cs2_hrnet

July 30, 2021

1 Libraries

[1]:
```
import warnings
warnings.filterwarnings('ignore')
import os
import sys
import numpy as np
import pandas as pd
from tqdm import tqdm
pd.set_option("display.max_colwidth", -1)
import cv2
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
import seaborn as sns
import datetime
from PIL import Image, ImageStat
import math
import tensorflow as tf
from tensorflow.keras.models import Model
from tensorflow.keras.layers import Input
from tensorflow.keras.layers import Activation
from tensorflow.keras.layers import BatchNormalization
from tensorflow.keras.layers import Conv2D
from tensorflow.keras.layers import UpSampling2D
from tensorflow.keras.layers import Add
from tensorflow.keras.initializers import RandomNormal
%load_ext tensorboard
```

[2]:
```
#seeding
seed = 2021
np.random.seed = seed
tf.seed = seed
```

[3]:
```
from google.colab import files
files.upload()
```

```
<IPython.core.display.HTML object>
```

```
Saving kaggle.json to kaggle.json
```

[3]:
```
{'kaggle.json':
b'{"username":"maksahu","key":"cff8c0f086aa6e0e50553f7ab0580687"}'}
```

[4]:
```
!mkdir -p ~/.kaggle
!cp kaggle.json ~/.kaggle/
!chmod 600 ~/.kaggle/kaggle.json
```

2 Data

[5]:
```
!kaggle competitions download -c data-science-bowl-2018
```

```
Warning: Looks like you're using an outdated API Version, please consider
updating (server 1.5.12 / client 1.5.4)
Downloading stage1_sample_submission.csv.zip to /content
  0% 0.00/2.62k [00:00<?, ?B/s]
100% 2.62k/2.62k [00:00<00:00, 4.78MB/s]
Downloading stage2_sample_submission_final.csv.zip to /content
  0% 0.00/112k [00:00<?, ?B/s]
100% 112k/112k [00:00<00:00, 37.6MB/s]
Downloading stage1_train_labels.csv.zip to /content
  0% 0.00/2.67M [00:00<?, ?B/s]
100% 2.67M/2.67M [00:00<00:00, 87.1MB/s]
Downloading stage1_solution.csv.zip to /content
  0% 0.00/386k [00:00<?, ?B/s]
100% 386k/386k [00:00<00:00, 125MB/s]
Downloading stage1_train.zip to /content
 78% 62.0M/79.1M [00:00<00:00, 150MB/s]
100% 79.1M/79.1M [00:00<00:00, 227MB/s]
Downloading stage1_test.zip to /content
  0% 0.00/9.10M [00:00<?, ?B/s]
100% 9.10M/9.10M [00:00<00:00, 150MB/s]
Downloading stage2_test_final.zip to /content
 95% 263M/276M [00:01<00:00, 232MB/s]
100% 276M/276M [00:01<00:00, 224MB/s]
```

[6]:
```
#Creating these two folder
!mkdir train test
```

[7]:
```
#Unziping the training and testing folders into directories
print('Unzipping stage1_train.zip')
!unzip -q "/content/stage1_train.zip" -d train/
print('Unzipped stage1_train.zip')

print('Unzipping stage1_test.zip')
!unzip -q "/content/stage1_train.zip" -d test/
```

```
print('Unzipped stage1_test.zip')
```

```
Unzipping stage1_train.zip
Unzipped stage1_train.zip
Unzipping stage1_test.zip
Unzipped stage1_test.zip
```

[8]:
```
# Root directories for training and testing
TRAIN_ROOT = './train'
TEST_ROOT = './test'
```

[9]:
```
# Function to create a dataframe of files which will be used for further␣
 ↪processing
def files_df(root_dir):
    subdir = os.listdir(root_dir)
    files = []
    df = pd.DataFrame()
    for dir in subdir:
        files.append(os.path.join(root_dir,dir))
    df['files'] = files
    return df
```

[10]:
```
train_df = files_df(TRAIN_ROOT)
test_df = files_df(TEST_ROOT)
```

[11]:
```
# Hyperparameters
IMG_WIDTH = 256
IMG_HEIGHT = 256
IMG_CHANNELS = 3
CLASSES = 1
BATCH_SIZE = 8
```

[12]:
```
# Function which will create a dataframe of image paths and mask paths along␣
 ↪with creating a single mask with multiple masks
def image_df(filenames):
    image_paths = []
    mask_paths = []
    df = pd.DataFrame()
    for filename in tqdm(filenames):
        file_path = os.path.join(filename,'images')
        image_path = os.path.join(file_path,os.listdir(file_path)[0])
        image_paths.append(image_path)

        mask = np.zeros((IMG_WIDTH,IMG_HEIGHT,CLASSES))
        mask_dir = file_path.replace("images", "masks")
        masks = os.listdir(mask_dir)
        for m in masks:
```

```
            mask_path = os.path.join(mask_dir,m)
            mask_  = cv2.imread(mask_path, cv2.IMREAD_UNCHANGED)
            mask_  = cv2.resize(mask_,(IMG_WIDTH,IMG_HEIGHT),interpolation=cv2.
↪INTER_NEAREST)
            mask_  = np.expand_dims(mask_, axis = -1)
            mask = np.maximum(mask,mask_)
        newmask_dir = mask_dir.replace("masks", "masks_")
        if not os.path.isdir(newmask_dir):
            os.mkdir(newmask_dir)
        newmask_path = image_path.replace("images", "masks_")
        mask_paths.append(newmask_path)
        cv2.imwrite(newmask_path, mask)
    df['images'] = image_paths
    df['masks'] = mask_paths
    return df
```

[13]:
```
# Training dataframe
train_filenames = train_df['files']
train = image_df(train_filenames)
```

```
100%|      | 670/670 [00:25<00:00, 25.79it/s]
```

[14]:
```
train.head()
```

[14]:

	images	masks
0	./train/d910b2b1be8406caecfe31a503d412ffc4e3d488286242ebc7381836121dd4ef/images/d910b2b1be8406caecfe31a503d412ffc4e3d488286242ebc7381836121dd4ef.png	./train/d910b2b1be8406caecfe31a503d412ffc4e3d488286242ebc7381836121dd4ef/masks_/d910b2b1be8406caecfe31a503d412ffc4e3d488286242ebc7381836121dd4ef.png
1	./train/a7f767ca9770b160f234780e172aeb35a50830ba10dc49c526f4712451abe1d2/images/a7f767ca9770b160f234780e172aeb35a50830ba10dc49c526f4712451abe1d2.png	./train/a7f767ca9770b160f234780e172aeb35a50830ba10dc49c526f4712451abe1d2/masks_/a7f767ca9770b160f234780e172aeb35a50830ba10dc49c526f4712451abe1d2.png
2	./train/be1916d0e5592c17f971315b5de720ef6894173087399daed94a52ef109c1572/images/be1916d0e5592c17f971315b5de720ef6894173087399daed94a52ef109c1572.png	./train/be1916d0e5592c17f971315b5de720ef6894173087399daed94a52ef109c1572/masks_/be1916d0e5592c17f971315b5de720ef6894173087399daed94a52ef109c1572.png
3	./train/d751ccb64fa767a65a966061218438bd1860695d96bbef11fdb2f0d3b8dedba8/images/d751ccb64fa767a65a966061218438bd1860695d96bbef11fdb2f0d3b8dedba8.png	./train/d751ccb64fa767a65a966061218438bd1860695d96bbef11fdb2f0d3b8dedba8/masks_/d751ccb64fa767a65a966061218438bd1860695d96bbef11fdb2f0d3b8dedba8.png
4	./train/80632d6be60c8462e50d51bcf5caf15308931603095d6b5e772a115cd0d0470c/images/80632d6be60c8462e50d51bcf5caf15308931603095d6b5e772a115cd0d0470c.png	./train/80632d6be60c8462e50d51bcf5caf15308931603095d6b5e772a115cd0d0470c/masks_/80632d6be60c8462e50d51bcf5caf15308931603095d6b5e772a115cd0d0470c.png

3 Train Test Split

[15]:
```
X_train, X_val = train_test_split(train, test_size=0.1, random_state=42)
```

[16]:
```
X_train.head()
```

[16]:
```
                                                                                                images
masks
300  ./train/c304a1fdf3bca2f4b4580d2cac59942e2224a7678001bf5ed9d9852f57708932/im
ages/c304a1fdf3bca2f4b4580d2cac59942e2224a7678001bf5ed9d9852f57708932.png  ./tra
in/c304a1fdf3bca2f4b4580d2cac59942e2224a7678001bf5ed9d9852f57708932/masks_/c304a
1fdf3bca2f4b4580d2cac59942e2224a7678001bf5ed9d9852f57708932.png
60   ./train/9e4f8ec60a0d622a02c0e16eedcc0101f88ddefbcec2383946c4572b57a1e43a/im
ages/9e4f8ec60a0d622a02c0e16eedcc0101f88ddefbcec2383946c4572b57a1e43a.png  ./tra
in/9e4f8ec60a0d622a02c0e16eedcc0101f88ddefbcec2383946c4572b57a1e43a/masks_/9e4f8
ec60a0d622a02c0e16eedcc0101f88ddefbcec2383946c4572b57a1e43a.png
133  ./train/6c67b78e8164801059375ed9a607f61e67a7ae347e92e36a7f20514224541d56/im
ages/6c67b78e8164801059375ed9a607f61e67a7ae347e92e36a7f20514224541d56.png  ./tra
in/6c67b78e8164801059375ed9a607f61e67a7ae347e92e36a7f20514224541d56/masks_/6c67b
78e8164801059375ed9a607f61e67a7ae347e92e36a7f20514224541d56.png
30   ./train/0bda515e370294ed94efd36bd53782288acacb040c171df2ed97fd691fc9d8fe/im
ages/0bda515e370294ed94efd36bd53782288acacb040c171df2ed97fd691fc9d8fe.png  ./tra
in/0bda515e370294ed94efd36bd53782288acacb040c171df2ed97fd691fc9d8fe/masks_/0bda5
15e370294ed94efd36bd53782288acacb040c171df2ed97fd691fc9d8fe.png
69   ./train/623cf6987b3fac8f384c09f40d98c5e739c097aa9a9627054542aa27f7d38db1/im
ages/623cf6987b3fac8f384c09f40d98c5e739c097aa9a9627054542aa27f7d38db1.png  ./tra
in/623cf6987b3fac8f384c09f40d98c5e739c097aa9a9627054542aa27f7d38db1/masks_/623cf
6987b3fac8f384c09f40d98c5e739c097aa9a9627054542aa27f7d38db1.png
```

[17]:
```
X_val.head()
```

[17]:
```
                                                                                                images
masks
361  ./train/c395870ad9f5a3ae651b50efab9b20c3e6b9aea15d4c731eb34c0cf9e3800a72/im
ages/c395870ad9f5a3ae651b50efab9b20c3e6b9aea15d4c731eb34c0cf9e3800a72.png  ./tra
in/c395870ad9f5a3ae651b50efab9b20c3e6b9aea15d4c731eb34c0cf9e3800a72/masks_/c3958
70ad9f5a3ae651b50efab9b20c3e6b9aea15d4c731eb34c0cf9e3800a72.png
158  ./train/fc345dac2205deb169bd70197f07f053bada80b61ffa69fdfb490758323ead69/im
ages/fc345dac2205deb169bd70197f07f053bada80b61ffa69fdfb490758323ead69.png  ./tra
in/fc345dac2205deb169bd70197f07f053bada80b61ffa69fdfb490758323ead69/masks_/fc345
dac2205deb169bd70197f07f053bada80b61ffa69fdfb490758323ead69.png
480  ./train/8f94a80b95a881d0efdec36affc915dca9609f4cba8134c4a91b219d418778aa/im
ages/8f94a80b95a881d0efdec36affc915dca9609f4cba8134c4a91b219d418778aa.png  ./tra
in/8f94a80b95a881d0efdec36affc915dca9609f4cba8134c4a91b219d418778aa/masks_/8f94a
80b95a881d0efdec36affc915dca9609f4cba8134c4a91b219d418778aa.png
640  ./train/2cfa61bef6542dd359717e9131ce6f076c415a3bd7f48cb093b0d7f3b2ca785d/im
ages/2cfa61bef6542dd359717e9131ce6f076c415a3bd7f48cb093b0d7f3b2ca785d.png  ./tra
```

```
in/2cfa61bef6542dd359717e9131ce6f076c415a3bd7f48cb093b0d7f3b2ca785d/masks_/2cfa6
1bef6542dd359717e9131ce6f076c415a3bd7f48cb093b0d7f3b2ca785d.png
275  ./train/0d2bf916cc8de90d02f4cd4c23ea79b227dbc45d845b4124ffea380c92d34c8c/im
ages/0d2bf916cc8de90d02f4cd4c23ea79b227dbc45d845b4124ffea380c92d34c8c.png  ./tra
in/0d2bf916cc8de90d02f4cd4c23ea79b227dbc45d845b4124ffea380c92d34c8c/masks_/0d2bf
916cc8de90d02f4cd4c23ea79b227dbc45d845b4124ffea380c92d34c8c.png
```

4 Data Preprocessing

[18]:
```python
# Function to parse image and mask file path and convert them into image and␣
↪mask
def parse_function(image_path, mask_path):
    image_string = tf.io.read_file(image_path)
    image = tf.image.decode_png(image_string, channels=IMG_CHANNELS)#
    image = tf.image.convert_image_dtype(image, tf.float32)
    image = tf.image.resize(image, [IMG_HEIGHT, IMG_WIDTH]) # height x width

    mask_string = tf.io.read_file(mask_path)
    mask = tf.image.decode_png(mask_string, channels=CLASSES)#
    mask = tf.image.convert_image_dtype(mask, tf.float32)
    mask = tf.image.resize(mask, [IMG_HEIGHT, IMG_WIDTH])
    return image, mask
```

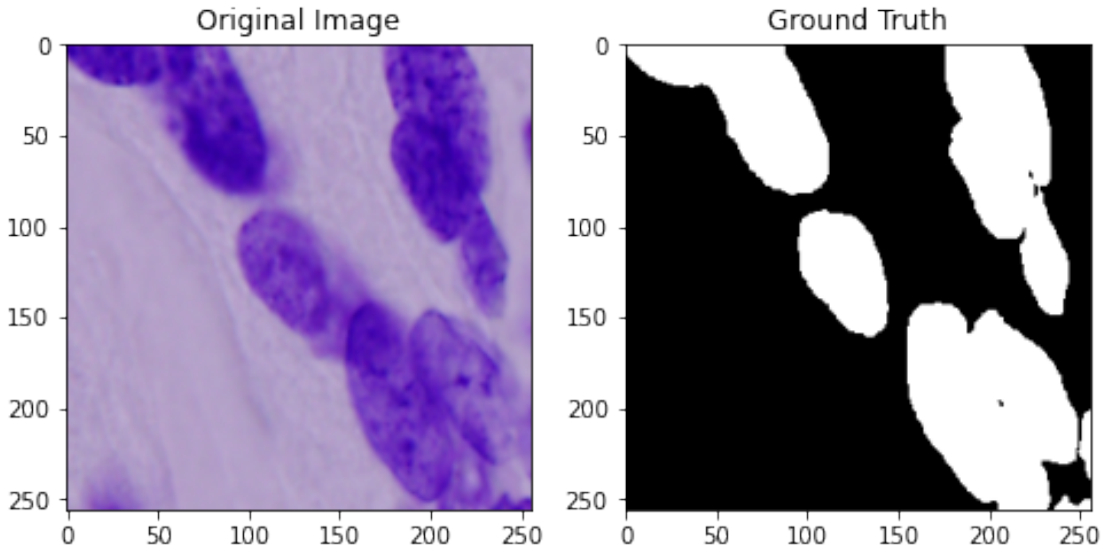
[19]:
```python
# Training dataset
train_ds = tf.data.Dataset.from_tensor_slices((X_train['images'],␣
↪X_train['masks']))
train_ds = train_ds.shuffle(X_train.shape[0])
train_ds = train_ds.map(parse_function, num_parallel_calls=tf.data.AUTOTUNE)
train_ds = train_ds.batch(BATCH_SIZE)
train_ds = train_ds.prefetch(1)
```

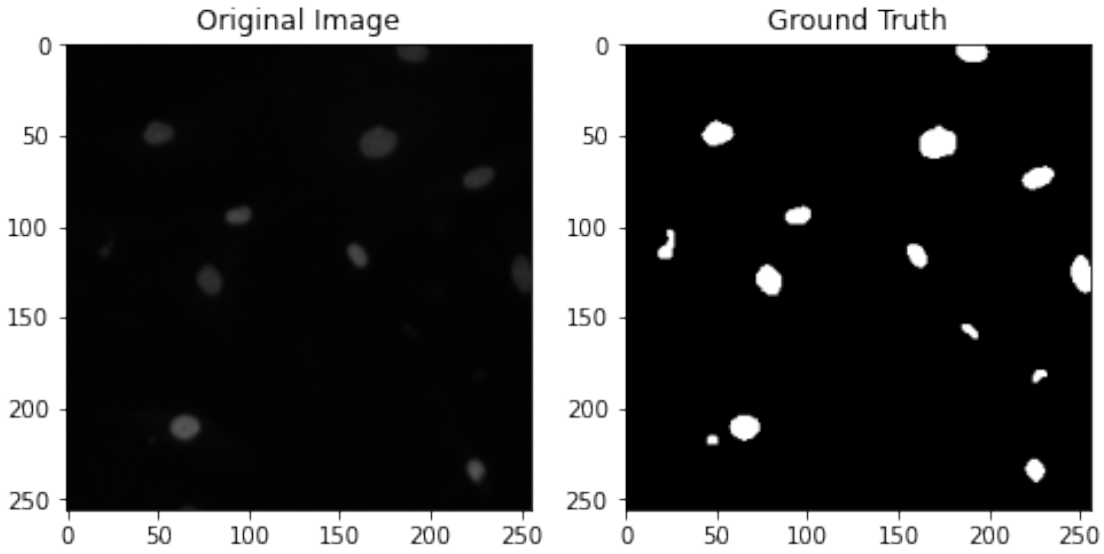
[20]:
```python
# Validation dataset
val_ds = tf.data.Dataset.from_tensor_slices((X_val['images'], X_val['masks']))
val_ds = val_ds.map(parse_function, num_parallel_calls=tf.data.AUTOTUNE)
val_ds = val_ds.batch(BATCH_SIZE)
val_ds = val_ds.prefetch(1)
```

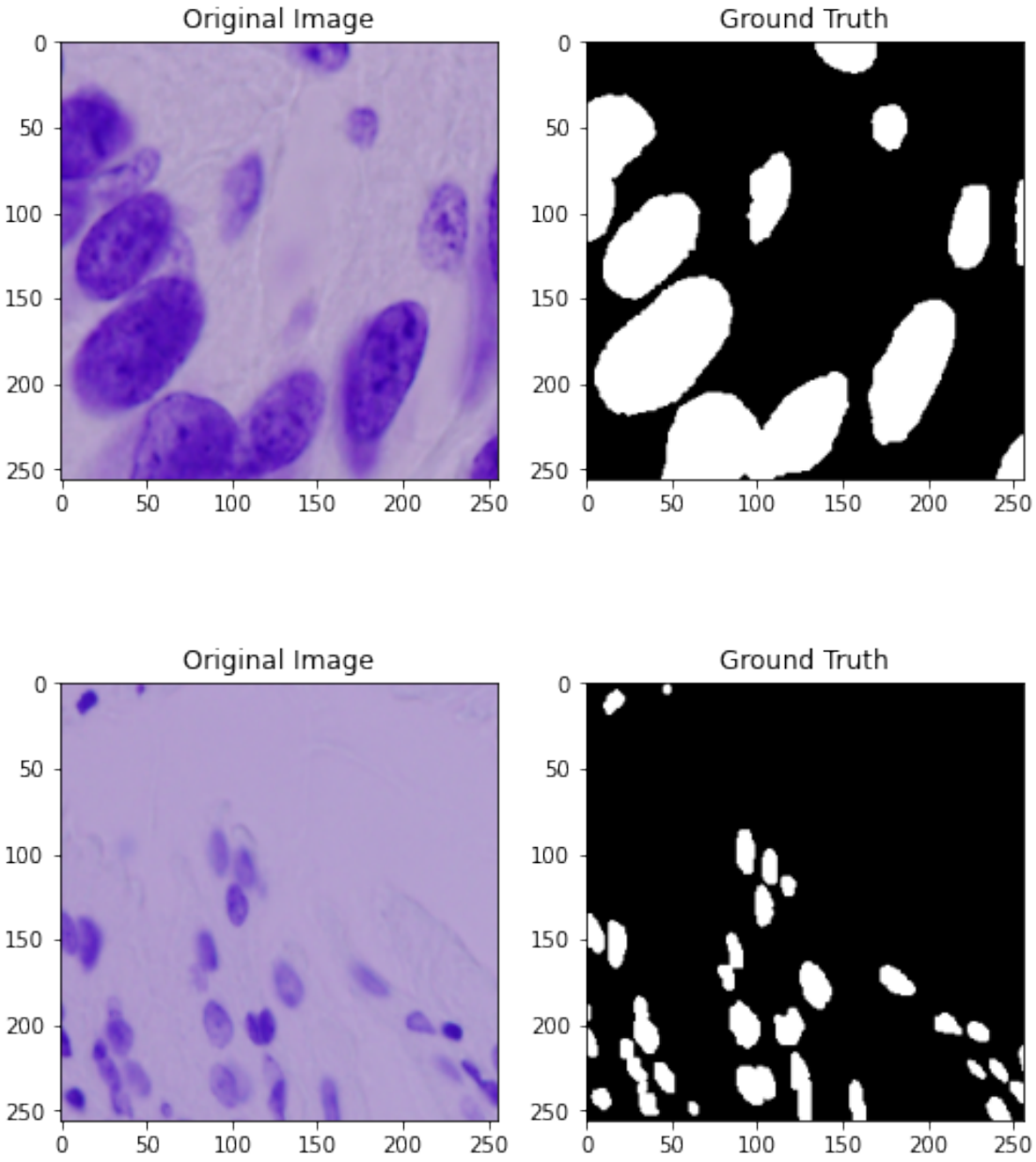
5 Sample of Train and Validation datasets

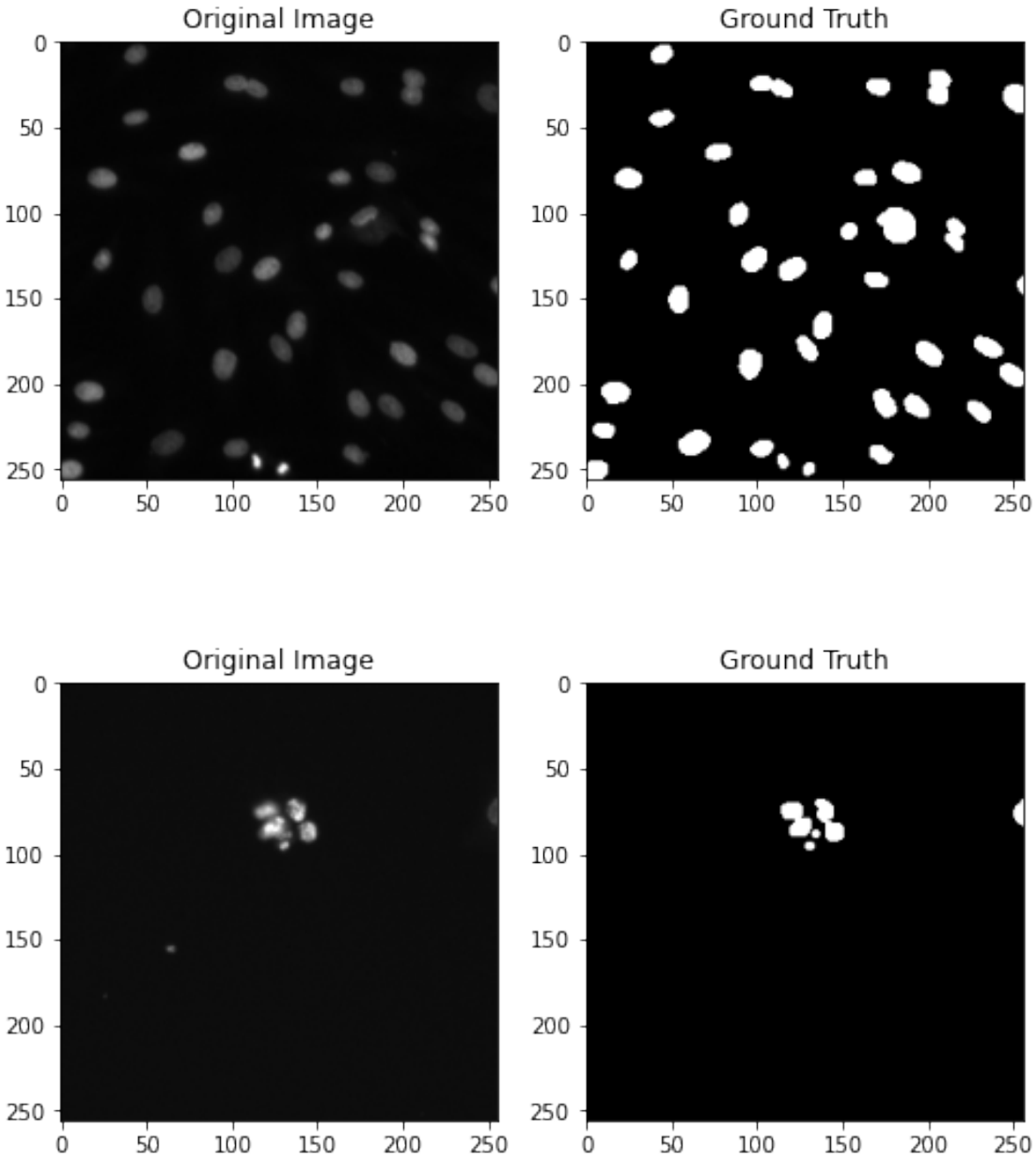
[21]:
```python
# Sample of training dataset
for image, mask in train_ds.take(1):
    for i in range(BATCH_SIZE):
        fig = plt.figure(figsize=(8,4))
        ax1 = fig.add_subplot(121)
        ax1.title.set_text('Original Image')
```

