, 32) 36864
['conv5_block22_1_relu[0][0]']

conv5_block22_concat (Concaten (None, 7, 7, 1344) 0
['conv5_block21_concat[0][0]',
ate)
'conv5_block22_2_conv[0][0]']

conv5_block23_0_bn (BatchNorma (None, 7, 7, 1344) 5376
['conv5_block22_concat[0][0]']
lization)

conv5_block23_0_relu (Activati (None, 7, 7, 1344) 0
['conv5_block23_0_bn[0][0]']
on)

conv5_block23_1_conv (Conv2D) (None, 7, 7, 128) 172032
['conv5_block23_0_relu[0][0]']

conv5_block23_1_bn (BatchNorma (None, 7, 7, 128) 512
['conv5_block23_1_conv[0][0]']
lization)

conv5_block23_1_relu (Activati (None, 7, 7, 128) 0
['conv5_block23_1_bn[0][0]']
on)

conv5_block23_2_conv (Conv2D) (None, 7, 7, 32) 36864
['conv5_block23_1_relu[0][0]']

conv5_block23_concat (Concaten (None, 7, 7, 1376) 0
['conv5_block22_concat[0][0]',
ate)
'conv5_block23_2_conv[0][0]']

conv5_block24_0_bn (BatchNorma (None, 7, 7, 1376) 5504
['conv5_block23_concat[0][0]']
lization)

conv5_block24_0_relu (Activati (None, 7, 7, 1376) 0
['conv5_block24_0_bn[0][0]']
on)

conv5_block24_1_conv (Conv2D) (None, 7, 7, 128) 176128
['conv5_block24_0_relu[0][0]']

conv5_block24_1_bn (BatchNorma (None, 7, 7, 128) 512
['conv5_block24_1_conv[0][0]']

```

```

lization)

conv5_block24_1_relu (Activation) (None, 7, 7, 128) 0
['conv5_block24_1_bn[0][0]']
on)

conv5_block24_2_conv (Conv2D) (None, 7, 7, 32) 36864
['conv5_block24_1_relu[0][0]']

conv5_block24_concat (Concatenation) (None, 7, 7, 1408) 0
['conv5_block23_concat[0][0]',
ate)
'conv5_block24_2_conv[0][0]']

conv5_block25_0_bn (BatchNormalization) (None, 7, 7, 1408) 5632
['conv5_block24_concat[0][0]']
lization)

conv5_block25_0_relu (Activation) (None, 7, 7, 1408) 0
['conv5_block25_0_bn[0][0]']
on)

conv5_block25_1_conv (Conv2D) (None, 7, 7, 128) 180224
['conv5_block25_0_relu[0][0]']

conv5_block25_1_bn (BatchNormalization) (None, 7, 7, 128) 512
['conv5_block25_1_conv[0][0]']
lization)

conv5_block25_1_relu (Activation) (None, 7, 7, 128) 0
['conv5_block25_1_bn[0][0]']
on)

conv5_block25_2_conv (Conv2D) (None, 7, 7, 32) 36864
['conv5_block25_1_relu[0][0]']

conv5_block25_concat (Concatenation) (None, 7, 7, 1440) 0
['conv5_block24_concat[0][0]',
ate)
'conv5_block25_2_conv[0][0]']

conv5_block26_0_bn (BatchNormalization) (None, 7, 7, 1440) 5760
['conv5_block25_concat[0][0]']
lization)