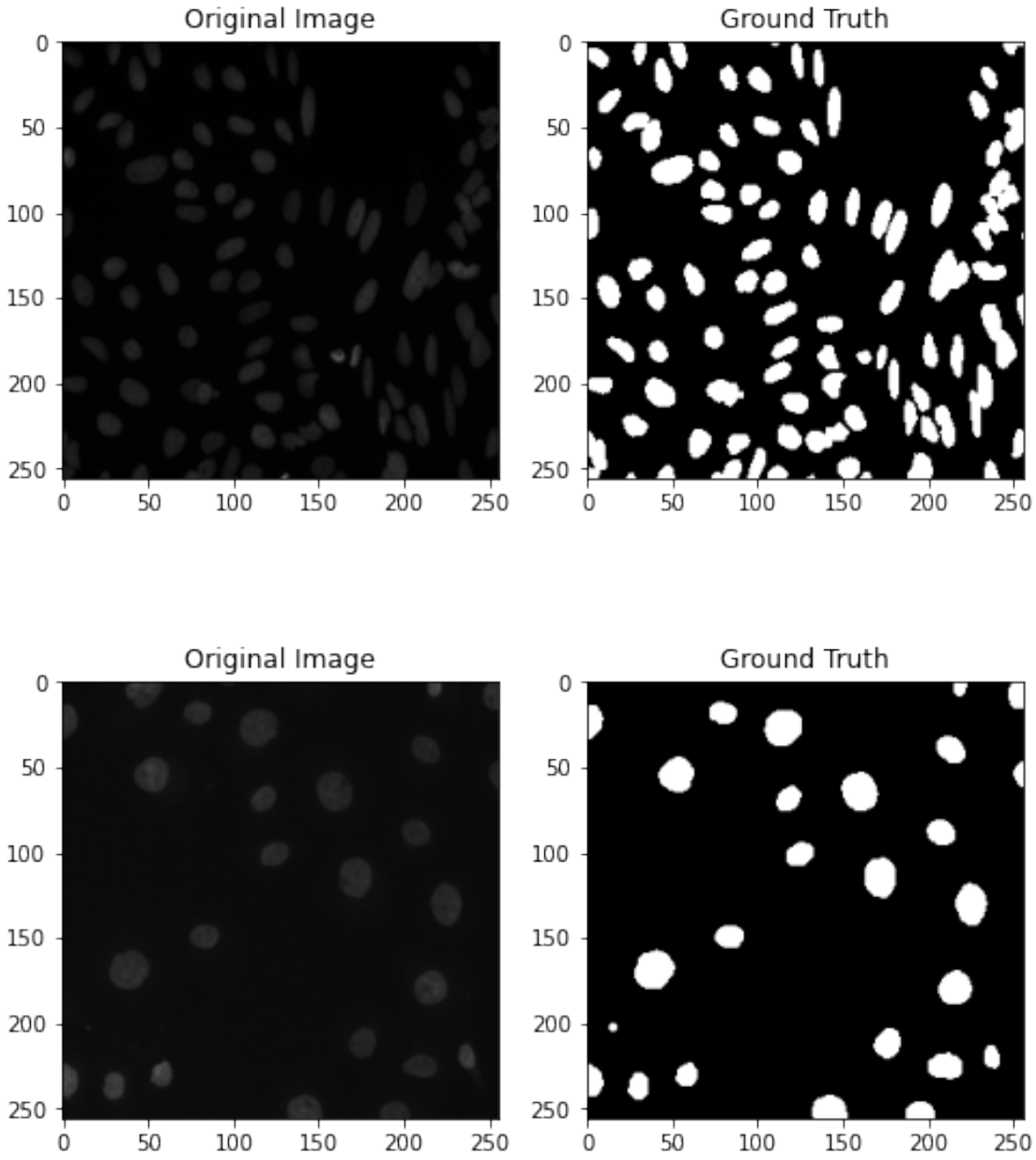
```
        ax1.imshow(image[i])
        ax2 = fig.add_subplot(122)
        ax2.title.set_text('Ground Truth')
        ax2.imshow(mask[i][:,:,0], cmap='gray')
        plt.show()
```





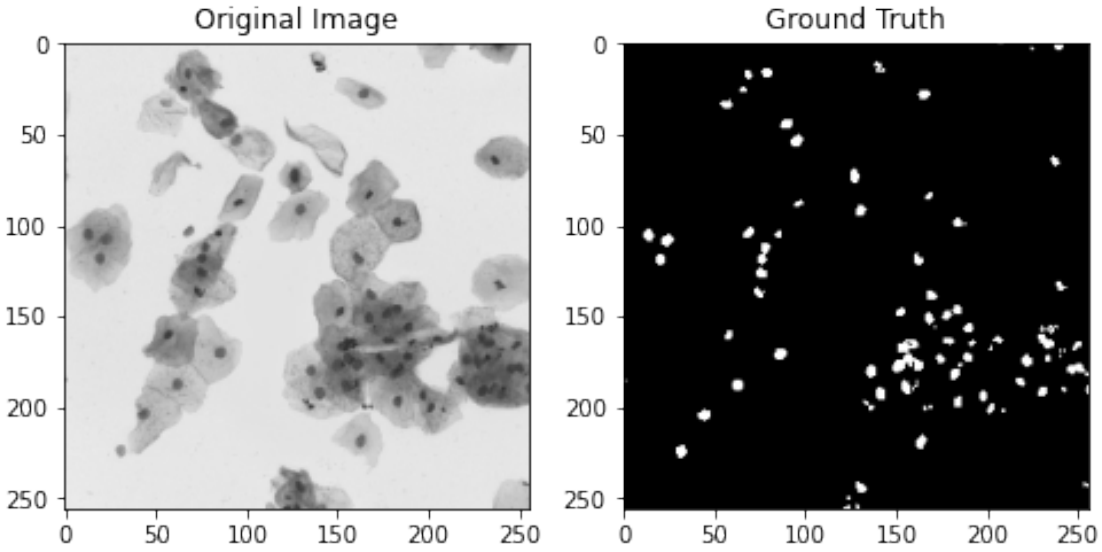

Original Image
Ground Truth
Original Image
Ground Truth
0
50
100
150
200
250

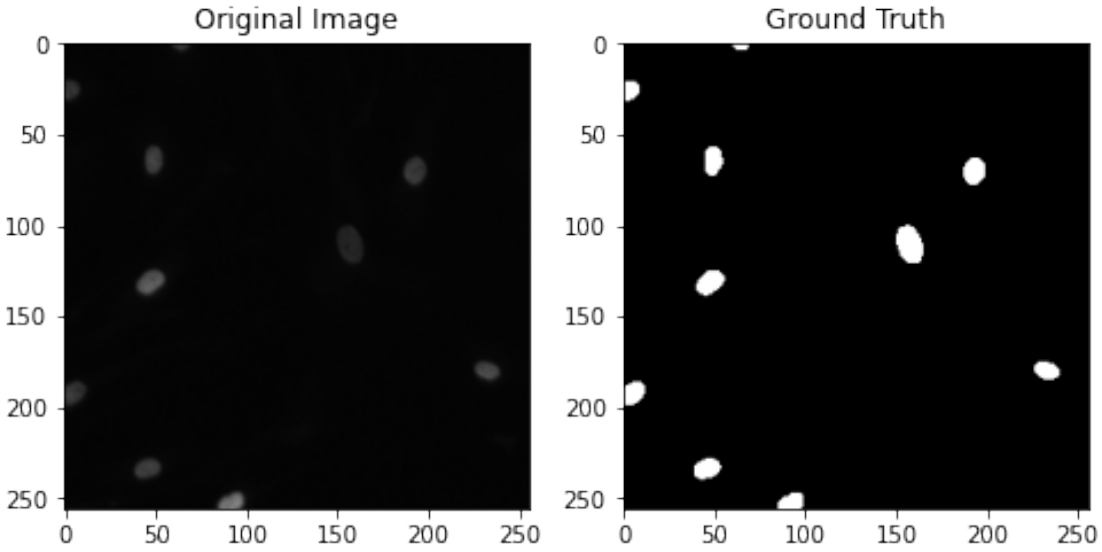

Original Image
Ground Truth
Original Image
Ground Truth
0
50
100
150
200
250

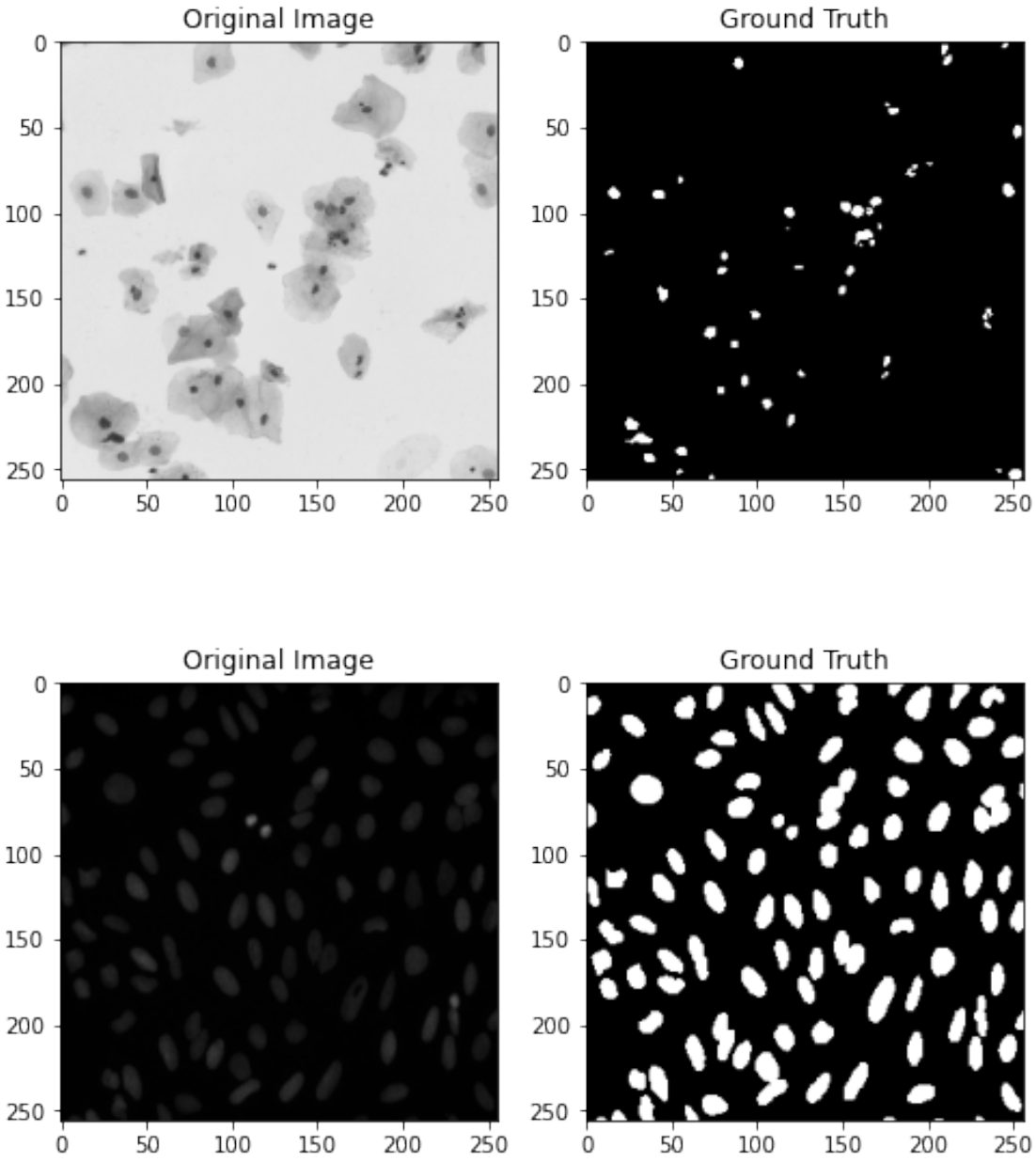


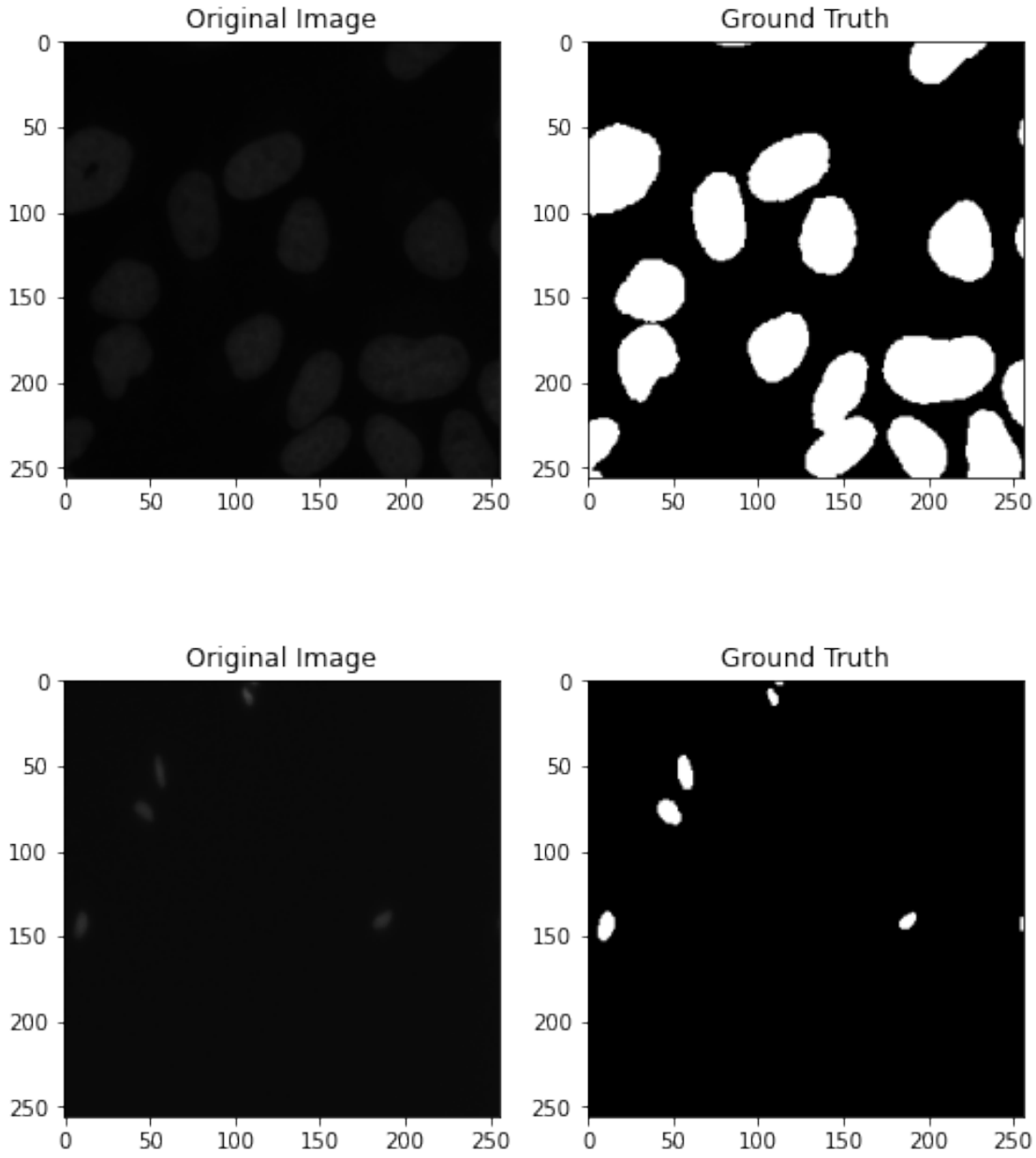
[22]:
```
# Sample of validation dataset
for image, mask in val_ds.take(1):
    for i in range(BATCH_SIZE):
        fig = plt.figure(figsize=(8,4))
        ax1 = fig.add_subplot(121)
        ax1.title.set_text('Original Image')
        ax1.imshow(image[i])
        ax2 = fig.add_subplot(122)
        ax2.title.set_text('Ground Truth')
```

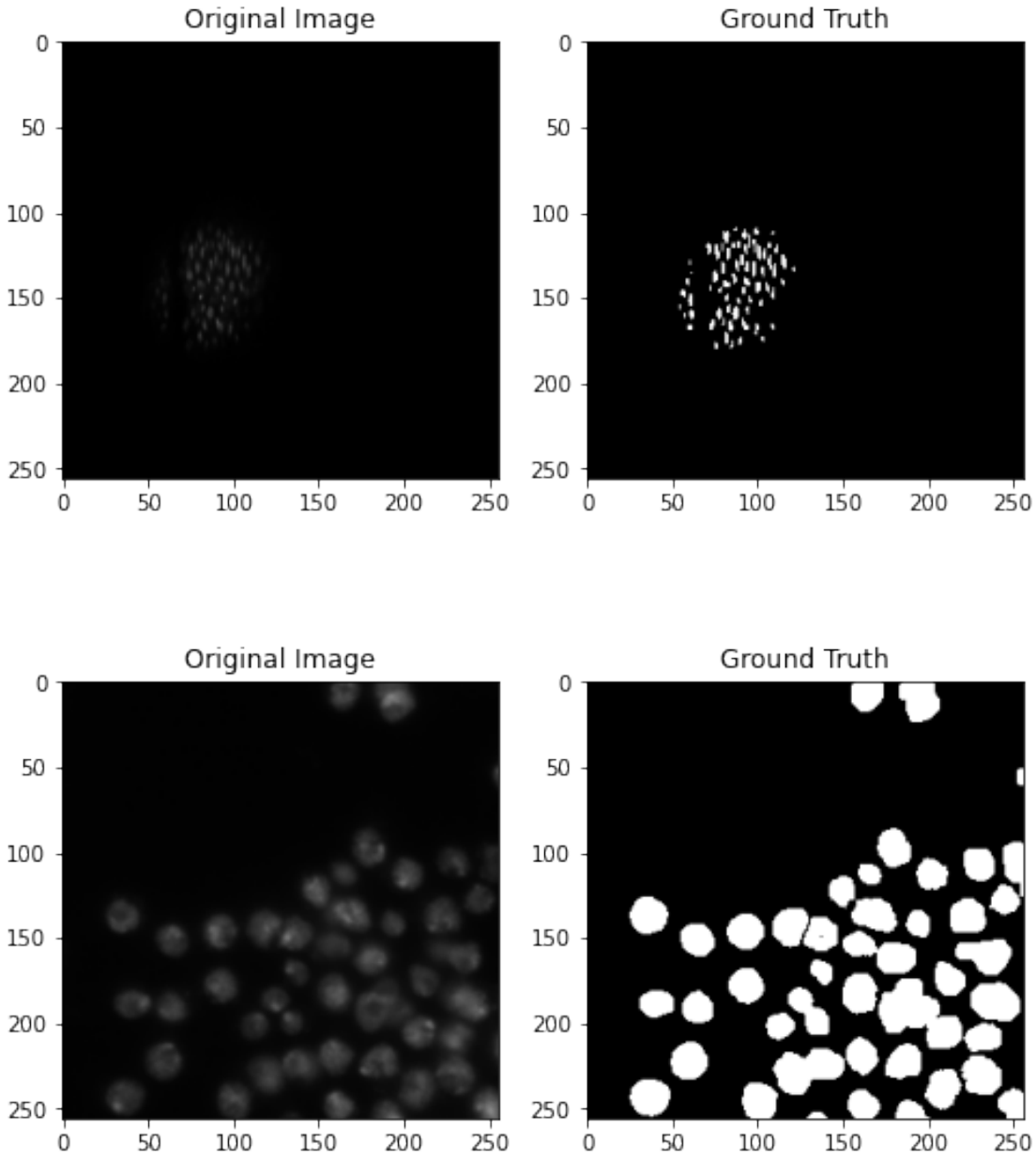
```
        ax2.imshow(mask[i][:,:,0], cmap='gray')
        plt.show()
```






Original Image
Ground Truth
Original Image
Ground Truth
0
50
100
150
200
250


Original Image
Ground Truth
Original Image
Ground Truth
0
50
100
150
200
250



6 HRNet

6.1 Performance Metric

[23]:
```
# Custom MeanIoU Metric function
class MeanIoU(tf.keras.metrics.Metric):
    def __init__(self, num_classes, thres=0.5, name='mean_iou', dtype=None):
        super(MeanIoU, self).__init__(name=name, dtype=dtype)
        self.num_classes = num_classes
```

```
        self.thres = thres
        self.total_cm = self.add_weight('total_confusion_matrix',
                                        shape=(num_classes, num_classes),
                                        initializer=tf.zeros_initializer())

    def update_state(self, y_true, y_pred, sample_weight=None):

        y_true = tf.cast(y_true, self._dtype)
        y_pred = tf.cast(y_pred, self._dtype)
        if y_pred.shape.ndims > 1:
            y_pred = tf.reshape(y_pred, [-1])
        if y_true.shape.ndims > 1:
            y_true = tf.reshape(y_true, [-1])

        y_pred = tf.where(y_pred > self.thres, 1.0, 0.0)

        if sample_weight is not None:
            sample_weight = tf.cast(sample_weight, self._dtype)
            if sample_weight.shape.ndims > 1:
                sample_weight = tf.reshape(sample_weight, [-1])
        current_cm = tf.math.confusion_matrix(y_true,
                                              y_pred,
                                              self.num_classes,
                                              weights=sample_weight,
                                              dtype=self._dtype)

        return self.total_cm.assign_add(current_cm)

    def result(self):
        sum_over_row = tf.cast(tf.reduce_sum(self.total_cm, axis=0), dtype=self.
↪_dtype)
        sum_over_col = tf.cast(tf.reduce_sum(self.total_cm, axis=1), dtype=self.
↪_dtype)
        true_positives = tf.cast(tf.linalg.tensor_diag_part(self.total_cm),␣
↪dtype=self._dtype)
        denominator = sum_over_row + sum_over_col - true_positives
        num_valid_entries = tf.reduce_sum(tf.cast(tf.math.
↪not_equal(denominator, 0), dtype=self._dtype))
        iou = tf.math.divide_no_nan(true_positives, denominator)
        return tf.math.divide_no_nan(tf.reduce_sum(iou, name='mean_iou'),␣
↪num_valid_entries)

    def reset_states(self):
        # The state of the metric will be reset at the start of each epoch.
        tf.keras.backend.set_value(self.total_cm, np.zeros((self.num_classes,␣
↪self.num_classes)))
```

```
    def get_config(self):
        config = {'num_classes': self.num_classes}
        base_config = super(MeanIoU, self).get_config()
        return dict(list(base_config.items()) + list(config.items()))
```

6.2 Architecture

[54]:
```
# Hyperparameters
BN_MOMENTUM = 0.1
BN_EPSILON = 1e-5
INITIALIZER = 'he_normal'#RandomNormal(stddev=0.001)#'glorot_normal'
```

[55]:
```
# Functions to build layers
# code referred from https://github.com/1044197988/TF.
 ↪Keras-Commonly-used-models/blob/master/
 ↪%E5%B8%B8%E7%94%A8%E5%88%86%E5%89%B2%E6%A8%A1%E5%9E%8B/HRNet.py
def conv(x, outsize, kernel_size, strides_=1, padding_='same', activation=None):
    return Conv2D(outsize, kernel_size, strides=strides_, padding=padding_,
                  kernel_initializer=INITIALIZER, use_bias=False,
                  activation=activation)(x)

def BasicBlock(x, size, downsampe=False):
    residual = x

    out = conv(x, size, 3)
    out = BatchNormalization(epsilon=BN_EPSILON, momentum=BN_MOMENTUM)(out)
    out = Activation('relu')(out)

    out = conv(out, size, 3)
    out = BatchNormalization(epsilon=BN_EPSILON, momentum=BN_MOMENTUM)(out)

    if downsampe:
        residual = conv(x, size, 1, padding_='valid')
        residual = BatchNormalization(epsilon=BN_EPSILON,␣
 ↪momentum=BN_MOMENTUM)(residual)

    out = Add()([out, residual])
    out = Activation('relu')(out)

    return out

def BottleNeckBlock(x, size, downsampe=False):
    residual = x

    out = conv(x, size, 1, padding_='valid')
    out = BatchNormalization(epsilon=BN_EPSILON, momentum=BN_MOMENTUM)(out)
```

```
    out = Activation('relu')(out)

    out = conv(out, size, 3)
    out = BatchNormalization(epsilon=BN_EPSILON, momentum=BN_MOMENTUM)(out)
    out = Activation('relu')(out)

    out = conv(out, size * 4, 1, padding_='valid')
    out = BatchNormalization(epsilon=BN_EPSILON, momentum=BN_MOMENTUM)(out)

    if downsampe:
        residual = conv(x, size * 4, 1, padding_='valid')
        residual = BatchNormalization(epsilon=BN_EPSILON,␣
↪momentum=BN_MOMENTUM)(residual)

    out = Add()([out, residual])
    out = Activation('relu')(out)

    return out

def layer1(x):
    x = BottleNeckBlock(x, 64, downsampe=True)
    x = BottleNeckBlock(x, 64)
    x = BottleNeckBlock(x, 64)
    x = BottleNeckBlock(x, 64)

    return x

def transition_layer(x, in_channels, out_channels):
    num_in = len(in_channels)
    num_out = len(out_channels)
    out = []

    for i in range(num_out):
        if i < num_in:
            if in_channels[i] != out_channels[i]:
                residual = conv(x[i], out_channels[i], 3)
                residual = BatchNormalization(epsilon=BN_EPSILON,␣
↪momentum=BN_MOMENTUM)(residual)
                residual = Activation('relu')(residual)
                out.append(residual)
            else:
                out.append(x[i])
        else:
            residual = conv(x[-1], out_channels[i], 3, strides_=2)
            residual = BatchNormalization(epsilon=BN_EPSILON,␣
↪momentum=BN_MOMENTUM)(residual)
            residual = Activation('relu')(residual)
```

```
            out.append(residual)

    return out

def branches(x, block_num, channels):
    out = []
    for i in range(len(channels)):
        residual = x[i]
        for j in range(block_num):
            residual = BasicBlock(residual, channels[i])
        out.append(residual)
    return out

def fuse_layers(x, channels, multi_scale_output=True):
    out = []

    for i in range(len(channels) if multi_scale_output else 1):
        residual = x[i]
        for j in range(len(channels)):
            if j > i:
                y = conv(x[j], channels[i], 1, padding_='valid')
                y = BatchNormalization(epsilon=BN_EPSILON,␣
↪momentum=BN_MOMENTUM)(y)
                y = UpSampling2D(size=2 ** (j - i))(y)
                residual = Add()([residual, y])
            elif j < i:
                y = x[j]
                for k in range(i - j):
                    if k == i - j - 1:
                        y = conv(y, channels[i], 3, strides_=2)
                        y = BatchNormalization(epsilon=BN_EPSILON,␣
↪momentum=BN_MOMENTUM)(y)
                    else:
                        y = conv(y, channels[j], 3, strides_=2)
                        y = BatchNormalization(epsilon=BN_EPSILON,␣
↪momentum=BN_MOMENTUM)(y)
                        y = Activation('relu')(y)
                residual = Add()([residual, y])

        residual = Activation('relu')(residual)
        out.append(residual)

    return out
```

[56]:
```
# Functions to create model
```

```
# code referred from https://github.com/1044197988/TF.
 ↪Keras-Commonly-used-models/blob/master/
 ↪%E5%B8%B8%E7%94%A8%E5%88%86%E5%89%B2%E6%A8%A1%E5%9E%8B/HRNet.py
def HighResolutionModule(x, channels, multi_scale_output=True):
    residual = branches(x, 4, channels)
    out = fuse_layers(residual, channels, multi_scale_output=multi_scale_output)
    return out


def stage(x, num_modules, channels, multi_scale_output=True):
    out = x
    for i in range(num_modules):
        if i == num_modules - 1 and multi_scale_output == False:
            out = HighResolutionModule(out, channels, multi_scale_output=False)
        else:
            out = HighResolutionModule(out, channels)

    return out


def hrnet_keras(input_size=(256, 256, 3)):
    channels_2 = [32, 64]
    channels_3 = [32, 64, 128]
    channels_4 = [32, 64, 128, 256]
    num_modules_2 = 1
    num_modules_3 = 4
    num_modules_4 = 3

    inputs = Input(input_size)
    x = conv(inputs, 64, 3, strides_=2)
    x = BatchNormalization(epsilon=BN_EPSILON, momentum=BN_MOMENTUM)(x)
    x = conv(x, 64, 3, strides_=2)
    x = BatchNormalization(epsilon=BN_EPSILON, momentum=BN_MOMENTUM)(x)
    x = Activation('relu')(x)

    la1 = layer1(x)
    tr1 = transition_layer([la1], [256], channels_2)
    st2 = stage(tr1, num_modules_2, channels_2)
    tr2 = transition_layer(st2, channels_2, channels_3)
    st3 = stage(tr2, num_modules_3, channels_3)
    tr3 = transition_layer(st3, channels_3, channels_4)
    st4 = stage(tr3, num_modules_4, channels_4, multi_scale_output=False)
    up1 = UpSampling2D()(st4[0])
    up1 = conv(up1, 32, 3)
    up1 = BatchNormalization(epsilon=BN_EPSILON, momentum=BN_MOMENTUM)(up1)
    up1 = Activation('relu')(up1)
    up2 = UpSampling2D()(up1)
```

```
    up2 = conv(up2, 32, 3)
    up2 = BatchNormalization(epsilon=BN_EPSILON, momentum=BN_MOMENTUM)(up2)
    up2 = Activation('relu')(up2)
    final = conv(up2, 1, 1, padding_='valid', activation='sigmoid')

    model = Model(inputs=inputs, outputs=final)

    return model
```

[57]:
```
model = hrnet_keras()
model.summary()
```

```
Model: "model_2"
__________________________________________________________________________________
__________________
Layer (type)                    Output Shape         Param #     Connected to
==================================================================================
==================
input_3 (InputLayer)            [(None, 256, 256, 3) 0
__________________________________________________________________________________
__________________
conv2d_590 (Conv2D)             (None, 128, 128, 64) 1728        input_3[0][0]
__________________________________________________________________________________
__________________
batch_normalization_588 (BatchN (None, 128, 128, 64) 256
conv2d_590[0][0]
__________________________________________________________________________________
__________________
conv2d_591 (Conv2D)             (None, 64, 64, 64)   36864
batch_normalization_588[0][0]
__________________________________________________________________________________
__________________
batch_normalization_589 (BatchN (None, 64, 64, 64)   256
conv2d_591[0][0]
__________________________________________________________________________________
__________________
activation_524 (Activation)     (None, 64, 64, 64)   0
batch_normalization_589[0][0]
__________________________________________________________________________________
__________________
conv2d_592 (Conv2D)             (None, 64, 64, 64)   4096
activation_524[0][0]
__________________________________________________________________________________
__________________
batch_normalization_590 (BatchN (None, 64, 64, 64)   256
conv2d_592[0][0]
__________________________________________________________________________________
```

```
__________________
activation_525 (Activation)     (None, 64, 64, 64)   0
batch_normalization_590[0][0]

__________________________________________________________________________________
__________________
conv2d_593 (Conv2D)             (None, 64, 64, 64)   36864
activation_525[0][0]

__________________________________________________________________________________
__________________
batch_normalization_591 (BatchN (None, 64, 64, 64)   256
conv2d_593[0][0]

__________________________________________________________________________________
__________________
activation_526 (Activation)     (None, 64, 64, 64)   0
batch_normalization_591[0][0]

__________________________________________________________________________________
__________________
conv2d_594 (Conv2D)             (None, 64, 64, 256)  16384
activation_526[0][0]

__________________________________________________________________________________
__________________
conv2d_595 (Conv2D)             (None, 64, 64, 256)  16384
activation_524[0][0]

__________________________________________________________________________________
__________________
batch_normalization_592 (BatchN (None, 64, 64, 256)  1024
conv2d_594[0][0]

__________________________________________________________________________________
__________________
batch_normalization_593 (BatchN (None, 64, 64, 256)  1024
conv2d_595[0][0]

__________________________________________________________________________________
__________________
add_322 (Add)                   (None, 64, 64, 256)  0
batch_normalization_592[0][0]
batch_normalization_593[0][0]

__________________________________________________________________________________
__________________
activation_527 (Activation)     (None, 64, 64, 256)  0           add_322[0][0]

__________________________________________________________________________________
__________________
conv2d_596 (Conv2D)             (None, 64, 64, 64)   16384
activation_527[0][0]

__________________________________________________________________________________
__________________
batch_normalization_594 (BatchN (None, 64, 64, 64)   256
conv2d_596[0][0]

__________________________________________________________________________________
```

```
__________________
activation_528 (Activation)     (None, 64, 64, 64)   0
batch_normalization_594[0][0]

__________________________________________________________________________________
__________________
conv2d_597 (Conv2D)             (None, 64, 64, 64)   36864
activation_528[0][0]

__________________________________________________________________________________
__________________
batch_normalization_595 (BatchN (None, 64, 64, 64)   256
conv2d_597[0][0]

__________________________________________________________________________________
__________________
activation_529 (Activation)     (None, 64, 64, 64)   0
batch_normalization_595[0][0]

__________________________________________________________________________________
__________________
conv2d_598 (Conv2D)             (None, 64, 64, 256)  16384
activation_529[0][0]

__________________________________________________________________________________
__________________
batch_normalization_596 (BatchN (None, 64, 64, 256)  1024
conv2d_598[0][0]

__________________________________________________________________________________
__________________
add_323 (Add)                   (None, 64, 64, 256)  0
batch_normalization_596[0][0]
activation_527[0][0]

__________________________________________________________________________________
__________________
activation_530 (Activation)     (None, 64, 64, 256)  0           add_323[0][0]

__________________________________________________________________________________
__________________
conv2d_599 (Conv2D)             (None, 64, 64, 64)   16384
activation_530[0][0]

__________________________________________________________________________________
__________________
batch_normalization_597 (BatchN (None, 64, 64, 64)   256
conv2d_599[0][0]

__________________________________________________________________________________
__________________
activation_531 (Activation)     (None, 64, 64, 64)   0
batch_normalization_597[0][0]

__________________________________________________________________________________
__________________
conv2d_600 (Conv2D)             (None, 64, 64, 64)   36864
activation_531[0][0]

__________________________________________________________________________________
```

```
__________________
batch_normalization_598 (BatchN (None, 64, 64, 64)   256
conv2d_600[0][0]
__________________________________________________________________________________
__________________
activation_532 (Activation)     (None, 64, 64, 64)   0
batch_normalization_598[0][0]
__________________________________________________________________________________
__________________
conv2d_601 (Conv2D)             (None, 64, 64, 256)  16384
activation_532[0][0]
__________________________________________________________________________________
__________________
batch_normalization_599 (BatchN (None, 64, 64, 256)  1024
conv2d_601[0][0]
__________________________________________________________________________________
__________________
add_324 (Add)                   (None, 64, 64, 256)  0
batch_normalization_599[0][0]
activation_530[0][0]
__________________________________________________________________________________
__________________
activation_533 (Activation)     (None, 64, 64, 256)  0           add_324[0][0]
__________________________________________________________________________________
__________________
conv2d_602 (Conv2D)             (None, 64, 64, 64)   16384
activation_533[0][0]
__________________________________________________________________________________
__________________
batch_normalization_600 (BatchN (None, 64, 64, 64)   256
conv2d_602[0][0]
__________________________________________________________________________________
__________________
activation_534 (Activation)     (None, 64, 64, 64)   0
batch_normalization_600[0][0]
__________________________________________________________________________________
__________________
conv2d_603 (Conv2D)             (None, 64, 64, 64)   36864
activation_534[0][0]
__________________________________________________________________________________
__________________
batch_normalization_601 (BatchN (None, 64, 64, 64)   256
conv2d_603[0][0]
__________________________________________________________________________________
__________________
activation_535 (Activation)     (None, 64, 64, 64)   0
batch_normalization_601[0][0]
__________________________________________________________________________________
```

```
__________________
conv2d_604 (Conv2D)             (None, 64, 64, 256)  16384
activation_535[0][0]
__________________________________________________________________________________
__________________
batch_normalization_602 (BatchN (None, 64, 64, 256)  1024
conv2d_604[0][0]
__________________________________________________________________________________
__________________
add_325 (Add)                   (None, 64, 64, 256)  0
batch_normalization_602[0][0]
activation_533[0][0]
__________________________________________________________________________________
__________________
activation_536 (Activation)     (None, 64, 64, 256)  0           add_325[0][0]
__________________________________________________________________________________
__________________
conv2d_605 (Conv2D)             (None, 64, 64, 32)   73728
activation_536[0][0]
__________________________________________________________________________________
__________________
batch_normalization_603 (BatchN (None, 64, 64, 32)   128
conv2d_605[0][0]
__________________________________________________________________________________
__________________
conv2d_606 (Conv2D)             (None, 32, 32, 64)   147456
activation_536[0][0]
__________________________________________________________________________________
__________________
activation_537 (Activation)     (None, 64, 64, 32)   0
batch_normalization_603[0][0]
__________________________________________________________________________________
__________________
batch_normalization_604 (BatchN (None, 32, 32, 64)   256
conv2d_606[0][0]
__________________________________________________________________________________
__________________
conv2d_607 (Conv2D)             (None, 64, 64, 32)   9216
activation_537[0][0]
__________________________________________________________________________________
__________________
activation_538 (Activation)     (None, 32, 32, 64)   0
batch_normalization_604[0][0]
__________________________________________________________________________________
__________________
batch_normalization_605 (BatchN (None, 64, 64, 32)   128
conv2d_607[0][0]
__________________________________________________________________________________
```

```
------------------
conv2d_615 (Conv2D)             (None, 32, 32, 64)   36864
activation_538[0][0]

------------------------------------------------------------------------------
------------------
activation_539 (Activation)     (None, 64, 64, 32)   0
batch_normalization_605[0][0]

------------------------------------------------------------------------------
------------------
batch_normalization_613 (BatchN (None, 32, 32, 64)   256
conv2d_615[0][0]

------------------------------------------------------------------------------
------------------
conv2d_608 (Conv2D)             (None, 64, 64, 32)   9216
activation_539[0][0]

------------------------------------------------------------------------------
------------------
activation_547 (Activation)     (None, 32, 32, 64)   0
batch_normalization_613[0][0]

------------------------------------------------------------------------------
------------------
batch_normalization_606 (BatchN (None, 64, 64, 32)   128
conv2d_608[0][0]

------------------------------------------------------------------------------
------------------
conv2d_616 (Conv2D)             (None, 32, 32, 64)   36864
activation_547[0][0]

------------------------------------------------------------------------------
------------------
add_326 (Add)                   (None, 64, 64, 32)   0
batch_normalization_606[0][0]
activation_537[0][0]

------------------------------------------------------------------------------
------------------
batch_normalization_614 (BatchN (None, 32, 32, 64)   256
conv2d_616[0][0]

------------------------------------------------------------------------------
------------------
activation_540 (Activation)     (None, 64, 64, 32)   0           add_326[0][0]

------------------------------------------------------------------------------
------------------
add_330 (Add)                   (None, 32, 32, 64)   0
batch_normalization_614[0][0]
activation_538[0][0]

------------------------------------------------------------------------------
------------------
conv2d_609 (Conv2D)             (None, 64, 64, 32)   9216
activation_540[0][0]
```

```
__________________________________________________________________________________
__________________
activation_548 (Activation)     (None, 32, 32, 64)   0           add_330[0][0]
__________________________________________________________________________________
__________________
batch_normalization_607 (BatchN (None, 64, 64, 32)   128
conv2d_609[0][0]
__________________________________________________________________________________
__________________
conv2d_617 (Conv2D)             (None, 32, 32, 64)   36864
activation_548[0][0]
__________________________________________________________________________________
__________________
activation_541 (Activation)     (None, 64, 64, 32)   0
batch_normalization_607[0][0]
__________________________________________________________________________________
__________________
batch_normalization_615 (BatchN (None, 32, 32, 64)   256
conv2d_617[0][0]
__________________________________________________________________________________
__________________
conv2d_610 (Conv2D)             (None, 64, 64, 32)   9216
activation_541[0][0]
__________________________________________________________________________________
__________________
activation_549 (Activation)     (None, 32, 32, 64)   0
batch_normalization_615[0][0]
__________________________________________________________________________________
__________________
batch_normalization_608 (BatchN (None, 64, 64, 32)   128
conv2d_610[0][0]
__________________________________________________________________________________
__________________
conv2d_618 (Conv2D)             (None, 32, 32, 64)   36864
activation_549[0][0]
__________________________________________________________________________________
__________________
add_327 (Add)                   (None, 64, 64, 32)   0
batch_normalization_608[0][0]
activation_540[0][0]
__________________________________________________________________________________
__________________
batch_normalization_616 (BatchN (None, 32, 32, 64)   256
conv2d_618[0][0]
__________________________________________________________________________________
__________________
activation_542 (Activation)     (None, 64, 64, 32)   0           add_327[0][0]
__________________________________________________________________________________
```

```
__________________
add_331 (Add)                   (None, 32, 32, 64)   0
batch_normalization_616[0][0]
activation_548[0][0]
__________________________________________________________________________________
__________________
conv2d_611 (Conv2D)             (None, 64, 64, 32)   9216
activation_542[0][0]
__________________________________________________________________________________
__________________
activation_550 (Activation)     (None, 32, 32, 64)   0           add_331[0][0]
__________________________________________________________________________________
__________________
batch_normalization_609 (BatchN (None, 64, 64, 32)   128
conv2d_611[0][0]
__________________________________________________________________________________
__________________
conv2d_619 (Conv2D)             (None, 32, 32, 64)   36864
activation_550[0][0]
__________________________________________________________________________________
__________________
activation_543 (Activation)     (None, 64, 64, 32)   0
batch_normalization_609[0][0]
__________________________________________________________________________________
__________________
batch_normalization_617 (BatchN (None, 32, 32, 64)   256
conv2d_619[0][0]
__________________________________________________________________________________
__________________
conv2d_612 (Conv2D)             (None, 64, 64, 32)   9216
activation_543[0][0]
__________________________________________________________________________________
__________________
activation_551 (Activation)     (None, 32, 32, 64)   0
batch_normalization_617[0][0]
__________________________________________________________________________________
__________________
batch_normalization_610 (BatchN (None, 64, 64, 32)   128
conv2d_612[0][0]
__________________________________________________________________________________
__________________
conv2d_620 (Conv2D)             (None, 32, 32, 64)   36864
activation_551[0][0]
__________________________________________________________________________________
__________________
add_328 (Add)                   (None, 64, 64, 32)   0
batch_normalization_610[0][0]
activation_542[0][0]
```

```
__________________________________________________________________________________
__________________
batch_normalization_618 (BatchN (None, 32, 32, 64)   256
conv2d_620[0][0]
__________________________________________________________________________________
__________________
activation_544 (Activation)     (None, 64, 64, 32)   0           add_328[0][0]
__________________________________________________________________________________
__________________
add_332 (Add)                   (None, 32, 32, 64)   0
batch_normalization_618[0][0]
activation_550[0][0]
__________________________________________________________________________________
__________________
conv2d_613 (Conv2D)             (None, 64, 64, 32)   9216
activation_544[0][0]
__________________________________________________________________________________
__________________
activation_552 (Activation)     (None, 32, 32, 64)   0           add_332[0][0]
__________________________________________________________________________________
__________________
batch_normalization_611 (BatchN (None, 64, 64, 32)   128
conv2d_613[0][0]
__________________________________________________________________________________
__________________
conv2d_621 (Conv2D)             (None, 32, 32, 64)   36864
activation_552[0][0]
__________________________________________________________________________________
__________________
activation_545 (Activation)     (None, 64, 64, 32)   0
batch_normalization_611[0][0]
__________________________________________________________________________________
__________________
batch_normalization_619 (BatchN (None, 32, 32, 64)   256
conv2d_621[0][0]
__________________________________________________________________________________
__________________
conv2d_614 (Conv2D)             (None, 64, 64, 32)   9216
activation_545[0][0]
__________________________________________________________________________________
__________________
activation_553 (Activation)     (None, 32, 32, 64)   0
batch_normalization_619[0][0]
__________________________________________________________________________________
__________________
batch_normalization_612 (BatchN (None, 64, 64, 32)   128
conv2d_614[0][0]
__________________________________________________________________________________
```

```
__________________
conv2d_622 (Conv2D)             (None, 32, 32, 64)   36864
activation_553[0][0]

_____________________________________________________________________________
__________________
add_329 (Add)                   (None, 64, 64, 32)   0
batch_normalization_612[0][0]
activation_544[0][0]

_____________________________________________________________________________
__________________
batch_normalization_620 (BatchN (None, 32, 32, 64)   256
conv2d_622[0][0]

_____________________________________________________________________________
__________________
activation_546 (Activation)     (None, 64, 64, 32)   0           add_329[0][0]

_____________________________________________________________________________
__________________
add_333 (Add)                   (None, 32, 32, 64)   0
batch_normalization_620[0][0]
activation_552[0][0]

_____________________________________________________________________________
__________________
activation_554 (Activation)     (None, 32, 32, 64)   0           add_333[0][0]

_____________________________________________________________________________
__________________
conv2d_624 (Conv2D)             (None, 32, 32, 64)   18432
activation_546[0][0]

_____________________________________________________________________________
__________________
conv2d_623 (Conv2D)             (None, 32, 32, 32)   2048
activation_554[0][0]

_____________________________________________________________________________
__________________
batch_normalization_622 (BatchN (None, 32, 32, 64)   256
conv2d_624[0][0]

_____________________________________________________________________________
__________________
batch_normalization_621 (BatchN (None, 32, 32, 32)   128
conv2d_623[0][0]

_____________________________________________________________________________
__________________
add_335 (Add)                   (None, 32, 32, 64)   0
activation_554[0][0]
batch_normalization_622[0][0]

_____________________________________________________________________________
__________________
up_sampling2d_60 (UpSampling2D) (None, 64, 64, 32)   0
batch_normalization_621[0][0]
```

```
__________________________________________________________________________________
__________________
activation_556 (Activation)     (None, 32, 32, 64)   0           add_335[0][0]
__________________________________________________________________________________
__________________
add_334 (Add)                   (None, 64, 64, 32)   0
activation_546[0][0]
up_sampling2d_60[0][0]
__________________________________________________________________________________
__________________
conv2d_625 (Conv2D)             (None, 16, 16, 128)  73728
activation_556[0][0]
__________________________________________________________________________________
__________________
activation_555 (Activation)     (None, 64, 64, 32)   0           add_334[0][0]
__________________________________________________________________________________
__________________
batch_normalization_623 (BatchN (None, 16, 16, 128)  512
conv2d_625[0][0]
__________________________________________________________________________________
__________________
conv2d_626 (Conv2D)             (None, 64, 64, 32)   9216
activation_555[0][0]
__________________________________________________________________________________
__________________
conv2d_634 (Conv2D)             (None, 32, 32, 64)   36864
activation_556[0][0]
__________________________________________________________________________________
__________________
activation_557 (Activation)     (None, 16, 16, 128)  0
batch_normalization_623[0][0]
__________________________________________________________________________________
__________________
batch_normalization_624 (BatchN (None, 64, 64, 32)   128
conv2d_626[0][0]
__________________________________________________________________________________
__________________
batch_normalization_632 (BatchN (None, 32, 32, 64)   256
conv2d_634[0][0]
__________________________________________________________________________________
__________________
conv2d_642 (Conv2D)             (None, 16, 16, 128)  147456
activation_557[0][0]
__________________________________________________________________________________
__________________
activation_558 (Activation)     (None, 64, 64, 32)   0
batch_normalization_624[0][0]
__________________________________________________________________________________
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------------------
activation_566 (Activation)     (None, 32, 32, 64)   0
batch_normalization_632[0][0]

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------------------
batch_normalization_640 (BatchN (None, 16, 16, 128)  512
conv2d_642[0][0]

--------------------------------------------------------------------------------
------------------
conv2d_627 (Conv2D)             (None, 64, 64, 32)   9216
activation_558[0][0]

--------------------------------------------------------------------------------
------------------
conv2d_635 (Conv2D)             (None, 32, 32, 64)   36864
activation_566[0][0]

--------------------------------------------------------------------------------
------------------
activation_574 (Activation)     (None, 16, 16, 128)  0
batch_normalization_640[0][0]

--------------------------------------------------------------------------------
------------------
batch_normalization_625 (BatchN (None, 64, 64, 32)   128
conv2d_627[0][0]

--------------------------------------------------------------------------------
------------------
batch_normalization_633 (BatchN (None, 32, 32, 64)   256
conv2d_635[0][0]

--------------------------------------------------------------------------------
------------------
conv2d_643 (Conv2D)             (None, 16, 16, 128)  147456
activation_574[0][0]

--------------------------------------------------------------------------------
------------------
add_336 (Add)                   (None, 64, 64, 32)   0
batch_normalization_625[0][0]
activation_555[0][0]

--------------------------------------------------------------------------------
------------------
add_340 (Add)                   (None, 32, 32, 64)   0
batch_normalization_633[0][0]
activation_556[0][0]

--------------------------------------------------------------------------------
------------------
batch_normalization_641 (BatchN (None, 16, 16, 128)  512
conv2d_643[0][0]

--------------------------------------------------------------------------------
------------------
activation_559 (Activation)     (None, 64, 64, 32)   0           add_336[0][0]
```