conv5_block26_0_relu (Activation) (None, 7, 7, 1440) 0
['conv5_block26_0_bn[0][0]']
on)

```

conv5_block26_1_conv (Conv2D)	(None, 7, 7, 128)	184320
['conv5_block26_0_relu[0][0]']		
conv5_block26_1_bn (Batch Normalization)	(None, 7, 7, 128)	512
['conv5_block26_1_conv[0][0]']		
conv5_block26_1_relu (Activation)	(None, 7, 7, 128)	0
['conv5_block26_1_bn[0][0]']		
conv5_block26_2_conv (Conv2D)	(None, 7, 7, 32)	36864
['conv5_block26_1_relu[0][0]']		
conv5_block26_concat (Concatenation)	(None, 7, 7, 1472)	0
['conv5_block25_concat[0][0]', 'conv5_block26_2_conv[0][0]']		
conv5_block27_0_bn (Batch Normalization)	(None, 7, 7, 1472)	5888
['conv5_block26_concat[0][0]']		
conv5_block27_0_relu (Activation)	(None, 7, 7, 1472)	0
['conv5_block27_0_bn[0][0]']		
conv5_block27_1_conv (Conv2D)	(None, 7, 7, 128)	188416
['conv5_block27_0_relu[0][0]']		
conv5_block27_1_bn (Batch Normalization)	(None, 7, 7, 128)	512
['conv5_block27_1_conv[0][0]']		
conv5_block27_1_relu (Activation)	(None, 7, 7, 128)	0
['conv5_block27_1_bn[0][0]']		
conv5_block27_2_conv (Conv2D)	(None, 7, 7, 32)	36864
['conv5_block27_1_relu[0][0]']		
conv5_block27_concat (Concatenation)	(None, 7, 7, 1504)	0
['conv5_block26_concat[0][0]', 'conv5_block27_2_conv[0][0]']		
conv5_block28_0_bn (Batch Normalization)	(None, 7, 7, 1504)	6016


```

['conv5_block27_concat[0][0]']
lization)

conv5_block28_0_relu (Activati (None, 7, 7, 1504) 0
['conv5_block28_0_bn[0][0]']
on)

conv5_block28_1_conv (Conv2D) (None, 7, 7, 128) 192512
['conv5_block28_0_relu[0][0]']

conv5_block28_1_bn (BatchNorma (None, 7, 7, 128) 512
['conv5_block28_1_conv[0][0]']
lization)

conv5_block28_1_relu (Activati (None, 7, 7, 128) 0
['conv5_block28_1_bn[0][0]']
on)

conv5_block28_2_conv (Conv2D) (None, 7, 7, 32) 36864
['conv5_block28_1_relu[0][0]']

conv5_block28_concat (Concaten (None, 7, 7, 1536) 0
['conv5_block27_concat[0][0]',
ate)
'conv5_block28_2_conv[0][0]']

conv5_block29_0_bn (BatchNorma (None, 7, 7, 1536) 6144
['conv5_block28_concat[0][0]']
lization)

conv5_block29_0_relu (Activati (None, 7, 7, 1536) 0
['conv5_block29_0_bn[0][0]']
on)

conv5_block29_1_conv (Conv2D) (None, 7, 7, 128) 196608
['conv5_block29_0_relu[0][0]']

conv5_block29_1_bn (BatchNorma (None, 7, 7, 128) 512
['conv5_block29_1_conv[0][0]']
lization)

conv5_block29_1_relu (Activati (None, 7, 7, 128) 0
['conv5_block29_1_bn[0][0]']
on)

conv5_block29_2_conv (Conv2D) (None, 7, 7, 32) 36864
['conv5_block29_1_relu[0][0]']

```

```

conv5_block29_concat (Concaten (None, 7, 7, 1568) 0
['conv5_block28_concat[0][0]',
ate)
'conv5_block29_2_conv[0][0]']

conv5_block30_0_bn (BatchNorma (None, 7, 7, 1568) 6272
['conv5_block29_concat[0][0]']
lization)

conv5_block30_0_relu (Activati (None, 7, 7, 1568) 0
['conv5_block30_0_bn[0][0]']
on)

conv5_block30_1_conv (Conv2D) (None, 7, 7, 128) 200704
['conv5_block30_0_relu[0][0]']

conv5_block30_1_bn (BatchNorma (None, 7, 7, 128) 512
['conv5_block30_1_conv[0][0]']
lization)