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__________________________________________________________________________________
__________________
activation_567 (Activation)     (None, 32, 32, 64)   0           add_340[0][0]
__________________________________________________________________________________
__________________
add_344 (Add)                   (None, 16, 16, 128)  0
batch_normalization_641[0][0]
activation_557[0][0]
__________________________________________________________________________________
__________________
conv2d_628 (Conv2D)             (None, 64, 64, 32)   9216
activation_559[0][0]
__________________________________________________________________________________
__________________
conv2d_636 (Conv2D)             (None, 32, 32, 64)   36864
activation_567[0][0]
__________________________________________________________________________________
__________________
activation_575 (Activation)     (None, 16, 16, 128)  0           add_344[0][0]
__________________________________________________________________________________
__________________
batch_normalization_626 (BatchN (None, 64, 64, 32)   128
conv2d_628[0][0]
__________________________________________________________________________________
__________________
batch_normalization_634 (BatchN (None, 32, 32, 64)   256
conv2d_636[0][0]
__________________________________________________________________________________
__________________
conv2d_644 (Conv2D)             (None, 16, 16, 128)  147456
activation_575[0][0]
__________________________________________________________________________________
__________________
activation_560 (Activation)     (None, 64, 64, 32)   0
batch_normalization_626[0][0]
__________________________________________________________________________________
__________________
activation_568 (Activation)     (None, 32, 32, 64)   0
batch_normalization_634[0][0]
__________________________________________________________________________________
__________________
batch_normalization_642 (BatchN (None, 16, 16, 128)  512
conv2d_644[0][0]
__________________________________________________________________________________
__________________
conv2d_629 (Conv2D)             (None, 64, 64, 32)   9216
activation_560[0][0]
__________________________________________________________________________________
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__________________
conv2d_637 (Conv2D)             (None, 32, 32, 64)   36864
activation_568[0][0]

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__________________
activation_576 (Activation)     (None, 16, 16, 128)  0
batch_normalization_642[0][0]

__________________________________________________________________________________
__________________
batch_normalization_627 (BatchN (None, 64, 64, 32)   128
conv2d_629[0][0]

__________________________________________________________________________________
__________________
batch_normalization_635 (BatchN (None, 32, 32, 64)   256
conv2d_637[0][0]

__________________________________________________________________________________
__________________
conv2d_645 (Conv2D)             (None, 16, 16, 128)  147456
activation_576[0][0]

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__________________
add_337 (Add)                   (None, 64, 64, 32)   0
batch_normalization_627[0][0]
activation_559[0][0]

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__________________
add_341 (Add)                   (None, 32, 32, 64)   0
batch_normalization_635[0][0]
activation_567[0][0]

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__________________
batch_normalization_643 (BatchN (None, 16, 16, 128)  512
conv2d_645[0][0]

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__________________
activation_561 (Activation)     (None, 64, 64, 32)   0           add_337[0][0]

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__________________
activation_569 (Activation)     (None, 32, 32, 64)   0           add_341[0][0]

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__________________
add_345 (Add)                   (None, 16, 16, 128)  0
batch_normalization_643[0][0]
activation_575[0][0]

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__________________
conv2d_630 (Conv2D)             (None, 64, 64, 32)   9216
activation_561[0][0]
```

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__________________________________________________________________________________
__________________
conv2d_638 (Conv2D)             (None, 32, 32, 64)   36864
activation_569[0][0]
__________________________________________________________________________________
__________________
activation_577 (Activation)     (None, 16, 16, 128)  0           add_345[0][0]
__________________________________________________________________________________
__________________
batch_normalization_628 (BatchN (None, 64, 64, 32)   128
conv2d_630[0][0]
__________________________________________________________________________________
__________________
batch_normalization_636 (BatchN (None, 32, 32, 64)   256
conv2d_638[0][0]
__________________________________________________________________________________
__________________
conv2d_646 (Conv2D)             (None, 16, 16, 128)  147456
activation_577[0][0]
__________________________________________________________________________________
__________________
activation_562 (Activation)     (None, 64, 64, 32)   0
batch_normalization_628[0][0]
__________________________________________________________________________________
__________________
activation_570 (Activation)     (None, 32, 32, 64)   0
batch_normalization_636[0][0]
__________________________________________________________________________________
__________________
batch_normalization_644 (BatchN (None, 16, 16, 128)  512
conv2d_646[0][0]
__________________________________________________________________________________
__________________
conv2d_631 (Conv2D)             (None, 64, 64, 32)   9216
activation_562[0][0]
__________________________________________________________________________________
__________________
conv2d_639 (Conv2D)             (None, 32, 32, 64)   36864
activation_570[0][0]
__________________________________________________________________________________
__________________
activation_578 (Activation)     (None, 16, 16, 128)  0
batch_normalization_644[0][0]
__________________________________________________________________________________
__________________
batch_normalization_629 (BatchN (None, 64, 64, 32)   128
conv2d_631[0][0]
__________________________________________________________________________________
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------------------
batch_normalization_637 (BatchN (None, 32, 32, 64)   256
conv2d_639[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_647 (Conv2D)             (None, 16, 16, 128)  147456
activation_578[0][0]
--------------------------------------------------------------------------------
------------------
add_338 (Add)                   (None, 64, 64, 32)   0
batch_normalization_629[0][0]
activation_561[0][0]
--------------------------------------------------------------------------------
------------------
add_342 (Add)                   (None, 32, 32, 64)   0
batch_normalization_637[0][0]
activation_569[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_645 (BatchN (None, 16, 16, 128)  512
conv2d_647[0][0]
--------------------------------------------------------------------------------
------------------
activation_563 (Activation)     (None, 64, 64, 32)   0           add_338[0][0]
--------------------------------------------------------------------------------
------------------
activation_571 (Activation)     (None, 32, 32, 64)   0           add_342[0][0]
--------------------------------------------------------------------------------
------------------
add_346 (Add)                   (None, 16, 16, 128)  0
batch_normalization_645[0][0]
activation_577[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_632 (Conv2D)             (None, 64, 64, 32)   9216
activation_563[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_640 (Conv2D)             (None, 32, 32, 64)   36864
activation_571[0][0]
--------------------------------------------------------------------------------
------------------
activation_579 (Activation)     (None, 16, 16, 128)  0           add_346[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_630 (BatchN (None, 64, 64, 32)   128
conv2d_632[0][0]
--------------------------------------------------------------------------------
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------------------
batch_normalization_638 (BatchN (None, 32, 32, 64)   256
conv2d_640[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_648 (Conv2D)             (None, 16, 16, 128)  147456
activation_579[0][0]
--------------------------------------------------------------------------------
------------------
activation_564 (Activation)     (None, 64, 64, 32)   0
batch_normalization_630[0][0]
--------------------------------------------------------------------------------
------------------
activation_572 (Activation)     (None, 32, 32, 64)   0
batch_normalization_638[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_646 (BatchN (None, 16, 16, 128)  512
conv2d_648[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_633 (Conv2D)             (None, 64, 64, 32)   9216
activation_564[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_641 (Conv2D)             (None, 32, 32, 64)   36864
activation_572[0][0]
--------------------------------------------------------------------------------
------------------
activation_580 (Activation)     (None, 16, 16, 128)  0
batch_normalization_646[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_631 (BatchN (None, 64, 64, 32)   128
conv2d_633[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_639 (BatchN (None, 32, 32, 64)   256
conv2d_641[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_649 (Conv2D)             (None, 16, 16, 128)  147456
activation_580[0][0]
--------------------------------------------------------------------------------
------------------
add_339 (Add)                   (None, 64, 64, 32)   0
batch_normalization_631[0][0]
activation_563[0][0]
```

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__________________
add_343 (Add)                   (None, 32, 32, 64)   0
batch_normalization_639[0][0]
activation_571[0][0]
__________________________________________________________________________________
__________________
batch_normalization_647 (BatchN (None, 16, 16, 128)  512
conv2d_649[0][0]
__________________________________________________________________________________
__________________
activation_565 (Activation)     (None, 64, 64, 32)   0           add_339[0][0]
__________________________________________________________________________________
__________________
activation_573 (Activation)     (None, 32, 32, 64)   0           add_343[0][0]
__________________________________________________________________________________
__________________
add_347 (Add)                   (None, 16, 16, 128)  0
batch_normalization_647[0][0]
activation_579[0][0]
__________________________________________________________________________________
__________________
conv2d_650 (Conv2D)             (None, 32, 32, 32)   2048
activation_573[0][0]
__________________________________________________________________________________
__________________
activation_581 (Activation)     (None, 16, 16, 128)  0           add_347[0][0]
__________________________________________________________________________________
__________________
conv2d_654 (Conv2D)             (None, 32, 32, 32)   9216
activation_565[0][0]
__________________________________________________________________________________
__________________
batch_normalization_648 (BatchN (None, 32, 32, 32)   128
conv2d_650[0][0]
__________________________________________________________________________________
__________________
conv2d_651 (Conv2D)             (None, 16, 16, 32)   4096
activation_581[0][0]
__________________________________________________________________________________
__________________
batch_normalization_652 (BatchN (None, 32, 32, 32)   128
conv2d_654[0][0]
__________________________________________________________________________________
__________________
up_sampling2d_61 (UpSampling2D) (None, 64, 64, 32)   0
batch_normalization_648[0][0]
__________________________________________________________________________________
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__________________
batch_normalization_649 (BatchN (None, 16, 16, 32)   128
conv2d_651[0][0]
__________________________________________________________________________________
__________________
activation_584 (Activation)     (None, 32, 32, 32)   0
batch_normalization_652[0][0]
__________________________________________________________________________________
__________________
add_348 (Add)                   (None, 64, 64, 32)   0
activation_565[0][0]
up_sampling2d_61[0][0]
__________________________________________________________________________________
__________________
up_sampling2d_62 (UpSampling2D) (None, 64, 64, 32)   0
batch_normalization_649[0][0]
__________________________________________________________________________________
__________________
conv2d_655 (Conv2D)             (None, 16, 16, 128)  36864
activation_584[0][0]
__________________________________________________________________________________
__________________
add_349 (Add)                   (None, 64, 64, 32)   0           add_348[0][0]
up_sampling2d_62[0][0]
__________________________________________________________________________________
__________________
conv2d_652 (Conv2D)             (None, 32, 32, 64)   18432
activation_565[0][0]
__________________________________________________________________________________
__________________
conv2d_653 (Conv2D)             (None, 16, 16, 64)   8192
activation_581[0][0]
__________________________________________________________________________________
__________________
batch_normalization_653 (BatchN (None, 16, 16, 128)  512
conv2d_655[0][0]
__________________________________________________________________________________
__________________
conv2d_656 (Conv2D)             (None, 16, 16, 128)  73728
activation_573[0][0]
__________________________________________________________________________________
__________________
activation_582 (Activation)     (None, 64, 64, 32)   0           add_349[0][0]
__________________________________________________________________________________
__________________
batch_normalization_650 (BatchN (None, 32, 32, 64)   256
conv2d_652[0][0]
__________________________________________________________________________________
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------------------
batch_normalization_651 (BatchN (None, 16, 16, 64)   256
conv2d_653[0][0]
--------------------------------------------------------------------------------
------------------
add_352 (Add)                   (None, 16, 16, 128)  0
activation_581[0][0]
batch_normalization_653[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_654 (BatchN (None, 16, 16, 128)  512
conv2d_656[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_657 (Conv2D)             (None, 64, 64, 32)   9216
activation_582[0][0]
--------------------------------------------------------------------------------
------------------
add_350 (Add)                   (None, 32, 32, 64)   0
activation_573[0][0]
batch_normalization_650[0][0]
--------------------------------------------------------------------------------
------------------
up_sampling2d_63 (UpSampling2D) (None, 32, 32, 64)   0
batch_normalization_651[0][0]
--------------------------------------------------------------------------------
------------------
add_353 (Add)                   (None, 16, 16, 128)  0           add_352[0][0]
batch_normalization_654[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_655 (BatchN (None, 64, 64, 32)   128
conv2d_657[0][0]
--------------------------------------------------------------------------------
------------------
add_351 (Add)                   (None, 32, 32, 64)   0           add_350[0][0]
up_sampling2d_63[0][0]
--------------------------------------------------------------------------------
------------------
activation_585 (Activation)     (None, 16, 16, 128)  0           add_353[0][0]
--------------------------------------------------------------------------------
------------------
activation_586 (Activation)     (None, 64, 64, 32)   0
batch_normalization_655[0][0]
--------------------------------------------------------------------------------
------------------
activation_583 (Activation)     (None, 32, 32, 64)   0           add_351[0][0]
--------------------------------------------------------------------------------
```

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__________________
conv2d_673 (Conv2D)             (None, 16, 16, 128)  147456
activation_585[0][0]
____________________________________________________________________________
__________________
conv2d_658 (Conv2D)             (None, 64, 64, 32)   9216
activation_586[0][0]
____________________________________________________________________________
__________________
conv2d_665 (Conv2D)             (None, 32, 32, 64)   36864
activation_583[0][0]
____________________________________________________________________________
__________________
batch_normalization_671 (BatchN (None, 16, 16, 128)  512
conv2d_673[0][0]
____________________________________________________________________________
__________________
batch_normalization_656 (BatchN (None, 64, 64, 32)   128
conv2d_658[0][0]
____________________________________________________________________________
__________________
batch_normalization_663 (BatchN (None, 32, 32, 64)   256
conv2d_665[0][0]
____________________________________________________________________________
__________________
activation_602 (Activation)     (None, 16, 16, 128)  0
batch_normalization_671[0][0]
____________________________________________________________________________
__________________
add_354 (Add)                   (None, 64, 64, 32)   0
batch_normalization_656[0][0]
activation_582[0][0]
____________________________________________________________________________
__________________
activation_594 (Activation)     (None, 32, 32, 64)   0
batch_normalization_663[0][0]
____________________________________________________________________________
__________________
conv2d_674 (Conv2D)             (None, 16, 16, 128)  147456
activation_602[0][0]
____________________________________________________________________________
__________________
activation_587 (Activation)     (None, 64, 64, 32)   0           add_354[0][0]
____________________________________________________________________________
__________________
conv2d_666 (Conv2D)             (None, 32, 32, 64)   36864
activation_594[0][0]
____________________________________________________________________________
```

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__________________
batch_normalization_672 (BatchN (None, 16, 16, 128)  512
conv2d_674[0][0]
__________________________________________________________________________________
__________________
conv2d_659 (Conv2D)             (None, 64, 64, 32)   9216
activation_587[0][0]
__________________________________________________________________________________
__________________
batch_normalization_664 (BatchN (None, 32, 32, 64)   256
conv2d_666[0][0]
__________________________________________________________________________________
__________________
add_362 (Add)                   (None, 16, 16, 128)  0
batch_normalization_672[0][0]
activation_585[0][0]
__________________________________________________________________________________
__________________
batch_normalization_657 (BatchN (None, 64, 64, 32)   128
conv2d_659[0][0]
__________________________________________________________________________________
__________________
add_358 (Add)                   (None, 32, 32, 64)   0
batch_normalization_664[0][0]
activation_583[0][0]
__________________________________________________________________________________
__________________
activation_603 (Activation)     (None, 16, 16, 128)  0           add_362[0][0]
__________________________________________________________________________________
__________________
activation_588 (Activation)     (None, 64, 64, 32)   0
batch_normalization_657[0][0]
__________________________________________________________________________________
__________________
activation_595 (Activation)     (None, 32, 32, 64)   0           add_358[0][0]
__________________________________________________________________________________
__________________
conv2d_675 (Conv2D)             (None, 16, 16, 128)  147456
activation_603[0][0]
__________________________________________________________________________________
__________________
conv2d_660 (Conv2D)             (None, 64, 64, 32)   9216
activation_588[0][0]
__________________________________________________________________________________
__________________
conv2d_667 (Conv2D)             (None, 32, 32, 64)   36864
activation_595[0][0]
__________________________________________________________________________________
```

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__________________
batch_normalization_673 (BatchN (None, 16, 16, 128)  512
conv2d_675[0][0]
__________________________________________________________________________________
__________________
batch_normalization_658 (BatchN (None, 64, 64, 32)   128
conv2d_660[0][0]
__________________________________________________________________________________
__________________
batch_normalization_665 (BatchN (None, 32, 32, 64)   256
conv2d_667[0][0]
__________________________________________________________________________________
__________________
activation_604 (Activation)     (None, 16, 16, 128)  0
batch_normalization_673[0][0]
__________________________________________________________________________________
__________________
add_355 (Add)                   (None, 64, 64, 32)   0
batch_normalization_658[0][0]
activation_587[0][0]
__________________________________________________________________________________
__________________
activation_596 (Activation)     (None, 32, 32, 64)   0
batch_normalization_665[0][0]
__________________________________________________________________________________
__________________
conv2d_676 (Conv2D)             (None, 16, 16, 128)  147456
activation_604[0][0]
__________________________________________________________________________________
__________________
activation_589 (Activation)     (None, 64, 64, 32)   0           add_355[0][0]
__________________________________________________________________________________
__________________
conv2d_668 (Conv2D)             (None, 32, 32, 64)   36864
activation_596[0][0]
__________________________________________________________________________________
__________________
batch_normalization_674 (BatchN (None, 16, 16, 128)  512
conv2d_676[0][0]
__________________________________________________________________________________
__________________
conv2d_661 (Conv2D)             (None, 64, 64, 32)   9216
activation_589[0][0]
__________________________________________________________________________________
__________________
batch_normalization_666 (BatchN (None, 32, 32, 64)   256
conv2d_668[0][0]
__________________________________________________________________________________
```

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__________________
add_363 (Add)                   (None, 16, 16, 128)  0
batch_normalization_674[0][0]
activation_603[0][0]
__________________________________________________________________________________
__________________
batch_normalization_659 (BatchN (None, 64, 64, 32)   128
conv2d_661[0][0]
__________________________________________________________________________________
__________________
add_359 (Add)                   (None, 32, 32, 64)   0
batch_normalization_666[0][0]
activation_595[0][0]
__________________________________________________________________________________
__________________
activation_605 (Activation)     (None, 16, 16, 128)  0           add_363[0][0]
__________________________________________________________________________________
__________________
activation_590 (Activation)     (None, 64, 64, 32)   0
batch_normalization_659[0][0]
__________________________________________________________________________________
__________________
activation_597 (Activation)     (None, 32, 32, 64)   0           add_359[0][0]
__________________________________________________________________________________
__________________
conv2d_677 (Conv2D)             (None, 16, 16, 128)  147456
activation_605[0][0]
__________________________________________________________________________________
__________________
conv2d_662 (Conv2D)             (None, 64, 64, 32)   9216
activation_590[0][0]
__________________________________________________________________________________
__________________
conv2d_669 (Conv2D)             (None, 32, 32, 64)   36864
activation_597[0][0]
__________________________________________________________________________________
__________________
batch_normalization_675 (BatchN (None, 16, 16, 128)  512
conv2d_677[0][0]
__________________________________________________________________________________
__________________
batch_normalization_660 (BatchN (None, 64, 64, 32)   128
conv2d_662[0][0]
__________________________________________________________________________________
__________________
batch_normalization_667 (BatchN (None, 32, 32, 64)   256
conv2d_669[0][0]
__________________________________________________________________________________
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------------------
activation_606 (Activation)     (None, 16, 16, 128)  0
batch_normalization_675[0][0]

--------------------------------------------------------------------------------
------------------
add_356 (Add)                   (None, 64, 64, 32)   0
batch_normalization_660[0][0]
activation_589[0][0]

--------------------------------------------------------------------------------
------------------
activation_598 (Activation)     (None, 32, 32, 64)   0
batch_normalization_667[0][0]

--------------------------------------------------------------------------------
------------------
conv2d_678 (Conv2D)             (None, 16, 16, 128)  147456
activation_606[0][0]

--------------------------------------------------------------------------------
------------------
activation_591 (Activation)     (None, 64, 64, 32)   0           add_356[0][0]

--------------------------------------------------------------------------------
------------------
conv2d_670 (Conv2D)             (None, 32, 32, 64)   36864
activation_598[0][0]

--------------------------------------------------------------------------------
------------------
batch_normalization_676 (BatchN (None, 16, 16, 128)  512
conv2d_678[0][0]

--------------------------------------------------------------------------------
------------------
conv2d_663 (Conv2D)             (None, 64, 64, 32)   9216
activation_591[0][0]

--------------------------------------------------------------------------------
------------------
batch_normalization_668 (BatchN (None, 32, 32, 64)   256
conv2d_670[0][0]

--------------------------------------------------------------------------------
------------------
add_364 (Add)                   (None, 16, 16, 128)  0
batch_normalization_676[0][0]
activation_605[0][0]

--------------------------------------------------------------------------------
------------------
batch_normalization_661 (BatchN (None, 64, 64, 32)   128
conv2d_663[0][0]

--------------------------------------------------------------------------------
------------------
add_360 (Add)                   (None, 32, 32, 64)   0
batch_normalization_668[0][0]
```

```
activation_597[0][0]
__________________________________________________________________________________
__________________
activation_607 (Activation)     (None, 16, 16, 128)  0           add_364[0][0]
__________________________________________________________________________________
__________________
activation_592 (Activation)     (None, 64, 64, 32)   0
batch_normalization_661[0][0]
__________________________________________________________________________________
__________________
activation_599 (Activation)     (None, 32, 32, 64)   0           add_360[0][0]
__________________________________________________________________________________
__________________
conv2d_679 (Conv2D)             (None, 16, 16, 128)  147456
activation_607[0][0]
__________________________________________________________________________________
__________________
conv2d_664 (Conv2D)             (None, 64, 64, 32)   9216
activation_592[0][0]
__________________________________________________________________________________
__________________
conv2d_671 (Conv2D)             (None, 32, 32, 64)   36864
activation_599[0][0]
__________________________________________________________________________________
__________________
batch_normalization_677 (BatchN (None, 16, 16, 128)  512
conv2d_679[0][0]
__________________________________________________________________________________
__________________
batch_normalization_662 (BatchN (None, 64, 64, 32)   128
conv2d_664[0][0]
__________________________________________________________________________________
__________________
batch_normalization_669 (BatchN (None, 32, 32, 64)   256
conv2d_671[0][0]
__________________________________________________________________________________
__________________
activation_608 (Activation)     (None, 16, 16, 128)  0
batch_normalization_677[0][0]
__________________________________________________________________________________
__________________
add_357 (Add)                   (None, 64, 64, 32)   0
batch_normalization_662[0][0]
activation_591[0][0]
__________________________________________________________________________________
__________________
activation_600 (Activation)     (None, 32, 32, 64)   0
batch_normalization_669[0][0]
```

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__________________________________________________________________________________
__________________
conv2d_680 (Conv2D)             (None, 16, 16, 128)  147456
activation_608[0][0]
__________________________________________________________________________________
__________________
activation_593 (Activation)     (None, 64, 64, 32)   0           add_357[0][0]
__________________________________________________________________________________
__________________
conv2d_672 (Conv2D)             (None, 32, 32, 64)   36864
activation_600[0][0]
__________________________________________________________________________________
__________________
batch_normalization_678 (BatchN (None, 16, 16, 128)  512
conv2d_680[0][0]
__________________________________________________________________________________
__________________
batch_normalization_670 (BatchN (None, 32, 32, 64)   256
conv2d_672[0][0]
__________________________________________________________________________________
__________________
add_365 (Add)                   (None, 16, 16, 128)  0
batch_normalization_678[0][0]
activation_607[0][0]
__________________________________________________________________________________
__________________
conv2d_685 (Conv2D)             (None, 32, 32, 32)   9216
activation_593[0][0]
__________________________________________________________________________________
__________________
add_361 (Add)                   (None, 32, 32, 64)   0
batch_normalization_670[0][0]
activation_599[0][0]
__________________________________________________________________________________
__________________
activation_609 (Activation)     (None, 16, 16, 128)  0           add_365[0][0]
__________________________________________________________________________________
__________________
batch_normalization_683 (BatchN (None, 32, 32, 32)   128
conv2d_685[0][0]
__________________________________________________________________________________
__________________
activation_601 (Activation)     (None, 32, 32, 64)   0           add_361[0][0]
__________________________________________________________________________________
__________________
conv2d_683 (Conv2D)             (None, 32, 32, 64)   18432
activation_593[0][0]
__________________________________________________________________________________
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__________________
conv2d_684 (Conv2D)             (None, 16, 16, 64)   8192
activation_609[0][0]
__________________________________________________________________________________
__________________
activation_612 (Activation)     (None, 32, 32, 32)   0
batch_normalization_683[0][0]
__________________________________________________________________________________
__________________
conv2d_681 (Conv2D)             (None, 32, 32, 32)   2048
activation_601[0][0]
__________________________________________________________________________________
__________________
batch_normalization_681 (BatchN (None, 32, 32, 64)   256
conv2d_683[0][0]
__________________________________________________________________________________
__________________
batch_normalization_682 (BatchN (None, 16, 16, 64)   256
conv2d_684[0][0]
__________________________________________________________________________________
__________________
conv2d_686 (Conv2D)             (None, 16, 16, 128)  36864
activation_612[0][0]
__________________________________________________________________________________
__________________
batch_normalization_679 (BatchN (None, 32, 32, 32)   128
conv2d_681[0][0]
__________________________________________________________________________________
__________________
conv2d_682 (Conv2D)             (None, 16, 16, 32)   4096
activation_609[0][0]
__________________________________________________________________________________
__________________
add_368 (Add)                   (None, 32, 32, 64)   0
activation_601[0][0]
batch_normalization_681[0][0]
__________________________________________________________________________________
__________________
up_sampling2d_66 (UpSampling2D) (None, 32, 32, 64)   0
batch_normalization_682[0][0]
__________________________________________________________________________________
__________________
batch_normalization_684 (BatchN (None, 16, 16, 128)  512
conv2d_686[0][0]
__________________________________________________________________________________
__________________
conv2d_687 (Conv2D)             (None, 16, 16, 128)  73728
activation_601[0][0]
```

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__________________
up_sampling2d_64 (UpSampling2D) (None, 64, 64, 32)   0
batch_normalization_679[0][0]
__________________________________________________________________________________
__________________
batch_normalization_680 (BatchN (None, 16, 16, 32)   128
conv2d_682[0][0]
__________________________________________________________________________________
__________________
add_369 (Add)                   (None, 32, 32, 64)   0           add_368[0][0]
up_sampling2d_66[0][0]
__________________________________________________________________________________
__________________
add_370 (Add)                   (None, 16, 16, 128)  0
activation_609[0][0]
batch_normalization_684[0][0]
__________________________________________________________________________________
__________________
batch_normalization_685 (BatchN (None, 16, 16, 128)  512
conv2d_687[0][0]
__________________________________________________________________________________
__________________
add_366 (Add)                   (None, 64, 64, 32)   0
activation_593[0][0]
up_sampling2d_64[0][0]
__________________________________________________________________________________
__________________
up_sampling2d_65 (UpSampling2D) (None, 64, 64, 32)   0
batch_normalization_680[0][0]
__________________________________________________________________________________
__________________
activation_611 (Activation)     (None, 32, 32, 64)   0           add_369[0][0]
__________________________________________________________________________________
__________________
add_371 (Add)                   (None, 16, 16, 128)  0           add_370[0][0]
batch_normalization_685[0][0]
__________________________________________________________________________________
__________________
add_367 (Add)                   (None, 64, 64, 32)   0           add_366[0][0]
up_sampling2d_65[0][0]
__________________________________________________________________________________
__________________
conv2d_696 (Conv2D)             (None, 32, 32, 64)   36864
activation_611[0][0]
__________________________________________________________________________________
__________________
activation_613 (Activation)     (None, 16, 16, 128)  0           add_371[0][0]
```

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__________________
activation_610 (Activation)     (None, 64, 64, 32)   0           add_367[0][0]
____________________________________________________________________________
__________________
batch_normalization_694 (BatchN (None, 32, 32, 64)   256
conv2d_696[0][0]
____________________________________________________________________________
__________________
conv2d_704 (Conv2D)             (None, 16, 16, 128)  147456
activation_613[0][0]
____________________________________________________________________________
__________________
conv2d_688 (Conv2D)             (None, 64, 64, 32)   9216
activation_610[0][0]
____________________________________________________________________________
__________________
activation_622 (Activation)     (None, 32, 32, 64)   0
batch_normalization_694[0][0]
____________________________________________________________________________
__________________
batch_normalization_702 (BatchN (None, 16, 16, 128)  512
conv2d_704[0][0]
____________________________________________________________________________
__________________
batch_normalization_686 (BatchN (None, 64, 64, 32)   128
conv2d_688[0][0]
____________________________________________________________________________
__________________
conv2d_697 (Conv2D)             (None, 32, 32, 64)   36864
activation_622[0][0]
____________________________________________________________________________
__________________
activation_630 (Activation)     (None, 16, 16, 128)  0
batch_normalization_702[0][0]
____________________________________________________________________________
__________________
activation_614 (Activation)     (None, 64, 64, 32)   0
batch_normalization_686[0][0]
____________________________________________________________________________
__________________
batch_normalization_695 (BatchN (None, 32, 32, 64)   256
conv2d_697[0][0]
____________________________________________________________________________
__________________
conv2d_705 (Conv2D)             (None, 16, 16, 128)  147456
activation_630[0][0]
____________________________________________________________________________
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__________________
conv2d_689 (Conv2D)             (None, 64, 64, 32)   9216
activation_614[0][0]

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__________________
add_376 (Add)                   (None, 32, 32, 64)   0
batch_normalization_695[0][0]
activation_611[0][0]

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__________________
batch_normalization_703 (BatchN (None, 16, 16, 128)  512
conv2d_705[0][0]

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__________________
batch_normalization_687 (BatchN (None, 64, 64, 32)   128
conv2d_689[0][0]

__________________________________________________________________________________
__________________
activation_623 (Activation)     (None, 32, 32, 64)   0           add_376[0][0]

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__________________
add_380 (Add)                   (None, 16, 16, 128)  0
batch_normalization_703[0][0]
activation_613[0][0]

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__________________
add_372 (Add)                   (None, 64, 64, 32)   0
batch_normalization_687[0][0]
activation_610[0][0]

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__________________
conv2d_698 (Conv2D)             (None, 32, 32, 64)   36864
activation_623[0][0]

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__________________
activation_631 (Activation)     (None, 16, 16, 128)  0           add_380[0][0]

__________________________________________________________________________________
__________________
activation_615 (Activation)     (None, 64, 64, 32)   0           add_372[0][0]

__________________________________________________________________________________
__________________
batch_normalization_696 (BatchN (None, 32, 32, 64)   256
conv2d_698[0][0]

__________________________________________________________________________________
__________________
conv2d_706 (Conv2D)             (None, 16, 16, 128)  147456
activation_631[0][0]

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------------------
conv2d_690 (Conv2D)             (None, 64, 64, 32)   9216
activation_615[0][0]

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------------------
activation_624 (Activation)     (None, 32, 32, 64)   0
batch_normalization_696[0][0]

------------------------------------------------------------------------------
------------------
batch_normalization_704 (BatchN (None, 16, 16, 128)  512
conv2d_706[0][0]

------------------------------------------------------------------------------
------------------
batch_normalization_688 (BatchN (None, 64, 64, 32)   128
conv2d_690[0][0]

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------------------
conv2d_699 (Conv2D)             (None, 32, 32, 64)   36864
activation_624[0][0]

------------------------------------------------------------------------------
------------------
activation_632 (Activation)     (None, 16, 16, 128)  0
batch_normalization_704[0][0]

------------------------------------------------------------------------------
------------------
activation_616 (Activation)     (None, 64, 64, 32)   0
batch_normalization_688[0][0]

------------------------------------------------------------------------------
------------------
batch_normalization_697 (BatchN (None, 32, 32, 64)   256
conv2d_699[0][0]

------------------------------------------------------------------------------
------------------
conv2d_707 (Conv2D)             (None, 16, 16, 128)  147456
activation_632[0][0]

------------------------------------------------------------------------------
------------------
conv2d_691 (Conv2D)             (None, 64, 64, 32)   9216
activation_616[0][0]

------------------------------------------------------------------------------
------------------
add_377 (Add)                   (None, 32, 32, 64)   0
batch_normalization_697[0][0]
activation_623[0][0]

------------------------------------------------------------------------------
------------------
batch_normalization_705 (BatchN (None, 16, 16, 128)  512
conv2d_707[0][0]
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__________________________________________________________________________________
__________________
batch_normalization_689 (BatchN (None, 64, 64, 32)   128
conv2d_691[0][0]
__________________________________________________________________________________
__________________
activation_625 (Activation)     (None, 32, 32, 64)   0           add_377[0][0]
__________________________________________________________________________________
__________________
add_381 (Add)                   (None, 16, 16, 128)  0
batch_normalization_705[0][0]
activation_631[0][0]
__________________________________________________________________________________
__________________
add_373 (Add)                   (None, 64, 64, 32)   0
batch_normalization_689[0][0]
activation_615[0][0]
__________________________________________________________________________________
__________________
conv2d_700 (Conv2D)             (None, 32, 32, 64)   36864
activation_625[0][0]
__________________________________________________________________________________
__________________
activation_633 (Activation)     (None, 16, 16, 128)  0           add_381[0][0]
__________________________________________________________________________________
__________________
activation_617 (Activation)     (None, 64, 64, 32)   0           add_373[0][0]
__________________________________________________________________________________
__________________
batch_normalization_698 (BatchN (None, 32, 32, 64)   256
conv2d_700[0][0]
__________________________________________________________________________________
__________________
conv2d_708 (Conv2D)             (None, 16, 16, 128)  147456
activation_633[0][0]
__________________________________________________________________________________
__________________
conv2d_692 (Conv2D)             (None, 64, 64, 32)   9216
activation_617[0][0]
__________________________________________________________________________________
__________________
activation_626 (Activation)     (None, 32, 32, 64)   0
batch_normalization_698[0][0]
__________________________________________________________________________________
__________________
batch_normalization_706 (BatchN (None, 16, 16, 128)  512
conv2d_708[0][0]
__________________________________________________________________________________
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------------------
batch_normalization_690 (BatchN (None, 64, 64, 32)   128
conv2d_692[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_701 (Conv2D)             (None, 32, 32, 64)   36864
activation_626[0][0]
--------------------------------------------------------------------------------
------------------
activation_634 (Activation)     (None, 16, 16, 128)  0
batch_normalization_706[0][0]
--------------------------------------------------------------------------------
------------------
activation_618 (Activation)     (None, 64, 64, 32)   0
batch_normalization_690[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_699 (BatchN (None, 32, 32, 64)   256
conv2d_701[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_709 (Conv2D)             (None, 16, 16, 128)  147456
activation_634[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_693 (Conv2D)             (None, 64, 64, 32)   9216
activation_618[0][0]
--------------------------------------------------------------------------------
------------------
add_378 (Add)                   (None, 32, 32, 64)   0
batch_normalization_699[0][0]
activation_625[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_707 (BatchN (None, 16, 16, 128)  512
conv2d_709[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_691 (BatchN (None, 64, 64, 32)   128
conv2d_693[0][0]
--------------------------------------------------------------------------------
------------------
activation_627 (Activation)     (None, 32, 32, 64)   0           add_378[0][0]
--------------------------------------------------------------------------------
------------------
add_382 (Add)                   (None, 16, 16, 128)  0
batch_normalization_707[0][0]
activation_633[0][0]
```

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__________________
add_374 (Add)                   (None, 64, 64, 32)   0
batch_normalization_691[0][0]
activation_617[0][0]
__________________________________________________________________________________
__________________
conv2d_702 (Conv2D)             (None, 32, 32, 64)   36864
activation_627[0][0]
__________________________________________________________________________________
__________________
activation_635 (Activation)     (None, 16, 16, 128)  0           add_382[0][0]
__________________________________________________________________________________
__________________
activation_619 (Activation)     (None, 64, 64, 32)   0           add_374[0][0]
__________________________________________________________________________________
__________________
batch_normalization_700 (BatchN (None, 32, 32, 64)   256
conv2d_702[0][0]
__________________________________________________________________________________
__________________
conv2d_710 (Conv2D)             (None, 16, 16, 128)  147456
activation_635[0][0]
__________________________________________________________________________________
__________________
conv2d_694 (Conv2D)             (None, 64, 64, 32)   9216
activation_619[0][0]
__________________________________________________________________________________
__________________
activation_628 (Activation)     (None, 32, 32, 64)   0
batch_normalization_700[0][0]
__________________________________________________________________________________
__________________
batch_normalization_708 (BatchN (None, 16, 16, 128)  512
conv2d_710[0][0]
__________________________________________________________________________________
__________________
batch_normalization_692 (BatchN (None, 64, 64, 32)   128
conv2d_694[0][0]
__________________________________________________________________________________
__________________
conv2d_703 (Conv2D)             (None, 32, 32, 64)   36864
activation_628[0][0]
__________________________________________________________________________________
__________________
activation_636 (Activation)     (None, 16, 16, 128)  0
batch_normalization_708[0][0]
__________________________________________________________________________________
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__________________
activation_620 (Activation)     (None, 64, 64, 32)   0
batch_normalization_692[0][0]

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__________________
batch_normalization_701 (BatchN (None, 32, 32, 64)   256
conv2d_703[0][0]

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__________________
conv2d_711 (Conv2D)             (None, 16, 16, 128)  147456
activation_636[0][0]

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__________________
conv2d_695 (Conv2D)             (None, 64, 64, 32)   9216
activation_620[0][0]

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__________________
add_379 (Add)                   (None, 32, 32, 64)   0
batch_normalization_701[0][0]
activation_627[0][0]

__________________________________________________________________________________
__________________
batch_normalization_709 (BatchN (None, 16, 16, 128)  512
conv2d_711[0][0]

__________________________________________________________________________________
__________________
batch_normalization_693 (BatchN (None, 64, 64, 32)   128
conv2d_695[0][0]

__________________________________________________________________________________
__________________
activation_629 (Activation)     (None, 32, 32, 64)   0           add_379[0][0]

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__________________
add_383 (Add)                   (None, 16, 16, 128)  0
batch_normalization_709[0][0]
activation_635[0][0]

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__________________
add_375 (Add)                   (None, 64, 64, 32)   0
batch_normalization_693[0][0]
activation_619[0][0]

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__________________
conv2d_712 (Conv2D)             (None, 32, 32, 32)   2048
activation_629[0][0]

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__________________
activation_637 (Activation)     (None, 16, 16, 128)  0           add_383[0][0]
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__________________________________________________________________________________
__________________
activation_621 (Activation)     (None, 64, 64, 32)   0           add_375[0][0]
__________________________________________________________________________________
__________________
batch_normalization_710 (BatchN (None, 32, 32, 32)   128
conv2d_712[0][0]
__________________________________________________________________________________
__________________
conv2d_713 (Conv2D)             (None, 16, 16, 32)   4096
activation_637[0][0]
__________________________________________________________________________________
__________________
up_sampling2d_67 (UpSampling2D) (None, 64, 64, 32)   0
batch_normalization_710[0][0]
__________________________________________________________________________________
__________________
batch_normalization_711 (BatchN (None, 16, 16, 32)   128
conv2d_713[0][0]
__________________________________________________________________________________
__________________
conv2d_716 (Conv2D)             (None, 32, 32, 32)   9216
activation_621[0][0]
__________________________________________________________________________________
__________________
add_384 (Add)                   (None, 64, 64, 32)   0
activation_621[0][0]
up_sampling2d_67[0][0]
__________________________________________________________________________________
__________________
up_sampling2d_68 (UpSampling2D) (None, 64, 64, 32)   0
batch_normalization_711[0][0]
__________________________________________________________________________________
__________________
batch_normalization_714 (BatchN (None, 32, 32, 32)   128
conv2d_716[0][0]
__________________________________________________________________________________
__________________
add_385 (Add)                   (None, 64, 64, 32)   0           add_384[0][0]
up_sampling2d_68[0][0]
__________________________________________________________________________________
__________________
conv2d_714 (Conv2D)             (None, 32, 32, 64)   18432
activation_621[0][0]
__________________________________________________________________________________
__________________
conv2d_715 (Conv2D)             (None, 16, 16, 64)   8192
activation_637[0][0]
```

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__________________
activation_640 (Activation)     (None, 32, 32, 32)   0
batch_normalization_714[0][0]
__________________________________________________________________________________
__________________
activation_638 (Activation)     (None, 64, 64, 32)   0           add_385[0][0]
__________________________________________________________________________________
__________________
batch_normalization_712 (BatchN (None, 32, 32, 64)   256
conv2d_714[0][0]
__________________________________________________________________________________
__________________
batch_normalization_713 (BatchN (None, 16, 16, 64)   256
conv2d_715[0][0]
__________________________________________________________________________________
__________________
conv2d_717 (Conv2D)             (None, 16, 16, 128)  36864
activation_640[0][0]
__________________________________________________________________________________
__________________
conv2d_719 (Conv2D)             (None, 64, 64, 32)   9216
activation_638[0][0]
__________________________________________________________________________________
__________________
add_386 (Add)                   (None, 32, 32, 64)   0
activation_629[0][0]
batch_normalization_712[0][0]
__________________________________________________________________________________
__________________
up_sampling2d_69 (UpSampling2D) (None, 32, 32, 64)   0
batch_normalization_713[0][0]
__________________________________________________________________________________
__________________
batch_normalization_715 (BatchN (None, 16, 16, 128)  512
conv2d_717[0][0]
__________________________________________________________________________________
__________________
conv2d_718 (Conv2D)             (None, 16, 16, 128)  73728
activation_629[0][0]
__________________________________________________________________________________
__________________
batch_normalization_717 (BatchN (None, 64, 64, 32)   128
conv2d_719[0][0]
__________________________________________________________________________________
__________________
add_387 (Add)                   (None, 32, 32, 64)   0           add_386[0][0]
up_sampling2d_69[0][0]
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__________________
add_388 (Add)                   (None, 16, 16, 128)  0
activation_637[0][0]
batch_normalization_715[0][0]
__________________________________________________________________________________
__________________
batch_normalization_716 (BatchN (None, 16, 16, 128)  512
conv2d_718[0][0]
__________________________________________________________________________________
__________________
activation_642 (Activation)     (None, 64, 64, 32)   0
batch_normalization_717[0][0]
__________________________________________________________________________________
__________________
activation_639 (Activation)     (None, 32, 32, 64)   0           add_387[0][0]
__________________________________________________________________________________
__________________
add_389 (Add)                   (None, 16, 16, 128)  0           add_388[0][0]
batch_normalization_716[0][0]
__________________________________________________________________________________
__________________
conv2d_720 (Conv2D)             (None, 64, 64, 32)   9216
activation_642[0][0]
__________________________________________________________________________________
__________________
conv2d_727 (Conv2D)             (None, 32, 32, 64)   36864
activation_639[0][0]
__________________________________________________________________________________
__________________
activation_641 (Activation)     (None, 16, 16, 128)  0           add_389[0][0]
__________________________________________________________________________________
__________________
batch_normalization_718 (BatchN (None, 64, 64, 32)   128
conv2d_720[0][0]
__________________________________________________________________________________
__________________
batch_normalization_725 (BatchN (None, 32, 32, 64)   256
conv2d_727[0][0]
__________________________________________________________________________________
__________________
conv2d_735 (Conv2D)             (None, 16, 16, 128)  147456
activation_641[0][0]
__________________________________________________________________________________
__________________
add_390 (Add)                   (None, 64, 64, 32)   0
batch_normalization_718[0][0]
activation_638[0][0]
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__________________
activation_650 (Activation)     (None, 32, 32, 64)   0
batch_normalization_725[0][0]
__________________________________________________________________________________
__________________
batch_normalization_733 (BatchN (None, 16, 16, 128)  512
conv2d_735[0][0]
__________________________________________________________________________________
__________________
activation_643 (Activation)     (None, 64, 64, 32)   0           add_390[0][0]
__________________________________________________________________________________
__________________
conv2d_728 (Conv2D)             (None, 32, 32, 64)   36864
activation_650[0][0]
__________________________________________________________________________________
__________________
activation_658 (Activation)     (None, 16, 16, 128)  0
batch_normalization_733[0][0]
__________________________________________________________________________________
__________________
conv2d_721 (Conv2D)             (None, 64, 64, 32)   9216
activation_643[0][0]
__________________________________________________________________________________
__________________
batch_normalization_726 (BatchN (None, 32, 32, 64)   256
conv2d_728[0][0]
__________________________________________________________________________________
__________________
conv2d_736 (Conv2D)             (None, 16, 16, 128)  147456
activation_658[0][0]
__________________________________________________________________________________
__________________
batch_normalization_719 (BatchN (None, 64, 64, 32)   128
conv2d_721[0][0]
__________________________________________________________________________________
__________________
add_394 (Add)                   (None, 32, 32, 64)   0
batch_normalization_726[0][0]
activation_639[0][0]
__________________________________________________________________________________
__________________
batch_normalization_734 (BatchN (None, 16, 16, 128)  512
conv2d_736[0][0]
__________________________________________________________________________________
__________________
activation_644 (Activation)     (None, 64, 64, 32)   0
batch_normalization_719[0][0]
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__________________
activation_651 (Activation)     (None, 32, 32, 64)   0           add_394[0][0]
__________________________________________________________________________________
__________________
add_398 (Add)                   (None, 16, 16, 128)  0
batch_normalization_734[0][0]
activation_641[0][0]
__________________________________________________________________________________
__________________
conv2d_722 (Conv2D)             (None, 64, 64, 32)   9216
activation_644[0][0]
__________________________________________________________________________________
__________________
conv2d_729 (Conv2D)             (None, 32, 32, 64)   36864
activation_651[0][0]
__________________________________________________________________________________
__________________
activation_659 (Activation)     (None, 16, 16, 128)  0           add_398[0][0]
__________________________________________________________________________________
__________________
batch_normalization_720 (BatchN (None, 64, 64, 32)   128
conv2d_722[0][0]
__________________________________________________________________________________
__________________
batch_normalization_727 (BatchN (None, 32, 32, 64)   256
conv2d_729[0][0]
__________________________________________________________________________________
__________________
conv2d_737 (Conv2D)             (None, 16, 16, 128)  147456
activation_659[0][0]
__________________________________________________________________________________
__________________
add_391 (Add)                   (None, 64, 64, 32)   0
batch_normalization_720[0][0]
activation_643[0][0]
__________________________________________________________________________________
__________________
activation_652 (Activation)     (None, 32, 32, 64)   0
batch_normalization_727[0][0]
__________________________________________________________________________________
__________________
batch_normalization_735 (BatchN (None, 16, 16, 128)  512
conv2d_737[0][0]
__________________________________________________________________________________
__________________
activation_645 (Activation)     (None, 64, 64, 32)   0           add_391[0][0]
__________________________________________________________________________________
```

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__________________
conv2d_730 (Conv2D)             (None, 32, 32, 64)   36864
activation_652[0][0]

__________________________________________________________________________________
__________________
activation_660 (Activation)     (None, 16, 16, 128)  0
batch_normalization_735[0][0]

__________________________________________________________________________________
__________________
conv2d_723 (Conv2D)             (None, 64, 64, 32)   9216
activation_645[0][0]

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__________________
batch_normalization_728 (BatchN (None, 32, 32, 64)   256
conv2d_730[0][0]

__________________________________________________________________________________
__________________
conv2d_738 (Conv2D)             (None, 16, 16, 128)  147456
activation_660[0][0]

__________________________________________________________________________________
__________________
batch_normalization_721 (BatchN (None, 64, 64, 32)   128
conv2d_723[0][0]

__________________________________________________________________________________
__________________
add_395 (Add)                   (None, 32, 32, 64)   0
batch_normalization_728[0][0]
activation_651[0][0]

__________________________________________________________________________________
__________________
batch_normalization_736 (BatchN (None, 16, 16, 128)  512
conv2d_738[0][0]

__________________________________________________________________________________
__________________
activation_646 (Activation)     (None, 64, 64, 32)   0
batch_normalization_721[0][0]

__________________________________________________________________________________
__________________
activation_653 (Activation)     (None, 32, 32, 64)   0           add_395[0][0]

__________________________________________________________________________________
__________________
add_399 (Add)                   (None, 16, 16, 128)  0
batch_normalization_736[0][0]
activation_659[0][0]

__________________________________________________________________________________
__________________
conv2d_724 (Conv2D)             (None, 64, 64, 32)   9216
activation_646[0][0]
```

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__________________________________________________________________________________
__________________
conv2d_731 (Conv2D)             (None, 32, 32, 64)   36864
activation_653[0][0]
__________________________________________________________________________________
__________________
activation_661 (Activation)     (None, 16, 16, 128)  0           add_399[0][0]
__________________________________________________________________________________
__________________
batch_normalization_722 (BatchN (None, 64, 64, 32)   128
conv2d_724[0][0]
__________________________________________________________________________________
__________________
batch_normalization_729 (BatchN (None, 32, 32, 64)   256
conv2d_731[0][0]
__________________________________________________________________________________
__________________
conv2d_739 (Conv2D)             (None, 16, 16, 128)  147456
activation_661[0][0]
__________________________________________________________________________________
__________________
add_392 (Add)                   (None, 64, 64, 32)   0
batch_normalization_722[0][0]
activation_645[0][0]
__________________________________________________________________________________
__________________
activation_654 (Activation)     (None, 32, 32, 64)   0
batch_normalization_729[0][0]
__________________________________________________________________________________
__________________
batch_normalization_737 (BatchN (None, 16, 16, 128)  512
conv2d_739[0][0]
__________________________________________________________________________________
__________________
activation_647 (Activation)     (None, 64, 64, 32)   0           add_392[0][0]
__________________________________________________________________________________
__________________
conv2d_732 (Conv2D)             (None, 32, 32, 64)   36864
activation_654[0][0]
__________________________________________________________________________________
__________________
activation_662 (Activation)     (None, 16, 16, 128)  0
batch_normalization_737[0][0]
__________________________________________________________________________________
__________________
conv2d_725 (Conv2D)             (None, 64, 64, 32)   9216
activation_647[0][0]
__________________________________________________________________________________
```