conv5_block30_1_relu (Activati (None, 7, 7, 128) 0
['conv5_block30_1_bn[0][0]']
on)

conv5_block30_2_conv (Conv2D) (None, 7, 7, 32) 36864
['conv5_block30_1_relu[0][0]']

conv5_block30_concat (Concaten (None, 7, 7, 1600) 0
['conv5_block29_concat[0][0]',
ate)
'conv5_block30_2_conv[0][0]']

conv5_block31_0_bn (BatchNorma (None, 7, 7, 1600) 6400
['conv5_block30_concat[0][0]']
lization)

conv5_block31_0_relu (Activati (None, 7, 7, 1600) 0
['conv5_block31_0_bn[0][0]']
on)

conv5_block31_1_conv (Conv2D) (None, 7, 7, 128) 204800
['conv5_block31_0_relu[0][0]']

conv5_block31_1_bn (BatchNorma (None, 7, 7, 128) 512
['conv5_block31_1_conv[0][0]']
lization)

conv5_block31_1_relu (Activati (None, 7, 7, 128) 0

```

```

['conv5_block31_1_bn[0][0]']
on)

conv5_block31_2_conv (Conv2D) (None, 7, 7, 32) 36864
['conv5_block31_1_relu[0][0]']

conv5_block31_concat (Concaten (None, 7, 7, 1632) 0
['conv5_block30_concat[0][0]',
ate)
'conv5_block31_2_conv[0][0]']

conv5_block32_0_bn (BatchNorma (None, 7, 7, 1632) 6528
['conv5_block31_concat[0][0]']
lization)

conv5_block32_0_relu (Activati (None, 7, 7, 1632) 0
['conv5_block32_0_bn[0][0]']
on)

conv5_block32_1_conv (Conv2D) (None, 7, 7, 128) 208896
['conv5_block32_0_relu[0][0]']

conv5_block32_1_bn (BatchNorma (None, 7, 7, 128) 512
['conv5_block32_1_conv[0][0]']
lization)

conv5_block32_1_relu (Activati (None, 7, 7, 128) 0
['conv5_block32_1_bn[0][0]']
on)

conv5_block32_2_conv (Conv2D) (None, 7, 7, 32) 36864
['conv5_block32_1_relu[0][0]']

conv5_block32_concat (Concaten (None, 7, 7, 1664) 0
['conv5_block31_concat[0][0]',
ate)
'conv5_block32_2_conv[0][0]']

bn (BatchNormalization) (None, 7, 7, 1664) 6656
['conv5_block32_concat[0][0]']

relu (Activation) (None, 7, 7, 1664) 0 ['bn[0][0]']

=====
=====
Total params: 12,642,880
Trainable params: 12,484,480
Non-trainable params: 158,400

```

```

-----
[8]: x = base_model.output
      x = GlobalAveragePooling2D()(x)
      output = Dense(num_classes, activation='softmax')(x)
      model = Model(inputs=base_model.input, outputs=output)

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

      tensorboard_callback = tf.keras.callbacks.TensorBoard(log_dir='logs')

      hist = model.fit(train_data, epochs=20, validation_data=val_data,
                      ↪callbacks=[tensorboard_callback])

```