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__________________
batch_normalization_730 (BatchN (None, 32, 32, 64)   256
conv2d_732[0][0]
__________________________________________________________________________________
__________________
conv2d_740 (Conv2D)             (None, 16, 16, 128)  147456
activation_662[0][0]
__________________________________________________________________________________
__________________
batch_normalization_723 (BatchN (None, 64, 64, 32)   128
conv2d_725[0][0]
__________________________________________________________________________________
__________________
add_396 (Add)                   (None, 32, 32, 64)   0
batch_normalization_730[0][0]
activation_653[0][0]
__________________________________________________________________________________
__________________
batch_normalization_738 (BatchN (None, 16, 16, 128)  512
conv2d_740[0][0]
__________________________________________________________________________________
__________________
activation_648 (Activation)     (None, 64, 64, 32)   0
batch_normalization_723[0][0]
__________________________________________________________________________________
__________________
activation_655 (Activation)     (None, 32, 32, 64)   0           add_396[0][0]
__________________________________________________________________________________
__________________
add_400 (Add)                   (None, 16, 16, 128)  0
batch_normalization_738[0][0]
activation_661[0][0]
__________________________________________________________________________________
__________________
conv2d_726 (Conv2D)             (None, 64, 64, 32)   9216
activation_648[0][0]
__________________________________________________________________________________
__________________
conv2d_733 (Conv2D)             (None, 32, 32, 64)   36864
activation_655[0][0]
__________________________________________________________________________________
__________________
activation_663 (Activation)     (None, 16, 16, 128)  0           add_400[0][0]
__________________________________________________________________________________
__________________
batch_normalization_724 (BatchN (None, 64, 64, 32)   128
conv2d_726[0][0]
__________________________________________________________________________________
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__________________
batch_normalization_731 (BatchN (None, 32, 32, 64)   256
conv2d_733[0][0]
__________________________________________________________________________________
__________________
conv2d_741 (Conv2D)             (None, 16, 16, 128)  147456
activation_663[0][0]
__________________________________________________________________________________
__________________
add_393 (Add)                   (None, 64, 64, 32)   0
batch_normalization_724[0][0]
activation_647[0][0]
__________________________________________________________________________________
__________________
activation_656 (Activation)     (None, 32, 32, 64)   0
batch_normalization_731[0][0]
__________________________________________________________________________________
__________________
batch_normalization_739 (BatchN (None, 16, 16, 128)  512
conv2d_741[0][0]
__________________________________________________________________________________
__________________
activation_649 (Activation)     (None, 64, 64, 32)   0           add_393[0][0]
__________________________________________________________________________________
__________________
conv2d_734 (Conv2D)             (None, 32, 32, 64)   36864
activation_656[0][0]
__________________________________________________________________________________
__________________
activation_664 (Activation)     (None, 16, 16, 128)  0
batch_normalization_739[0][0]
__________________________________________________________________________________
__________________
batch_normalization_732 (BatchN (None, 32, 32, 64)   256
conv2d_734[0][0]
__________________________________________________________________________________
__________________
conv2d_742 (Conv2D)             (None, 16, 16, 128)  147456
activation_664[0][0]
__________________________________________________________________________________
__________________
conv2d_747 (Conv2D)             (None, 32, 32, 32)   9216
activation_649[0][0]
__________________________________________________________________________________
__________________
add_397 (Add)                   (None, 32, 32, 64)   0
batch_normalization_732[0][0]
activation_655[0][0]
```

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__________________________________________________________________________________
__________________
batch_normalization_740 (BatchN (None, 16, 16, 128)  512
conv2d_742[0][0]
__________________________________________________________________________________
__________________
batch_normalization_745 (BatchN (None, 32, 32, 32)   128
conv2d_747[0][0]
__________________________________________________________________________________
__________________
activation_657 (Activation)     (None, 32, 32, 64)   0           add_397[0][0]
__________________________________________________________________________________
__________________
add_401 (Add)                   (None, 16, 16, 128)  0
batch_normalization_740[0][0]
activation_663[0][0]
__________________________________________________________________________________
__________________
activation_668 (Activation)     (None, 32, 32, 32)   0
batch_normalization_745[0][0]
__________________________________________________________________________________
__________________
conv2d_743 (Conv2D)             (None, 32, 32, 32)   2048
activation_657[0][0]
__________________________________________________________________________________
__________________
activation_665 (Activation)     (None, 16, 16, 128)  0           add_401[0][0]
__________________________________________________________________________________
__________________
conv2d_748 (Conv2D)             (None, 16, 16, 128)  36864
activation_668[0][0]
__________________________________________________________________________________
__________________
batch_normalization_741 (BatchN (None, 32, 32, 32)   128
conv2d_743[0][0]
__________________________________________________________________________________
__________________
conv2d_744 (Conv2D)             (None, 16, 16, 32)   4096
activation_665[0][0]
__________________________________________________________________________________
__________________
conv2d_745 (Conv2D)             (None, 32, 32, 64)   18432
activation_649[0][0]
__________________________________________________________________________________
__________________
conv2d_746 (Conv2D)             (None, 16, 16, 64)   8192
activation_665[0][0]
__________________________________________________________________________________
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------------------
batch_normalization_746 (BatchN (None, 16, 16, 128)  512
conv2d_748[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_749 (Conv2D)             (None, 16, 16, 128)  73728
activation_657[0][0]
--------------------------------------------------------------------------------
------------------
up_sampling2d_70 (UpSampling2D) (None, 64, 64, 32)   0
batch_normalization_741[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_742 (BatchN (None, 16, 16, 32)   128
conv2d_744[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_743 (BatchN (None, 32, 32, 64)   256
conv2d_745[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_744 (BatchN (None, 16, 16, 64)   256
conv2d_746[0][0]
--------------------------------------------------------------------------------
------------------
add_406 (Add)                   (None, 16, 16, 128)  0
activation_665[0][0]
batch_normalization_746[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_747 (BatchN (None, 16, 16, 128)  512
conv2d_749[0][0]
--------------------------------------------------------------------------------
------------------
add_402 (Add)                   (None, 64, 64, 32)   0
activation_649[0][0]
up_sampling2d_70[0][0]
--------------------------------------------------------------------------------
------------------
up_sampling2d_71 (UpSampling2D) (None, 64, 64, 32)   0
batch_normalization_742[0][0]
--------------------------------------------------------------------------------
------------------
add_404 (Add)                   (None, 32, 32, 64)   0
activation_657[0][0]
batch_normalization_743[0][0]
--------------------------------------------------------------------------------
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up_sampling2d_72 (UpSampling2D) (None, 32, 32, 64)   0
batch_normalization_744[0][0]
__________________________________________________________________________________
__________________
add_407 (Add)                   (None, 16, 16, 128)  0           add_406[0][0]
batch_normalization_747[0][0]
__________________________________________________________________________________
__________________
add_403 (Add)                   (None, 64, 64, 32)   0           add_402[0][0]
up_sampling2d_71[0][0]
__________________________________________________________________________________
__________________
add_405 (Add)                   (None, 32, 32, 64)   0           add_404[0][0]
up_sampling2d_72[0][0]
__________________________________________________________________________________
__________________
activation_669 (Activation)     (None, 16, 16, 128)  0           add_407[0][0]
__________________________________________________________________________________
__________________
activation_666 (Activation)     (None, 64, 64, 32)   0           add_403[0][0]
__________________________________________________________________________________
__________________
activation_667 (Activation)     (None, 32, 32, 64)   0           add_405[0][0]
__________________________________________________________________________________
__________________
conv2d_750 (Conv2D)             (None, 8, 8, 256)    294912
activation_669[0][0]
__________________________________________________________________________________
__________________
conv2d_751 (Conv2D)             (None, 64, 64, 32)   9216
activation_666[0][0]
__________________________________________________________________________________
__________________
conv2d_759 (Conv2D)             (None, 32, 32, 64)   36864
activation_667[0][0]
__________________________________________________________________________________
__________________
batch_normalization_748 (BatchN (None, 8, 8, 256)    1024
conv2d_750[0][0]
__________________________________________________________________________________
__________________
batch_normalization_749 (BatchN (None, 64, 64, 32)   128
conv2d_751[0][0]
__________________________________________________________________________________
__________________
batch_normalization_757 (BatchN (None, 32, 32, 64)   256
conv2d_759[0][0]
__________________________________________________________________________________
```

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------------------
conv2d_767 (Conv2D)             (None, 16, 16, 128)  147456
activation_669[0][0]

--------------------------------------------------------------------------------
------------------
activation_670 (Activation)     (None, 8, 8, 256)    0
batch_normalization_748[0][0]

--------------------------------------------------------------------------------
------------------
activation_671 (Activation)     (None, 64, 64, 32)   0
batch_normalization_749[0][0]

--------------------------------------------------------------------------------
------------------
activation_679 (Activation)     (None, 32, 32, 64)   0
batch_normalization_757[0][0]

--------------------------------------------------------------------------------
------------------
batch_normalization_765 (BatchN (None, 16, 16, 128)  512
conv2d_767[0][0]

--------------------------------------------------------------------------------
------------------
conv2d_775 (Conv2D)             (None, 8, 8, 256)    589824
activation_670[0][0]

--------------------------------------------------------------------------------
------------------
conv2d_752 (Conv2D)             (None, 64, 64, 32)   9216
activation_671[0][0]

--------------------------------------------------------------------------------
------------------
conv2d_760 (Conv2D)             (None, 32, 32, 64)   36864
activation_679[0][0]

--------------------------------------------------------------------------------
------------------
activation_687 (Activation)     (None, 16, 16, 128)  0
batch_normalization_765[0][0]

--------------------------------------------------------------------------------
------------------
batch_normalization_773 (BatchN (None, 8, 8, 256)    1024
conv2d_775[0][0]

--------------------------------------------------------------------------------
------------------
batch_normalization_750 (BatchN (None, 64, 64, 32)   128
conv2d_752[0][0]

--------------------------------------------------------------------------------
------------------
batch_normalization_758 (BatchN (None, 32, 32, 64)   256
conv2d_760[0][0]

--------------------------------------------------------------------------------
```

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__________________
conv2d_768 (Conv2D)             (None, 16, 16, 128)  147456
activation_687[0][0]

__________________________________________________________________________________
__________________
activation_695 (Activation)     (None, 8, 8, 256)    0
batch_normalization_773[0][0]

__________________________________________________________________________________
__________________
add_408 (Add)                   (None, 64, 64, 32)   0
batch_normalization_750[0][0]
activation_666[0][0]

__________________________________________________________________________________
__________________
add_412 (Add)                   (None, 32, 32, 64)   0
batch_normalization_758[0][0]
activation_667[0][0]

__________________________________________________________________________________
__________________
batch_normalization_766 (BatchN (None, 16, 16, 128)  512
conv2d_768[0][0]

__________________________________________________________________________________
__________________
conv2d_776 (Conv2D)             (None, 8, 8, 256)    589824
activation_695[0][0]

__________________________________________________________________________________
__________________
activation_672 (Activation)     (None, 64, 64, 32)   0           add_408[0][0]

__________________________________________________________________________________
__________________
activation_680 (Activation)     (None, 32, 32, 64)   0           add_412[0][0]

__________________________________________________________________________________
__________________
add_416 (Add)                   (None, 16, 16, 128)  0
batch_normalization_766[0][0]
activation_669[0][0]

__________________________________________________________________________________
__________________
batch_normalization_774 (BatchN (None, 8, 8, 256)    1024
conv2d_776[0][0]

__________________________________________________________________________________
__________________
conv2d_753 (Conv2D)             (None, 64, 64, 32)   9216
activation_672[0][0]

__________________________________________________________________________________
__________________
conv2d_761 (Conv2D)             (None, 32, 32, 64)   36864
activation_680[0][0]
```

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__________________________________________________________________________________
__________________
activation_688 (Activation)     (None, 16, 16, 128)  0           add_416[0][0]
__________________________________________________________________________________
__________________
add_420 (Add)                   (None, 8, 8, 256)    0
batch_normalization_774[0][0]
activation_670[0][0]
__________________________________________________________________________________
__________________
batch_normalization_751 (BatchN (None, 64, 64, 32)   128
conv2d_753[0][0]
__________________________________________________________________________________
__________________
batch_normalization_759 (BatchN (None, 32, 32, 64)   256
conv2d_761[0][0]
__________________________________________________________________________________
__________________
conv2d_769 (Conv2D)             (None, 16, 16, 128)  147456
activation_688[0][0]
__________________________________________________________________________________
__________________
activation_696 (Activation)     (None, 8, 8, 256)    0           add_420[0][0]
__________________________________________________________________________________
__________________
activation_673 (Activation)     (None, 64, 64, 32)   0
batch_normalization_751[0][0]
__________________________________________________________________________________
__________________
activation_681 (Activation)     (None, 32, 32, 64)   0
batch_normalization_759[0][0]
__________________________________________________________________________________
__________________
batch_normalization_767 (BatchN (None, 16, 16, 128)  512
conv2d_769[0][0]
__________________________________________________________________________________
__________________
conv2d_777 (Conv2D)             (None, 8, 8, 256)    589824
activation_696[0][0]
__________________________________________________________________________________
__________________
conv2d_754 (Conv2D)             (None, 64, 64, 32)   9216
activation_673[0][0]
__________________________________________________________________________________
__________________
conv2d_762 (Conv2D)             (None, 32, 32, 64)   36864
activation_681[0][0]
__________________________________________________________________________________
```

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------------------
activation_689 (Activation)     (None, 16, 16, 128)  0
batch_normalization_767[0][0]

--------------------------------------------------------------------------------
------------------
batch_normalization_775 (BatchN (None, 8, 8, 256)    1024
conv2d_777[0][0]

--------------------------------------------------------------------------------
------------------
batch_normalization_752 (BatchN (None, 64, 64, 32)   128
conv2d_754[0][0]

--------------------------------------------------------------------------------
------------------
batch_normalization_760 (BatchN (None, 32, 32, 64)   256
conv2d_762[0][0]

--------------------------------------------------------------------------------
------------------
conv2d_770 (Conv2D)             (None, 16, 16, 128)  147456
activation_689[0][0]

--------------------------------------------------------------------------------
------------------
activation_697 (Activation)     (None, 8, 8, 256)    0
batch_normalization_775[0][0]

--------------------------------------------------------------------------------
------------------
add_409 (Add)                   (None, 64, 64, 32)   0
batch_normalization_752[0][0]
activation_672[0][0]

--------------------------------------------------------------------------------
------------------
add_413 (Add)                   (None, 32, 32, 64)   0
batch_normalization_760[0][0]
activation_680[0][0]

--------------------------------------------------------------------------------
------------------
batch_normalization_768 (BatchN (None, 16, 16, 128)  512
conv2d_770[0][0]

--------------------------------------------------------------------------------
------------------
conv2d_778 (Conv2D)             (None, 8, 8, 256)    589824
activation_697[0][0]

--------------------------------------------------------------------------------
------------------
activation_674 (Activation)     (None, 64, 64, 32)   0           add_409[0][0]

--------------------------------------------------------------------------------
------------------
activation_682 (Activation)     (None, 32, 32, 64)   0           add_413[0][0]

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------------------
add_417 (Add)                   (None, 16, 16, 128)  0
batch_normalization_768[0][0]
activation_688[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_776 (BatchN (None, 8, 8, 256)    1024
conv2d_778[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_755 (Conv2D)             (None, 64, 64, 32)   9216
activation_674[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_763 (Conv2D)             (None, 32, 32, 64)   36864
activation_682[0][0]
--------------------------------------------------------------------------------
------------------
activation_690 (Activation)     (None, 16, 16, 128)  0           add_417[0][0]
--------------------------------------------------------------------------------
------------------
add_421 (Add)                   (None, 8, 8, 256)    0
batch_normalization_776[0][0]
activation_696[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_753 (BatchN (None, 64, 64, 32)   128
conv2d_755[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_761 (BatchN (None, 32, 32, 64)   256
conv2d_763[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_771 (Conv2D)             (None, 16, 16, 128)  147456
activation_690[0][0]
--------------------------------------------------------------------------------
------------------
activation_698 (Activation)     (None, 8, 8, 256)    0           add_421[0][0]
--------------------------------------------------------------------------------
------------------
activation_675 (Activation)     (None, 64, 64, 32)   0
batch_normalization_753[0][0]
--------------------------------------------------------------------------------
------------------
activation_683 (Activation)     (None, 32, 32, 64)   0
batch_normalization_761[0][0]
--------------------------------------------------------------------------------
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------------------
batch_normalization_769 (BatchN (None, 16, 16, 128)  512
conv2d_771[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_779 (Conv2D)             (None, 8, 8, 256)    589824
activation_698[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_756 (Conv2D)             (None, 64, 64, 32)   9216
activation_675[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_764 (Conv2D)             (None, 32, 32, 64)   36864
activation_683[0][0]
--------------------------------------------------------------------------------
------------------
activation_691 (Activation)     (None, 16, 16, 128)  0
batch_normalization_769[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_777 (BatchN (None, 8, 8, 256)    1024
conv2d_779[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_754 (BatchN (None, 64, 64, 32)   128
conv2d_756[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_762 (BatchN (None, 32, 32, 64)   256
conv2d_764[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_772 (Conv2D)             (None, 16, 16, 128)  147456
activation_691[0][0]
--------------------------------------------------------------------------------
------------------
activation_699 (Activation)     (None, 8, 8, 256)    0
batch_normalization_777[0][0]
--------------------------------------------------------------------------------
------------------
add_410 (Add)                   (None, 64, 64, 32)   0
batch_normalization_754[0][0]
activation_674[0][0]
--------------------------------------------------------------------------------
------------------
add_414 (Add)                   (None, 32, 32, 64)   0
batch_normalization_762[0][0]
```

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activation_682[0][0]
__________________________________________________________________________________
__________________
batch_normalization_770 (BatchN (None, 16, 16, 128)  512
conv2d_772[0][0]
__________________________________________________________________________________
__________________
conv2d_780 (Conv2D)             (None, 8, 8, 256)    589824
activation_699[0][0]
__________________________________________________________________________________
__________________
activation_676 (Activation)     (None, 64, 64, 32)   0           add_410[0][0]
__________________________________________________________________________________
__________________
activation_684 (Activation)     (None, 32, 32, 64)   0           add_414[0][0]
__________________________________________________________________________________
__________________
add_418 (Add)                   (None, 16, 16, 128)  0
batch_normalization_770[0][0]
activation_690[0][0]
__________________________________________________________________________________
__________________
batch_normalization_778 (BatchN (None, 8, 8, 256)    1024
conv2d_780[0][0]
__________________________________________________________________________________
__________________
conv2d_757 (Conv2D)             (None, 64, 64, 32)   9216
activation_676[0][0]
__________________________________________________________________________________
__________________
conv2d_765 (Conv2D)             (None, 32, 32, 64)   36864
activation_684[0][0]
__________________________________________________________________________________
__________________
activation_692 (Activation)     (None, 16, 16, 128)  0           add_418[0][0]
__________________________________________________________________________________
__________________
add_422 (Add)                   (None, 8, 8, 256)    0
batch_normalization_778[0][0]
activation_698[0][0]
__________________________________________________________________________________
__________________
batch_normalization_755 (BatchN (None, 64, 64, 32)   128
conv2d_757[0][0]
__________________________________________________________________________________
__________________
batch_normalization_763 (BatchN (None, 32, 32, 64)   256
conv2d_765[0][0]
```

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__________________________________________________________________________________
__________________
conv2d_773 (Conv2D)             (None, 16, 16, 128)  147456
activation_692[0][0]
__________________________________________________________________________________
__________________
activation_700 (Activation)     (None, 8, 8, 256)    0           add_422[0][0]
__________________________________________________________________________________
__________________
activation_677 (Activation)     (None, 64, 64, 32)   0
batch_normalization_755[0][0]
__________________________________________________________________________________
__________________
activation_685 (Activation)     (None, 32, 32, 64)   0
batch_normalization_763[0][0]
__________________________________________________________________________________
__________________
batch_normalization_771 (BatchN (None, 16, 16, 128)  512
conv2d_773[0][0]
__________________________________________________________________________________
__________________
conv2d_781 (Conv2D)             (None, 8, 8, 256)    589824
activation_700[0][0]
__________________________________________________________________________________
__________________
conv2d_758 (Conv2D)             (None, 64, 64, 32)   9216
activation_677[0][0]
__________________________________________________________________________________
__________________
conv2d_766 (Conv2D)             (None, 32, 32, 64)   36864
activation_685[0][0]
__________________________________________________________________________________
__________________
activation_693 (Activation)     (None, 16, 16, 128)  0
batch_normalization_771[0][0]
__________________________________________________________________________________
__________________
batch_normalization_779 (BatchN (None, 8, 8, 256)    1024
conv2d_781[0][0]
__________________________________________________________________________________
__________________
batch_normalization_756 (BatchN (None, 64, 64, 32)   128
conv2d_758[0][0]
__________________________________________________________________________________
__________________
batch_normalization_764 (BatchN (None, 32, 32, 64)   256
conv2d_766[0][0]
__________________________________________________________________________________
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__________________
conv2d_774 (Conv2D)             (None, 16, 16, 128)  147456
activation_693[0][0]

__________________________________________________________________________________
__________________
activation_701 (Activation)     (None, 8, 8, 256)    0
batch_normalization_779[0][0]

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__________________
add_411 (Add)                   (None, 64, 64, 32)   0
batch_normalization_756[0][0]
activation_676[0][0]

__________________________________________________________________________________
__________________
add_415 (Add)                   (None, 32, 32, 64)   0
batch_normalization_764[0][0]
activation_684[0][0]

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__________________
batch_normalization_772 (BatchN (None, 16, 16, 128)  512
conv2d_774[0][0]

__________________________________________________________________________________
__________________
conv2d_782 (Conv2D)             (None, 8, 8, 256)    589824
activation_701[0][0]

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__________________
activation_678 (Activation)     (None, 64, 64, 32)   0           add_411[0][0]

__________________________________________________________________________________
__________________
activation_686 (Activation)     (None, 32, 32, 64)   0           add_415[0][0]

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__________________
add_419 (Add)                   (None, 16, 16, 128)  0
batch_normalization_772[0][0]
activation_692[0][0]

__________________________________________________________________________________
__________________
batch_normalization_780 (BatchN (None, 8, 8, 256)    1024
conv2d_782[0][0]

__________________________________________________________________________________
__________________
conv2d_783 (Conv2D)             (None, 32, 32, 32)   2048
activation_686[0][0]

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__________________
activation_694 (Activation)     (None, 16, 16, 128)  0           add_419[0][0]

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__________________
add_423 (Add)                   (None, 8, 8, 256)    0
batch_normalization_780[0][0]
activation_700[0][0]
__________________________________________________________________________________
__________________
conv2d_793 (Conv2D)             (None, 32, 32, 32)   9216
activation_678[0][0]
__________________________________________________________________________________
__________________
batch_normalization_781 (BatchN (None, 32, 32, 32)   128
conv2d_783[0][0]
__________________________________________________________________________________
__________________
conv2d_784 (Conv2D)             (None, 16, 16, 32)   4096
activation_694[0][0]
__________________________________________________________________________________
__________________
activation_702 (Activation)     (None, 8, 8, 256)    0           add_423[0][0]
__________________________________________________________________________________
__________________
batch_normalization_791 (BatchN (None, 32, 32, 32)   128
conv2d_793[0][0]
__________________________________________________________________________________
__________________
up_sampling2d_73 (UpSampling2D) (None, 64, 64, 32)   0
batch_normalization_781[0][0]
__________________________________________________________________________________
__________________
batch_normalization_782 (BatchN (None, 16, 16, 32)   128
conv2d_784[0][0]
__________________________________________________________________________________
__________________
conv2d_785 (Conv2D)             (None, 8, 8, 32)     8192
activation_702[0][0]
__________________________________________________________________________________
__________________
conv2d_789 (Conv2D)             (None, 32, 32, 32)   9216
activation_678[0][0]
__________________________________________________________________________________
__________________
activation_707 (Activation)     (None, 32, 32, 32)   0
batch_normalization_791[0][0]
__________________________________________________________________________________
__________________
add_424 (Add)                   (None, 64, 64, 32)   0
activation_678[0][0]
up_sampling2d_73[0][0]
```

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__________________________________________________________________________________
__________________
up_sampling2d_74 (UpSampling2D) (None, 64, 64, 32)   0
batch_normalization_782[0][0]
__________________________________________________________________________________
__________________
batch_normalization_783 (BatchN (None, 8, 8, 32)     128
conv2d_785[0][0]
__________________________________________________________________________________
__________________
batch_normalization_787 (BatchN (None, 32, 32, 32)   128
conv2d_789[0][0]
__________________________________________________________________________________
__________________
conv2d_794 (Conv2D)             (None, 16, 16, 32)   9216
activation_707[0][0]
__________________________________________________________________________________
__________________
add_425 (Add)                   (None, 64, 64, 32)   0           add_424[0][0]
up_sampling2d_74[0][0]
__________________________________________________________________________________
__________________
up_sampling2d_75 (UpSampling2D) (None, 64, 64, 32)   0
batch_normalization_783[0][0]
__________________________________________________________________________________
__________________
activation_705 (Activation)     (None, 32, 32, 32)   0
batch_normalization_787[0][0]
__________________________________________________________________________________
__________________
batch_normalization_792 (BatchN (None, 16, 16, 32)   128
conv2d_794[0][0]
__________________________________________________________________________________
__________________
conv2d_796 (Conv2D)             (None, 16, 16, 64)   36864
activation_686[0][0]
__________________________________________________________________________________
__________________
add_426 (Add)                   (None, 64, 64, 32)   0           add_425[0][0]
up_sampling2d_75[0][0]
__________________________________________________________________________________
__________________
conv2d_786 (Conv2D)             (None, 32, 32, 64)   18432
activation_678[0][0]
__________________________________________________________________________________
__________________
conv2d_787 (Conv2D)             (None, 16, 16, 64)   8192
activation_694[0][0]
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__________________
conv2d_790 (Conv2D)             (None, 16, 16, 128)  36864
activation_705[0][0]
__________________________________________________________________________________
__________________
activation_708 (Activation)     (None, 16, 16, 32)   0
batch_normalization_792[0][0]
__________________________________________________________________________________
__________________
batch_normalization_794 (BatchN (None, 16, 16, 64)   256
conv2d_796[0][0]
__________________________________________________________________________________
__________________
activation_703 (Activation)     (None, 64, 64, 32)   0           add_426[0][0]
__________________________________________________________________________________
__________________
batch_normalization_784 (BatchN (None, 32, 32, 64)   256
conv2d_786[0][0]
__________________________________________________________________________________
__________________
batch_normalization_785 (BatchN (None, 16, 16, 64)   256
conv2d_787[0][0]
__________________________________________________________________________________
__________________
conv2d_788 (Conv2D)             (None, 8, 8, 64)     16384
activation_702[0][0]
__________________________________________________________________________________
__________________
batch_normalization_788 (BatchN (None, 16, 16, 128)  512
conv2d_790[0][0]
__________________________________________________________________________________
__________________
conv2d_791 (Conv2D)             (None, 16, 16, 128)  73728
activation_686[0][0]
__________________________________________________________________________________
__________________
conv2d_792 (Conv2D)             (None, 8, 8, 128)    32768
activation_702[0][0]
__________________________________________________________________________________
__________________
conv2d_795 (Conv2D)             (None, 8, 8, 256)    73728
activation_708[0][0]
__________________________________________________________________________________
__________________
activation_709 (Activation)     (None, 16, 16, 64)   0
batch_normalization_794[0][0]
__________________________________________________________________________________
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__________________
conv2d_799 (Conv2D)             (None, 64, 64, 32)   9216
activation_703[0][0]

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__________________
add_427 (Add)                   (None, 32, 32, 64)   0
activation_686[0][0]
batch_normalization_784[0][0]

__________________________________________________________________________________
__________________
up_sampling2d_76 (UpSampling2D) (None, 32, 32, 64)   0
batch_normalization_785[0][0]

__________________________________________________________________________________
__________________
batch_normalization_786 (BatchN (None, 8, 8, 64)     256
conv2d_788[0][0]

__________________________________________________________________________________
__________________
add_430 (Add)                   (None, 16, 16, 128)  0
activation_694[0][0]
batch_normalization_788[0][0]

__________________________________________________________________________________
__________________
batch_normalization_789 (BatchN (None, 16, 16, 128)  512
conv2d_791[0][0]

__________________________________________________________________________________
__________________
batch_normalization_790 (BatchN (None, 8, 8, 128)    512
conv2d_792[0][0]

__________________________________________________________________________________
__________________
batch_normalization_793 (BatchN (None, 8, 8, 256)    1024
conv2d_795[0][0]

__________________________________________________________________________________
__________________
conv2d_797 (Conv2D)             (None, 8, 8, 256)    147456
activation_709[0][0]

__________________________________________________________________________________
__________________
batch_normalization_797 (BatchN (None, 64, 64, 32)   128
conv2d_799[0][0]

__________________________________________________________________________________
__________________
add_428 (Add)                   (None, 32, 32, 64)   0           add_427[0][0]
up_sampling2d_76[0][0]

__________________________________________________________________________________
__________________
up_sampling2d_77 (UpSampling2D) (None, 32, 32, 64)   0
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batch_normalization_786[0][0]
__________________________________________________________________________________
__________________
add_431 (Add)                   (None, 16, 16, 128)  0           add_430[0][0]
batch_normalization_789[0][0]
__________________________________________________________________________________
__________________
up_sampling2d_78 (UpSampling2D) (None, 16, 16, 128)  0
batch_normalization_790[0][0]
__________________________________________________________________________________
__________________
add_433 (Add)                   (None, 8, 8, 256)    0
activation_702[0][0]
batch_normalization_793[0][0]
__________________________________________________________________________________
__________________
batch_normalization_795 (BatchN (None, 8, 8, 256)    1024
conv2d_797[0][0]
__________________________________________________________________________________
__________________
conv2d_798 (Conv2D)             (None, 8, 8, 256)    294912
activation_694[0][0]
__________________________________________________________________________________
__________________
activation_711 (Activation)     (None, 64, 64, 32)   0
batch_normalization_797[0][0]
__________________________________________________________________________________
__________________
add_429 (Add)                   (None, 32, 32, 64)   0           add_428[0][0]
up_sampling2d_77[0][0]
__________________________________________________________________________________
__________________
add_432 (Add)                   (None, 16, 16, 128)  0           add_431[0][0]
up_sampling2d_78[0][0]
__________________________________________________________________________________
__________________
add_434 (Add)                   (None, 8, 8, 256)    0           add_433[0][0]
batch_normalization_795[0][0]
__________________________________________________________________________________
__________________
batch_normalization_796 (BatchN (None, 8, 8, 256)    1024
conv2d_798[0][0]
__________________________________________________________________________________
__________________
conv2d_800 (Conv2D)             (None, 64, 64, 32)   9216
activation_711[0][0]
__________________________________________________________________________________
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activation_704 (Activation)     (None, 32, 32, 64)   0           add_429[0][0]
__________________________________________________________________________________________________
activation_706 (Activation)     (None, 16, 16, 128)  0           add_432[0][0]
__________________________________________________________________________________________________
add_435 (Add)                   (None, 8, 8, 256)    0           add_434[0][0]
batch_normalization_796[0][0]
__________________________________________________________________________________________________
batch_normalization_798 (BatchN (None, 64, 64, 32)   128
conv2d_800[0][0]
__________________________________________________________________________________________________
conv2d_807 (Conv2D)             (None, 32, 32, 64)   36864
activation_704[0][0]
__________________________________________________________________________________________________
conv2d_815 (Conv2D)             (None, 16, 16, 128)  147456
activation_706[0][0]
__________________________________________________________________________________________________
activation_710 (Activation)     (None, 8, 8, 256)    0           add_435[0][0]
__________________________________________________________________________________________________
add_436 (Add)                   (None, 64, 64, 32)   0
batch_normalization_798[0][0]
activation_703[0][0]
__________________________________________________________________________________________________
batch_normalization_805 (BatchN (None, 32, 32, 64)   256
conv2d_807[0][0]
__________________________________________________________________________________________________
batch_normalization_813 (BatchN (None, 16, 16, 128)  512
conv2d_815[0][0]
__________________________________________________________________________________________________
conv2d_823 (Conv2D)             (None, 8, 8, 256)    589824
activation_710[0][0]
__________________________________________________________________________________________________
activation_712 (Activation)     (None, 64, 64, 32)   0           add_436[0][0]
__________________________________________________________________________________________________
activation_719 (Activation)     (None, 32, 32, 64)   0
batch_normalization_805[0][0]
__________________________________________________________________________________________________
```

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__________________
activation_727 (Activation)     (None, 16, 16, 128)  0
batch_normalization_813[0][0]

__________________________________________________________________________________
__________________
batch_normalization_821 (BatchN (None, 8, 8, 256)    1024
conv2d_823[0][0]

__________________________________________________________________________________
__________________
conv2d_801 (Conv2D)             (None, 64, 64, 32)   9216
activation_712[0][0]

__________________________________________________________________________________
__________________
conv2d_808 (Conv2D)             (None, 32, 32, 64)   36864
activation_719[0][0]

__________________________________________________________________________________
__________________
conv2d_816 (Conv2D)             (None, 16, 16, 128)  147456
activation_727[0][0]

__________________________________________________________________________________
__________________
activation_735 (Activation)     (None, 8, 8, 256)    0
batch_normalization_821[0][0]

__________________________________________________________________________________
__________________
batch_normalization_799 (BatchN (None, 64, 64, 32)   128
conv2d_801[0][0]

__________________________________________________________________________________
__________________
batch_normalization_806 (BatchN (None, 32, 32, 64)   256
conv2d_808[0][0]

__________________________________________________________________________________
__________________
batch_normalization_814 (BatchN (None, 16, 16, 128)  512
conv2d_816[0][0]

__________________________________________________________________________________
__________________
conv2d_824 (Conv2D)             (None, 8, 8, 256)    589824
activation_735[0][0]

__________________________________________________________________________________
__________________
activation_713 (Activation)     (None, 64, 64, 32)   0
batch_normalization_799[0][0]

__________________________________________________________________________________
__________________
add_440 (Add)                   (None, 32, 32, 64)   0
batch_normalization_806[0][0]
activation_704[0][0]
```

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__________________________________________________________________________________
__________________
add_444 (Add)                   (None, 16, 16, 128)  0
batch_normalization_814[0][0]
activation_706[0][0]
__________________________________________________________________________________
__________________
batch_normalization_822 (BatchN (None, 8, 8, 256)    1024
conv2d_824[0][0]
__________________________________________________________________________________
__________________
conv2d_802 (Conv2D)             (None, 64, 64, 32)   9216
activation_713[0][0]
__________________________________________________________________________________
__________________
activation_720 (Activation)     (None, 32, 32, 64)   0           add_440[0][0]
__________________________________________________________________________________
__________________
activation_728 (Activation)     (None, 16, 16, 128)  0           add_444[0][0]
__________________________________________________________________________________
__________________
add_448 (Add)                   (None, 8, 8, 256)    0
batch_normalization_822[0][0]
activation_710[0][0]
__________________________________________________________________________________
__________________
batch_normalization_800 (BatchN (None, 64, 64, 32)   128
conv2d_802[0][0]
__________________________________________________________________________________
__________________
conv2d_809 (Conv2D)             (None, 32, 32, 64)   36864
activation_720[0][0]
__________________________________________________________________________________
__________________
conv2d_817 (Conv2D)             (None, 16, 16, 128)  147456
activation_728[0][0]
__________________________________________________________________________________
__________________
activation_736 (Activation)     (None, 8, 8, 256)    0           add_448[0][0]
__________________________________________________________________________________
__________________
add_437 (Add)                   (None, 64, 64, 32)   0
batch_normalization_800[0][0]
activation_712[0][0]
__________________________________________________________________________________
__________________
batch_normalization_807 (BatchN (None, 32, 32, 64)   256
conv2d_809[0][0]
```

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__________________________________________________________________________________
__________________
batch_normalization_815 (BatchN (None, 16, 16, 128)  512
conv2d_817[0][0]
__________________________________________________________________________________
__________________
conv2d_825 (Conv2D)             (None, 8, 8, 256)    589824
activation_736[0][0]
__________________________________________________________________________________
__________________
activation_714 (Activation)     (None, 64, 64, 32)   0           add_437[0][0]
__________________________________________________________________________________
__________________
activation_721 (Activation)     (None, 32, 32, 64)   0
batch_normalization_807[0][0]
__________________________________________________________________________________
__________________
activation_729 (Activation)     (None, 16, 16, 128)  0
batch_normalization_815[0][0]
__________________________________________________________________________________
__________________
batch_normalization_823 (BatchN (None, 8, 8, 256)    1024
conv2d_825[0][0]
__________________________________________________________________________________
__________________
conv2d_803 (Conv2D)             (None, 64, 64, 32)   9216
activation_714[0][0]
__________________________________________________________________________________
__________________
conv2d_810 (Conv2D)             (None, 32, 32, 64)   36864
activation_721[0][0]
__________________________________________________________________________________
__________________
conv2d_818 (Conv2D)             (None, 16, 16, 128)  147456
activation_729[0][0]
__________________________________________________________________________________
__________________
activation_737 (Activation)     (None, 8, 8, 256)    0
batch_normalization_823[0][0]
__________________________________________________________________________________
__________________
batch_normalization_801 (BatchN (None, 64, 64, 32)   128
conv2d_803[0][0]
__________________________________________________________________________________
__________________
batch_normalization_808 (BatchN (None, 32, 32, 64)   256
conv2d_810[0][0]
__________________________________________________________________________________
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batch_normalization_816 (BatchN (None, 16, 16, 128)  512
conv2d_818[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_826 (Conv2D)             (None, 8, 8, 256)    589824
activation_737[0][0]
--------------------------------------------------------------------------------
------------------
activation_715 (Activation)     (None, 64, 64, 32)   0
batch_normalization_801[0][0]
--------------------------------------------------------------------------------
------------------
add_441 (Add)                   (None, 32, 32, 64)   0
batch_normalization_808[0][0]
activation_720[0][0]
--------------------------------------------------------------------------------
------------------
add_445 (Add)                   (None, 16, 16, 128)  0
batch_normalization_816[0][0]
activation_728[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_824 (BatchN (None, 8, 8, 256)    1024
conv2d_826[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_804 (Conv2D)             (None, 64, 64, 32)   9216
activation_715[0][0]
--------------------------------------------------------------------------------
------------------
activation_722 (Activation)     (None, 32, 32, 64)   0           add_441[0][0]
--------------------------------------------------------------------------------
------------------
activation_730 (Activation)     (None, 16, 16, 128)  0           add_445[0][0]
--------------------------------------------------------------------------------
------------------
add_449 (Add)                   (None, 8, 8, 256)    0
batch_normalization_824[0][0]
activation_736[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_802 (BatchN (None, 64, 64, 32)   128
conv2d_804[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_811 (Conv2D)             (None, 32, 32, 64)   36864
activation_722[0][0]
```

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__________________________________________________________________________________
__________________
conv2d_819 (Conv2D)             (None, 16, 16, 128)  147456
activation_730[0][0]
__________________________________________________________________________________
__________________
activation_738 (Activation)     (None, 8, 8, 256)    0           add_449[0][0]
__________________________________________________________________________________
__________________
add_438 (Add)                   (None, 64, 64, 32)   0
batch_normalization_802[0][0]
activation_714[0][0]
__________________________________________________________________________________
__________________
batch_normalization_809 (BatchN (None, 32, 32, 64)   256
conv2d_811[0][0]
__________________________________________________________________________________
__________________
batch_normalization_817 (BatchN (None, 16, 16, 128)  512
conv2d_819[0][0]
__________________________________________________________________________________
__________________
conv2d_827 (Conv2D)             (None, 8, 8, 256)    589824
activation_738[0][0]
__________________________________________________________________________________
__________________
activation_716 (Activation)     (None, 64, 64, 32)   0           add_438[0][0]
__________________________________________________________________________________
__________________
activation_723 (Activation)     (None, 32, 32, 64)   0
batch_normalization_809[0][0]
__________________________________________________________________________________
__________________
activation_731 (Activation)     (None, 16, 16, 128)  0
batch_normalization_817[0][0]
__________________________________________________________________________________
__________________
batch_normalization_825 (BatchN (None, 8, 8, 256)    1024
conv2d_827[0][0]
__________________________________________________________________________________
__________________
conv2d_805 (Conv2D)             (None, 64, 64, 32)   9216
activation_716[0][0]
__________________________________________________________________________________
__________________
conv2d_812 (Conv2D)             (None, 32, 32, 64)   36864
activation_723[0][0]
__________________________________________________________________________________
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__________________
conv2d_820 (Conv2D)             (None, 16, 16, 128)  147456
activation_731[0][0]

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__________________
activation_739 (Activation)     (None, 8, 8, 256)    0
batch_normalization_825[0][0]

__________________________________________________________________________________
__________________
batch_normalization_803 (BatchN (None, 64, 64, 32)   128
conv2d_805[0][0]

__________________________________________________________________________________
__________________
batch_normalization_810 (BatchN (None, 32, 32, 64)   256
conv2d_812[0][0]

__________________________________________________________________________________
__________________
batch_normalization_818 (BatchN (None, 16, 16, 128)  512
conv2d_820[0][0]

__________________________________________________________________________________
__________________
conv2d_828 (Conv2D)             (None, 8, 8, 256)    589824
activation_739[0][0]

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__________________
activation_717 (Activation)     (None, 64, 64, 32)   0
batch_normalization_803[0][0]

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__________________
add_442 (Add)                   (None, 32, 32, 64)   0
batch_normalization_810[0][0]
activation_722[0][0]

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__________________
add_446 (Add)                   (None, 16, 16, 128)  0
batch_normalization_818[0][0]
activation_730[0][0]

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__________________
batch_normalization_826 (BatchN (None, 8, 8, 256)    1024
conv2d_828[0][0]

__________________________________________________________________________________
__________________
conv2d_806 (Conv2D)             (None, 64, 64, 32)   9216
activation_717[0][0]

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__________________
activation_724 (Activation)     (None, 32, 32, 64)   0           add_442[0][0]
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__________________
activation_732 (Activation)     (None, 16, 16, 128)  0           add_446[0][0]
__________________________________________________________________________________
__________________
add_450 (Add)                   (None, 8, 8, 256)    0
batch_normalization_826[0][0]
activation_738[0][0]
__________________________________________________________________________________
__________________
batch_normalization_804 (BatchN (None, 64, 64, 32)   128
conv2d_806[0][0]
__________________________________________________________________________________
__________________
conv2d_813 (Conv2D)             (None, 32, 32, 64)   36864
activation_724[0][0]
__________________________________________________________________________________
__________________
conv2d_821 (Conv2D)             (None, 16, 16, 128)  147456
activation_732[0][0]
__________________________________________________________________________________
__________________
activation_740 (Activation)     (None, 8, 8, 256)    0           add_450[0][0]
__________________________________________________________________________________
__________________
add_439 (Add)                   (None, 64, 64, 32)   0
batch_normalization_804[0][0]
activation_716[0][0]
__________________________________________________________________________________
__________________
batch_normalization_811 (BatchN (None, 32, 32, 64)   256
conv2d_813[0][0]
__________________________________________________________________________________
__________________
batch_normalization_819 (BatchN (None, 16, 16, 128)  512
conv2d_821[0][0]
__________________________________________________________________________________
__________________
conv2d_829 (Conv2D)             (None, 8, 8, 256)    589824
activation_740[0][0]
__________________________________________________________________________________
__________________
activation_718 (Activation)     (None, 64, 64, 32)   0           add_439[0][0]
__________________________________________________________________________________
__________________
activation_725 (Activation)     (None, 32, 32, 64)   0
batch_normalization_811[0][0]
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activation_733 (Activation)     (None, 16, 16, 128)  0
batch_normalization_819[0][0]

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batch_normalization_827 (BatchN (None, 8, 8, 256)    1024
conv2d_829[0][0]

------------------------------------------------------------------------------
------------------
conv2d_814 (Conv2D)             (None, 32, 32, 64)   36864
activation_725[0][0]

------------------------------------------------------------------------------
------------------
conv2d_822 (Conv2D)             (None, 16, 16, 128)  147456
activation_733[0][0]

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------------------
activation_741 (Activation)     (None, 8, 8, 256)    0
batch_normalization_827[0][0]

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conv2d_841 (Conv2D)             (None, 32, 32, 32)   9216
activation_718[0][0]

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------------------
batch_normalization_812 (BatchN (None, 32, 32, 64)   256
conv2d_814[0][0]

------------------------------------------------------------------------------
------------------
batch_normalization_820 (BatchN (None, 16, 16, 128)  512
conv2d_822[0][0]

------------------------------------------------------------------------------
------------------
conv2d_830 (Conv2D)             (None, 8, 8, 256)    589824
activation_741[0][0]

------------------------------------------------------------------------------
------------------
batch_normalization_839 (BatchN (None, 32, 32, 32)   128
conv2d_841[0][0]

------------------------------------------------------------------------------
------------------
add_443 (Add)                   (None, 32, 32, 64)   0
batch_normalization_812[0][0]
activation_724[0][0]

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------------------
add_447 (Add)                   (None, 16, 16, 128)  0
batch_normalization_820[0][0]
```

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activation_732[0][0]
__________________________________________________________________________________
__________________
batch_normalization_828 (BatchN (None, 8, 8, 256)    1024
conv2d_830[0][0]
__________________________________________________________________________________
__________________
conv2d_837 (Conv2D)             (None, 32, 32, 32)   9216
activation_718[0][0]
__________________________________________________________________________________
__________________
activation_747 (Activation)     (None, 32, 32, 32)   0
batch_normalization_839[0][0]
__________________________________________________________________________________
__________________
activation_726 (Activation)     (None, 32, 32, 64)   0           add_443[0][0]
__________________________________________________________________________________
__________________
activation_734 (Activation)     (None, 16, 16, 128)  0           add_447[0][0]
__________________________________________________________________________________
__________________
add_451 (Add)                   (None, 8, 8, 256)    0
batch_normalization_828[0][0]
activation_740[0][0]
__________________________________________________________________________________
__________________
batch_normalization_835 (BatchN (None, 32, 32, 32)   128
conv2d_837[0][0]
__________________________________________________________________________________
__________________
conv2d_842 (Conv2D)             (None, 16, 16, 32)   9216
activation_747[0][0]
__________________________________________________________________________________
__________________
activation_742 (Activation)     (None, 8, 8, 256)    0           add_451[0][0]
__________________________________________________________________________________
__________________
conv2d_834 (Conv2D)             (None, 32, 32, 64)   18432
activation_718[0][0]
__________________________________________________________________________________
__________________
conv2d_835 (Conv2D)             (None, 16, 16, 64)   8192
activation_734[0][0]
__________________________________________________________________________________
__________________
activation_745 (Activation)     (None, 32, 32, 32)   0
batch_normalization_835[0][0]
__________________________________________________________________________________
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------------------
batch_normalization_840 (BatchN (None, 16, 16, 32)   128
conv2d_842[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_844 (Conv2D)             (None, 16, 16, 64)   36864
activation_726[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_832 (BatchN (None, 32, 32, 64)   256
conv2d_834[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_833 (BatchN (None, 16, 16, 64)   256
conv2d_835[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_836 (Conv2D)             (None, 8, 8, 64)     16384
activation_742[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_838 (Conv2D)             (None, 16, 16, 128)  36864
activation_745[0][0]
--------------------------------------------------------------------------------
------------------
activation_748 (Activation)     (None, 16, 16, 32)   0
batch_normalization_840[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_842 (BatchN (None, 16, 16, 64)   256
conv2d_844[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_831 (Conv2D)             (None, 32, 32, 32)   2048
activation_726[0][0]
--------------------------------------------------------------------------------
------------------
add_455 (Add)                   (None, 32, 32, 64)   0
activation_726[0][0]
batch_normalization_832[0][0]
--------------------------------------------------------------------------------
------------------
up_sampling2d_82 (UpSampling2D) (None, 32, 32, 64)   0
batch_normalization_833[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_834 (BatchN (None, 8, 8, 64)     256
conv2d_836[0][0]
```