```

Epoch 1/20
168/168 [=====] - 43s 187ms/step - loss: 0.5526 -
accuracy: 0.8024 - val_loss: 4.9760 - val_accuracy: 0.4939
Epoch 2/20
168/168 [=====] - 30s 179ms/step - loss: 0.2275 -
accuracy: 0.9198 - val_loss: 0.5497 - val_accuracy: 0.8518
Epoch 3/20
168/168 [=====] - 30s 177ms/step - loss: 0.1875 -
accuracy: 0.9325 - val_loss: 0.6684 - val_accuracy: 0.8332
Epoch 4/20
168/168 [=====] - 30s 178ms/step - loss: 0.1518 -
accuracy: 0.9456 - val_loss: 0.4188 - val_accuracy: 0.8554
Epoch 5/20
168/168 [=====] - 30s 178ms/step - loss: 0.1519 -
accuracy: 0.9471 - val_loss: 0.8423 - val_accuracy: 0.7895
Epoch 6/20
168/168 [=====] - 30s 177ms/step - loss: 0.0903 -
accuracy: 0.9697 - val_loss: 0.1958 - val_accuracy: 0.9377
Epoch 7/20
168/168 [=====] - 30s 177ms/step - loss: 0.0575 -
accuracy: 0.9798 - val_loss: 0.2177 - val_accuracy: 0.9356
Epoch 8/20
168/168 [=====] - 30s 179ms/step - loss: 0.0446 -
accuracy: 0.9839 - val_loss: 0.2191 - val_accuracy: 0.9341
Epoch 9/20
168/168 [=====] - 30s 179ms/step - loss: 0.0748 -
accuracy: 0.9733 - val_loss: 0.2498 - val_accuracy: 0.9363
Epoch 10/20
168/168 [=====] - 30s 180ms/step - loss: 0.0875 -
accuracy: 0.9708 - val_loss: 0.3328 - val_accuracy: 0.9155
Epoch 11/20

```

```

168/168 [=====] - 30s 180ms/step - loss: 0.0495 -
accuracy: 0.9822 - val_loss: 0.4570 - val_accuracy: 0.8833
Epoch 12/20
168/168 [=====] - 31s 181ms/step - loss: 0.0549 -
accuracy: 0.9836 - val_loss: 0.6337 - val_accuracy: 0.8404
Epoch 13/20
168/168 [=====] - 30s 177ms/step - loss: 0.0425 -
accuracy: 0.9841 - val_loss: 0.3370 - val_accuracy: 0.9127
Epoch 14/20
168/168 [=====] - 30s 177ms/step - loss: 0.0600 -
accuracy: 0.9789 - val_loss: 0.4898 - val_accuracy: 0.8898
Epoch 15/20
168/168 [=====] - 30s 180ms/step - loss: 0.0954 -
accuracy: 0.9690 - val_loss: 0.2500 - val_accuracy: 0.9356
Epoch 16/20
168/168 [=====] - 31s 181ms/step - loss: 0.0196 -
accuracy: 0.9944 - val_loss: 0.2573 - val_accuracy: 0.9370
Epoch 17/20
168/168 [=====] - 30s 178ms/step - loss: 0.0175 -
accuracy: 0.9940 - val_loss: 0.2570 - val_accuracy: 0.9313
Epoch 18/20
168/168 [=====] - 30s 179ms/step - loss: 0.0170 -
accuracy: 0.9942 - val_loss: 0.2075 - val_accuracy: 0.9384
Epoch 19/20
168/168 [=====] - 31s 182ms/step - loss: 0.0299 -
accuracy: 0.9905 - val_loss: 0.2904 - val_accuracy: 0.9277
Epoch 20/20
168/168 [=====] - 31s 183ms/step - loss: 0.0806 -
accuracy: 0.9735 - val_loss: 0.6010 - val_accuracy: 0.8783

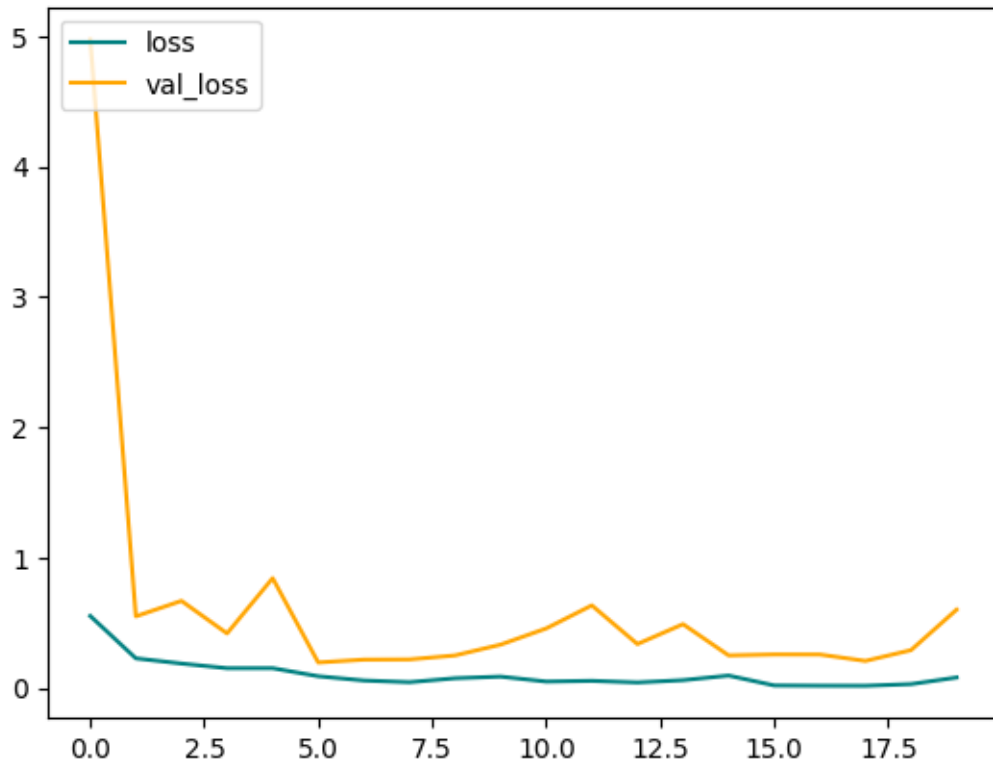
```

```

[9]: fig = plt.figure()
plt.plot(hist.history['loss'], color='teal', label='loss')
plt.plot(hist.history['val_loss'], color='orange', label='val_loss')
fig.suptitle('Loss', fontsize=20)
plt.legend(loc="upper left")
plt.show()

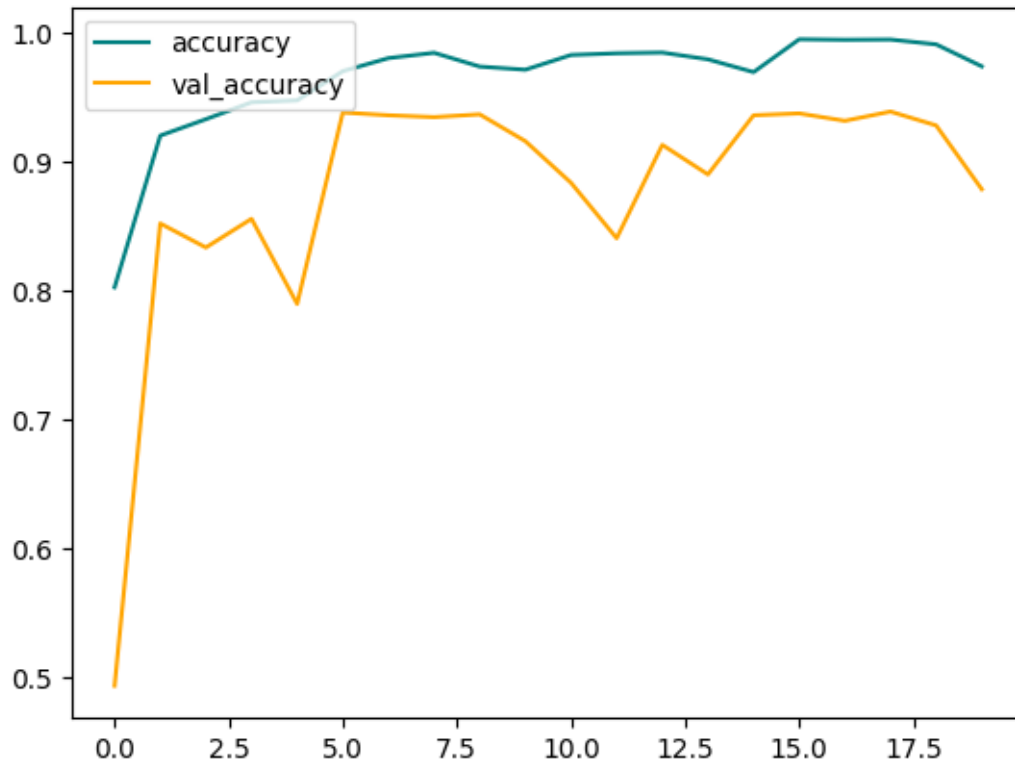
```

Loss



```
[10]: fig = plt.figure()
plt.plot(hist.history['accuracy'], color='teal', label='accuracy')
plt.plot(hist.history['val_accuracy'], color='orange', label='val_accuracy')
fig.suptitle('Accuracy', fontsize=20)
plt.legend(loc="upper left")
plt.show()
```

Accuracy



```
[11]: pre = Precision()
      re = Recall()
      acc = SparseCategoricalAccuracy()
```

```
[12]: for batch in test_data.as_numpy_iterator():
      X, y = batch
      yhat = model.predict(X)

      yhat_classes = tf.argmax(yhat, axis=1)

      pre.update_state(y, yhat_classes)
      re.update_state(y, yhat_classes)
      acc.update_state(y, yhat)
```

```
1/1 [=====] - 1s 1s/step
1/1 [=====] - 0s 29ms/step
1/1 [=====] - 0s 30ms/step
1/1 [=====] - 0s 29ms/step
1/1 [=====] - 0s 29ms/step
1/1 [=====] - 0s 30ms/step
```

```

1/1 [=====] - 0s 30ms/step
1/1 [=====] - 0s 33ms/step
1/1 [=====] - 0s 32ms/step
1/1 [=====] - 0s 32ms/step
1/1 [=====] - 0s 27ms/step
1/1 [=====] - 0s 28ms/step
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1/1 [=====] - 0s 27ms/step
1/1 [=====] - 0s 28ms/step
1/1 [=====] - 0s 30ms/step
1/1 [=====] - 1s 1s/step

```

```

[13]: print(f"Precision: {pre.result().numpy() * 100 : .2f}%")
      print(f"Recall: {re.result().numpy() * 100 : .2f}%")
      print(f"Accuracy: {acc.result().numpy() * 100 : .2f}%")

```

```

Precision: 99.67%
Recall: 96.18%
Accuracy: 87.91%

```

```

[14]: img = cv2.imread('Styles/test/Hatchback/8_jpg.rf.
      ↪c314c1d6777942876503fa1482c82240.jpg')

img_resized = cv2.resize(img, img_size)
img_expanded = np.expand_dims(img_resized, axis=0)

yhat = model.predict(img_expanded)
predicted_class = tf.argmax(yhat, axis=1).numpy()[0]

plt.imshow(img)
plt.title(f'Predicted class: {predicted_class}')
plt.axis('off')
plt.show()

```

```

1/1 [=====] - 1s 1s/step

```


Predicted class: 2



```
[15]: print(f'Predicted class is: {class_names[predicted_class]}')
      for idx, prob in enumerate(yhat[0]):
          print(f"Model probability for {class_names[idx]} is {prob * 100:.2f}%")
```

```
Predicted class is: Hatchback
Model probability for Convertible is 0.00%
Model probability for Coupe is 0.00%
Model probability for Hatchback is 100.00%
Model probability for Pick-Up is 0.00%
Model probability for SUV is 0.00%
Model probability for Sedan is 0.00%
Model probability for VAN is 0.00%
```

```
[16]: model_file_name = f"CarStyle{acc.result().numpy() * 100 : .2f}% DenseNet169.h5"
      model.save(os.path.join('models', model_file_name))
```

```
[ ]:
```