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__________________________________________________________________________________
__________________
batch_normalization_836 (BatchN (None, 16, 16, 128)  512
conv2d_838[0][0]
__________________________________________________________________________________
__________________
conv2d_839 (Conv2D)             (None, 16, 16, 128)  73728
activation_726[0][0]
__________________________________________________________________________________
__________________
conv2d_840 (Conv2D)             (None, 8, 8, 128)    32768
activation_742[0][0]
__________________________________________________________________________________
__________________
conv2d_843 (Conv2D)             (None, 8, 8, 256)    73728
activation_748[0][0]
__________________________________________________________________________________
__________________
activation_749 (Activation)     (None, 16, 16, 64)   0
batch_normalization_842[0][0]
__________________________________________________________________________________
__________________
batch_normalization_829 (BatchN (None, 32, 32, 32)   128
conv2d_831[0][0]
__________________________________________________________________________________
__________________
conv2d_832 (Conv2D)             (None, 16, 16, 32)   4096
activation_734[0][0]
__________________________________________________________________________________
__________________
add_456 (Add)                   (None, 32, 32, 64)   0           add_455[0][0]
up_sampling2d_82[0][0]
__________________________________________________________________________________
__________________
up_sampling2d_83 (UpSampling2D) (None, 32, 32, 64)   0
batch_normalization_834[0][0]
__________________________________________________________________________________
__________________
add_458 (Add)                   (None, 16, 16, 128)  0
activation_734[0][0]
batch_normalization_836[0][0]
__________________________________________________________________________________
__________________
batch_normalization_837 (BatchN (None, 16, 16, 128)  512
conv2d_839[0][0]
__________________________________________________________________________________
__________________
batch_normalization_838 (BatchN (None, 8, 8, 128)    512
```

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conv2d_840[0][0]
__________________________________________________________________________________
__________________
batch_normalization_841 (BatchN (None, 8, 8, 256)    1024
conv2d_843[0][0]
__________________________________________________________________________________
__________________
conv2d_845 (Conv2D)             (None, 8, 8, 256)    147456
activation_749[0][0]
__________________________________________________________________________________
__________________
up_sampling2d_79 (UpSampling2D) (None, 64, 64, 32)   0
batch_normalization_829[0][0]
__________________________________________________________________________________
__________________
batch_normalization_830 (BatchN (None, 16, 16, 32)   128
conv2d_832[0][0]
__________________________________________________________________________________
__________________
conv2d_833 (Conv2D)             (None, 8, 8, 32)     8192
activation_742[0][0]
__________________________________________________________________________________
__________________
add_457 (Add)                   (None, 32, 32, 64)   0           add_456[0][0]
up_sampling2d_83[0][0]
__________________________________________________________________________________
__________________
add_459 (Add)                   (None, 16, 16, 128)  0           add_458[0][0]
batch_normalization_837[0][0]
__________________________________________________________________________________
__________________
up_sampling2d_84 (UpSampling2D) (None, 16, 16, 128)  0
batch_normalization_838[0][0]
__________________________________________________________________________________
__________________
add_461 (Add)                   (None, 8, 8, 256)    0
activation_742[0][0]
batch_normalization_841[0][0]
__________________________________________________________________________________
__________________
batch_normalization_843 (BatchN (None, 8, 8, 256)    1024
conv2d_845[0][0]
__________________________________________________________________________________
__________________
conv2d_846 (Conv2D)             (None, 8, 8, 256)    294912
activation_734[0][0]
__________________________________________________________________________________
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```
add_452 (Add)                   (None, 64, 64, 32)   0
activation_718[0][0]
up_sampling2d_79[0][0]
__________________________________________________________________________________
__________________
up_sampling2d_80 (UpSampling2D) (None, 64, 64, 32)   0
batch_normalization_830[0][0]
__________________________________________________________________________________
__________________
batch_normalization_831 (BatchN (None, 8, 8, 32)     128
conv2d_833[0][0]
__________________________________________________________________________________
__________________
activation_744 (Activation)     (None, 32, 32, 64)   0           add_457[0][0]
__________________________________________________________________________________
__________________
add_460 (Add)                   (None, 16, 16, 128)  0           add_459[0][0]
up_sampling2d_84[0][0]
__________________________________________________________________________________
__________________
add_462 (Add)                   (None, 8, 8, 256)    0           add_461[0][0]
batch_normalization_843[0][0]
__________________________________________________________________________________
__________________
batch_normalization_844 (BatchN (None, 8, 8, 256)    1024
conv2d_846[0][0]
__________________________________________________________________________________
__________________
add_453 (Add)                   (None, 64, 64, 32)   0           add_452[0][0]
up_sampling2d_80[0][0]
__________________________________________________________________________________
__________________
up_sampling2d_81 (UpSampling2D) (None, 64, 64, 32)   0
batch_normalization_831[0][0]
__________________________________________________________________________________
__________________
conv2d_855 (Conv2D)             (None, 32, 32, 64)   36864
activation_744[0][0]
__________________________________________________________________________________
__________________
activation_746 (Activation)     (None, 16, 16, 128)  0           add_460[0][0]
__________________________________________________________________________________
__________________
add_463 (Add)                   (None, 8, 8, 256)    0           add_462[0][0]
batch_normalization_844[0][0]
__________________________________________________________________________________
__________________
add_454 (Add)                   (None, 64, 64, 32)   0           add_453[0][0]
```

```
up_sampling2d_81[0][0]
__________________________________________________________________________________
__________________
batch_normalization_853 (BatchN (None, 32, 32, 64)   256
conv2d_855[0][0]
__________________________________________________________________________________
__________________
conv2d_863 (Conv2D)             (None, 16, 16, 128)  147456
activation_746[0][0]
__________________________________________________________________________________
__________________
activation_750 (Activation)     (None, 8, 8, 256)    0           add_463[0][0]
__________________________________________________________________________________
__________________
activation_743 (Activation)     (None, 64, 64, 32)   0           add_454[0][0]
__________________________________________________________________________________
__________________
activation_759 (Activation)     (None, 32, 32, 64)   0
batch_normalization_853[0][0]
__________________________________________________________________________________
__________________
batch_normalization_861 (BatchN (None, 16, 16, 128)  512
conv2d_863[0][0]
__________________________________________________________________________________
__________________
conv2d_871 (Conv2D)             (None, 8, 8, 256)    589824
activation_750[0][0]
__________________________________________________________________________________
__________________
conv2d_847 (Conv2D)             (None, 64, 64, 32)   9216
activation_743[0][0]
__________________________________________________________________________________
__________________
conv2d_856 (Conv2D)             (None, 32, 32, 64)   36864
activation_759[0][0]
__________________________________________________________________________________
__________________
activation_767 (Activation)     (None, 16, 16, 128)  0
batch_normalization_861[0][0]
__________________________________________________________________________________
__________________
batch_normalization_869 (BatchN (None, 8, 8, 256)    1024
conv2d_871[0][0]
__________________________________________________________________________________
__________________
batch_normalization_845 (BatchN (None, 64, 64, 32)   128
conv2d_847[0][0]
__________________________________________________________________________________
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------------------
batch_normalization_854 (BatchN (None, 32, 32, 64)   256
conv2d_856[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_864 (Conv2D)             (None, 16, 16, 128)  147456
activation_767[0][0]
--------------------------------------------------------------------------------
------------------
activation_775 (Activation)     (None, 8, 8, 256)    0
batch_normalization_869[0][0]
--------------------------------------------------------------------------------
------------------
activation_751 (Activation)     (None, 64, 64, 32)   0
batch_normalization_845[0][0]
--------------------------------------------------------------------------------
------------------
add_468 (Add)                   (None, 32, 32, 64)   0
batch_normalization_854[0][0]
activation_744[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_862 (BatchN (None, 16, 16, 128)  512
conv2d_864[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_872 (Conv2D)             (None, 8, 8, 256)    589824
activation_775[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_848 (Conv2D)             (None, 64, 64, 32)   9216
activation_751[0][0]
--------------------------------------------------------------------------------
------------------
activation_760 (Activation)     (None, 32, 32, 64)   0           add_468[0][0]
--------------------------------------------------------------------------------
------------------
add_472 (Add)                   (None, 16, 16, 128)  0
batch_normalization_862[0][0]
activation_746[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_870 (BatchN (None, 8, 8, 256)    1024
conv2d_872[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_846 (BatchN (None, 64, 64, 32)   128
conv2d_848[0][0]
```

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__________________________________________________________________________________
__________________
conv2d_857 (Conv2D)             (None, 32, 32, 64)   36864
activation_760[0][0]
__________________________________________________________________________________
__________________
activation_768 (Activation)     (None, 16, 16, 128)  0           add_472[0][0]
__________________________________________________________________________________
__________________
add_476 (Add)                   (None, 8, 8, 256)    0
batch_normalization_870[0][0]
activation_750[0][0]
__________________________________________________________________________________
__________________
add_464 (Add)                   (None, 64, 64, 32)   0
batch_normalization_846[0][0]
activation_743[0][0]
__________________________________________________________________________________
__________________
batch_normalization_855 (BatchN (None, 32, 32, 64)   256
conv2d_857[0][0]
__________________________________________________________________________________
__________________
conv2d_865 (Conv2D)             (None, 16, 16, 128)  147456
activation_768[0][0]
__________________________________________________________________________________
__________________
activation_776 (Activation)     (None, 8, 8, 256)    0           add_476[0][0]
__________________________________________________________________________________
__________________
activation_752 (Activation)     (None, 64, 64, 32)   0           add_464[0][0]
__________________________________________________________________________________
__________________
activation_761 (Activation)     (None, 32, 32, 64)   0
batch_normalization_855[0][0]
__________________________________________________________________________________
__________________
batch_normalization_863 (BatchN (None, 16, 16, 128)  512
conv2d_865[0][0]
__________________________________________________________________________________
__________________
conv2d_873 (Conv2D)             (None, 8, 8, 256)    589824
activation_776[0][0]
__________________________________________________________________________________
__________________
conv2d_849 (Conv2D)             (None, 64, 64, 32)   9216
activation_752[0][0]
__________________________________________________________________________________
```

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------------------
conv2d_858 (Conv2D)             (None, 32, 32, 64)   36864
activation_761[0][0]

------------------------------------------------------------------------------
------------------
activation_769 (Activation)     (None, 16, 16, 128)  0
batch_normalization_863[0][0]

------------------------------------------------------------------------------
------------------
batch_normalization_871 (BatchN (None, 8, 8, 256)    1024
conv2d_873[0][0]

------------------------------------------------------------------------------
------------------
batch_normalization_847 (BatchN (None, 64, 64, 32)   128
conv2d_849[0][0]

------------------------------------------------------------------------------
------------------
batch_normalization_856 (BatchN (None, 32, 32, 64)   256
conv2d_858[0][0]

------------------------------------------------------------------------------
------------------
conv2d_866 (Conv2D)             (None, 16, 16, 128)  147456
activation_769[0][0]

------------------------------------------------------------------------------
------------------
activation_777 (Activation)     (None, 8, 8, 256)    0
batch_normalization_871[0][0]

------------------------------------------------------------------------------
------------------
activation_753 (Activation)     (None, 64, 64, 32)   0
batch_normalization_847[0][0]

------------------------------------------------------------------------------
------------------
add_469 (Add)                   (None, 32, 32, 64)   0
batch_normalization_856[0][0]
activation_760[0][0]

------------------------------------------------------------------------------
------------------
batch_normalization_864 (BatchN (None, 16, 16, 128)  512
conv2d_866[0][0]

------------------------------------------------------------------------------
------------------
conv2d_874 (Conv2D)             (None, 8, 8, 256)    589824
activation_777[0][0]

------------------------------------------------------------------------------
------------------
conv2d_850 (Conv2D)             (None, 64, 64, 32)   9216
activation_753[0][0]
```

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__________________________________________________________________________________
__________________
activation_762 (Activation)     (None, 32, 32, 64)   0           add_469[0][0]
__________________________________________________________________________________
__________________
add_473 (Add)                   (None, 16, 16, 128)  0
batch_normalization_864[0][0]
activation_768[0][0]
__________________________________________________________________________________
__________________
batch_normalization_872 (BatchN (None, 8, 8, 256)    1024
conv2d_874[0][0]
__________________________________________________________________________________
__________________
batch_normalization_848 (BatchN (None, 64, 64, 32)   128
conv2d_850[0][0]
__________________________________________________________________________________
__________________
conv2d_859 (Conv2D)             (None, 32, 32, 64)   36864
activation_762[0][0]
__________________________________________________________________________________
__________________
activation_770 (Activation)     (None, 16, 16, 128)  0           add_473[0][0]
__________________________________________________________________________________
__________________
add_477 (Add)                   (None, 8, 8, 256)    0
batch_normalization_872[0][0]
activation_776[0][0]
__________________________________________________________________________________
__________________
add_465 (Add)                   (None, 64, 64, 32)   0
batch_normalization_848[0][0]
activation_752[0][0]
__________________________________________________________________________________
__________________
batch_normalization_857 (BatchN (None, 32, 32, 64)   256
conv2d_859[0][0]
__________________________________________________________________________________
__________________
conv2d_867 (Conv2D)             (None, 16, 16, 128)  147456
activation_770[0][0]
__________________________________________________________________________________
__________________
activation_778 (Activation)     (None, 8, 8, 256)    0           add_477[0][0]
__________________________________________________________________________________
__________________
activation_754 (Activation)     (None, 64, 64, 32)   0           add_465[0][0]
__________________________________________________________________________________
```

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------------------
activation_763 (Activation)     (None, 32, 32, 64)   0
batch_normalization_857[0][0]
------------------------------------------------------------------------------
------------------
batch_normalization_865 (BatchN (None, 16, 16, 128)  512
conv2d_867[0][0]
------------------------------------------------------------------------------
------------------
conv2d_875 (Conv2D)             (None, 8, 8, 256)    589824
activation_778[0][0]
------------------------------------------------------------------------------
------------------
conv2d_851 (Conv2D)             (None, 64, 64, 32)   9216
activation_754[0][0]
------------------------------------------------------------------------------
------------------
conv2d_860 (Conv2D)             (None, 32, 32, 64)   36864
activation_763[0][0]
------------------------------------------------------------------------------
------------------
activation_771 (Activation)     (None, 16, 16, 128)  0
batch_normalization_865[0][0]
------------------------------------------------------------------------------
------------------
batch_normalization_873 (BatchN (None, 8, 8, 256)    1024
conv2d_875[0][0]
------------------------------------------------------------------------------
------------------
batch_normalization_849 (BatchN (None, 64, 64, 32)   128
conv2d_851[0][0]
------------------------------------------------------------------------------
------------------
batch_normalization_858 (BatchN (None, 32, 32, 64)   256
conv2d_860[0][0]
------------------------------------------------------------------------------
------------------
conv2d_868 (Conv2D)             (None, 16, 16, 128)  147456
activation_771[0][0]
------------------------------------------------------------------------------
------------------
activation_779 (Activation)     (None, 8, 8, 256)    0
batch_normalization_873[0][0]
------------------------------------------------------------------------------
------------------
activation_755 (Activation)     (None, 64, 64, 32)   0
batch_normalization_849[0][0]
------------------------------------------------------------------------------
```

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------------------
add_470 (Add)                   (None, 32, 32, 64)   0
batch_normalization_858[0][0]
activation_762[0][0]
------------------------------------------------------------------------------
------------------
batch_normalization_866 (BatchN (None, 16, 16, 128)  512
conv2d_868[0][0]
------------------------------------------------------------------------------
------------------
conv2d_876 (Conv2D)             (None, 8, 8, 256)    589824
activation_779[0][0]
------------------------------------------------------------------------------
------------------
conv2d_852 (Conv2D)             (None, 64, 64, 32)   9216
activation_755[0][0]
------------------------------------------------------------------------------
------------------
activation_764 (Activation)     (None, 32, 32, 64)   0           add_470[0][0]
------------------------------------------------------------------------------
------------------
add_474 (Add)                   (None, 16, 16, 128)  0
batch_normalization_866[0][0]
activation_770[0][0]
------------------------------------------------------------------------------
------------------
batch_normalization_874 (BatchN (None, 8, 8, 256)    1024
conv2d_876[0][0]
------------------------------------------------------------------------------
------------------
batch_normalization_850 (BatchN (None, 64, 64, 32)   128
conv2d_852[0][0]
------------------------------------------------------------------------------
------------------
conv2d_861 (Conv2D)             (None, 32, 32, 64)   36864
activation_764[0][0]
------------------------------------------------------------------------------
------------------
activation_772 (Activation)     (None, 16, 16, 128)  0           add_474[0][0]
------------------------------------------------------------------------------
------------------
add_478 (Add)                   (None, 8, 8, 256)    0
batch_normalization_874[0][0]
activation_778[0][0]
------------------------------------------------------------------------------
------------------
add_466 (Add)                   (None, 64, 64, 32)   0
batch_normalization_850[0][0]
```

```
activation_754[0][0]
__________________________________________________________________________________
__________________
batch_normalization_859 (BatchN (None, 32, 32, 64)   256
conv2d_861[0][0]
__________________________________________________________________________________
__________________
conv2d_869 (Conv2D)             (None, 16, 16, 128)  147456
activation_772[0][0]
__________________________________________________________________________________
__________________
activation_780 (Activation)     (None, 8, 8, 256)    0           add_478[0][0]
__________________________________________________________________________________
__________________
activation_756 (Activation)     (None, 64, 64, 32)   0           add_466[0][0]
__________________________________________________________________________________
__________________
activation_765 (Activation)     (None, 32, 32, 64)   0
batch_normalization_859[0][0]
__________________________________________________________________________________
__________________
batch_normalization_867 (BatchN (None, 16, 16, 128)  512
conv2d_869[0][0]
__________________________________________________________________________________
__________________
conv2d_877 (Conv2D)             (None, 8, 8, 256)    589824
activation_780[0][0]
__________________________________________________________________________________
__________________
conv2d_853 (Conv2D)             (None, 64, 64, 32)   9216
activation_756[0][0]
__________________________________________________________________________________
__________________
conv2d_862 (Conv2D)             (None, 32, 32, 64)   36864
activation_765[0][0]
__________________________________________________________________________________
__________________
activation_773 (Activation)     (None, 16, 16, 128)  0
batch_normalization_867[0][0]
__________________________________________________________________________________
__________________
batch_normalization_875 (BatchN (None, 8, 8, 256)    1024
conv2d_877[0][0]
__________________________________________________________________________________
__________________
batch_normalization_851 (BatchN (None, 64, 64, 32)   128
conv2d_853[0][0]
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------------------
batch_normalization_860 (BatchN (None, 32, 32, 64)   256
conv2d_862[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_870 (Conv2D)             (None, 16, 16, 128)  147456
activation_773[0][0]
--------------------------------------------------------------------------------
------------------
activation_781 (Activation)     (None, 8, 8, 256)    0
batch_normalization_875[0][0]
--------------------------------------------------------------------------------
------------------
activation_757 (Activation)     (None, 64, 64, 32)   0
batch_normalization_851[0][0]
--------------------------------------------------------------------------------
------------------
add_471 (Add)                   (None, 32, 32, 64)   0
batch_normalization_860[0][0]
activation_764[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_868 (BatchN (None, 16, 16, 128)  512
conv2d_870[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_878 (Conv2D)             (None, 8, 8, 256)    589824
activation_781[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_854 (Conv2D)             (None, 64, 64, 32)   9216
activation_757[0][0]
--------------------------------------------------------------------------------
------------------
activation_766 (Activation)     (None, 32, 32, 64)   0           add_471[0][0]
--------------------------------------------------------------------------------
------------------
add_475 (Add)                   (None, 16, 16, 128)  0
batch_normalization_868[0][0]
activation_772[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_876 (BatchN (None, 8, 8, 256)    1024
conv2d_878[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_852 (BatchN (None, 64, 64, 32)   128
conv2d_854[0][0]
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__________________________________________________________________________________
__________________
conv2d_879 (Conv2D)             (None, 32, 32, 32)   2048
activation_766[0][0]
__________________________________________________________________________________
__________________
activation_774 (Activation)     (None, 16, 16, 128)  0           add_475[0][0]
__________________________________________________________________________________
__________________
add_479 (Add)                   (None, 8, 8, 256)    0
batch_normalization_876[0][0]
activation_780[0][0]
__________________________________________________________________________________
__________________
add_467 (Add)                   (None, 64, 64, 32)   0
batch_normalization_852[0][0]
activation_756[0][0]
__________________________________________________________________________________
__________________
batch_normalization_877 (BatchN (None, 32, 32, 32)   128
conv2d_879[0][0]
__________________________________________________________________________________
__________________
conv2d_880 (Conv2D)             (None, 16, 16, 32)   4096
activation_774[0][0]
__________________________________________________________________________________
__________________
activation_782 (Activation)     (None, 8, 8, 256)    0           add_479[0][0]
__________________________________________________________________________________
__________________
activation_758 (Activation)     (None, 64, 64, 32)   0           add_467[0][0]
__________________________________________________________________________________
__________________
up_sampling2d_85 (UpSampling2D) (None, 64, 64, 32)   0
batch_normalization_877[0][0]
__________________________________________________________________________________
__________________
batch_normalization_878 (BatchN (None, 16, 16, 32)   128
conv2d_880[0][0]
__________________________________________________________________________________
__________________
conv2d_881 (Conv2D)             (None, 8, 8, 32)     8192
activation_782[0][0]
__________________________________________________________________________________
__________________
add_480 (Add)                   (None, 64, 64, 32)   0
activation_758[0][0]
up_sampling2d_85[0][0]
```

```
__________________________________________________________________________________
__________________
up_sampling2d_86 (UpSampling2D) (None, 64, 64, 32)   0
batch_normalization_878[0][0]
__________________________________________________________________________________
__________________
batch_normalization_879 (BatchN (None, 8, 8, 32)     128
conv2d_881[0][0]
__________________________________________________________________________________
__________________
add_481 (Add)                   (None, 64, 64, 32)   0           add_480[0][0]
up_sampling2d_86[0][0]
__________________________________________________________________________________
__________________
up_sampling2d_87 (UpSampling2D) (None, 64, 64, 32)   0
batch_normalization_879[0][0]
__________________________________________________________________________________
__________________
add_482 (Add)                   (None, 64, 64, 32)   0           add_481[0][0]
up_sampling2d_87[0][0]
__________________________________________________________________________________
__________________
activation_783 (Activation)     (None, 64, 64, 32)   0           add_482[0][0]
__________________________________________________________________________________
__________________
up_sampling2d_88 (UpSampling2D) (None, 128, 128, 32) 0
activation_783[0][0]
__________________________________________________________________________________
__________________
conv2d_882 (Conv2D)             (None, 128, 128, 32) 9216
up_sampling2d_88[0][0]
__________________________________________________________________________________
__________________
batch_normalization_880 (BatchN (None, 128, 128, 32) 128
conv2d_882[0][0]
__________________________________________________________________________________
__________________
activation_784 (Activation)     (None, 128, 128, 32) 0
batch_normalization_880[0][0]
__________________________________________________________________________________
__________________
up_sampling2d_89 (UpSampling2D) (None, 256, 256, 32) 0
activation_784[0][0]
__________________________________________________________________________________
__________________
conv2d_883 (Conv2D)             (None, 256, 256, 32) 9216
up_sampling2d_89[0][0]
__________________________________________________________________________________
```

```
------------------
batch_normalization_881 (BatchN (None, 256, 256, 32) 128
conv2d_883[0][0]

------------------------------------------------------------------------------
------------------
activation_785 (Activation)     (None, 256, 256, 32) 0
batch_normalization_881[0][0]

------------------------------------------------------------------------------
------------------
conv2d_884 (Conv2D)             (None, 256, 256, 1)  32
activation_785[0][0]
==============================================================================
==================
Total params: 28,608,608
Trainable params: 28,554,144
Non-trainable params: 54,464

------------------------------------------------------------------------------
------------------
```

[58]:
```
mean_iou = MeanIoU(2, 0.4)

model.compile(optimizer='adam', loss='binary_crossentropy', metrics=[mean_iou])
```

6.3 Callbacks

[59]:
```
!rm -rf ./model_save/
```

[60]:
```
# Modelcheckpoint callback
if not os.path.exists('model_save'):
    os.makedirs('model_save')
filepath="model_save/weights-{epoch:04d}.hdf5"
checkpoint = tf.keras.callbacks.ModelCheckpoint(filepath=filepath,
                                        save_best_only=True,
                                        mode='auto',
                                        monitor='val_loss')
```

[61]:
```
!rm -rf ./model/
```

[62]:
```
# Tensorboard Callback
log_dir = os.path.join("model", datetime.datetime.now().
 ↪strftime("%Y%m%d-%H%M%S"))
tensorboard_callback = tf.keras.callbacks.TensorBoard(log_dir=log_dir,
                                                      histogram_freq=1,
                                                      write_graph=True)
```

6.4 Training

[63]:
```
callbacks_list = [checkpoint, tensorboard_callback]
history = model.fit(train_ds,
                    initial_epoch = 0,
                    epochs=30,
                    callbacks=callbacks_list,
                    validation_data=val_ds)
```

```
Epoch 1/30
76/76 [==============================] - 55s 398ms/step - loss: 0.3061 -
mean_iou: 0.6544 - val_loss: 2.6546 - val_mean_iou: 0.6599
Epoch 2/30
76/76 [==============================] - 23s 298ms/step - loss: 0.1733 -
mean_iou: 0.7930 - val_loss: 3.1867 - val_mean_iou: 0.7570
Epoch 3/30
76/76 [==============================] - 22s 291ms/step - loss: 0.1224 -
mean_iou: 0.8435 - val_loss: 0.7679 - val_mean_iou: 0.2655
Epoch 4/30
76/76 [==============================] - 22s 291ms/step - loss: 0.1087 -
mean_iou: 0.8517 - val_loss: 0.6303 - val_mean_iou: 0.7287
Epoch 5/30
76/76 [==============================] - 22s 290ms/step - loss: 0.1011 -
mean_iou: 0.8555 - val_loss: 0.1152 - val_mean_iou: 0.8424
Epoch 6/30
76/76 [==============================] - 22s 294ms/step - loss: 0.0919 -
mean_iou: 0.8672 - val_loss: 0.1221 - val_mean_iou: 0.8189
Epoch 7/30
76/76 [==============================] - 22s 288ms/step - loss: 0.0851 -
mean_iou: 0.8772 - val_loss: 0.0942 - val_mean_iou: 0.8850
Epoch 8/30
76/76 [==============================] - 22s 293ms/step - loss: 0.0798 -
mean_iou: 0.8831 - val_loss: 0.1510 - val_mean_iou: 0.8596
Epoch 9/30
76/76 [==============================] - 23s 299ms/step - loss: 0.0759 -
mean_iou: 0.8868 - val_loss: 0.5305 - val_mean_iou: 0.6982
Epoch 10/30
76/76 [==============================] - 23s 295ms/step - loss: 0.0766 -
mean_iou: 0.8851 - val_loss: 0.0911 - val_mean_iou: 0.8752
Epoch 11/30
76/76 [==============================] - 22s 287ms/step - loss: 0.0740 -
mean_iou: 0.8889 - val_loss: 4.0136 - val_mean_iou: 0.5084
Epoch 12/30
76/76 [==============================] - 22s 293ms/step - loss: 0.0698 -
mean_iou: 0.8933 - val_loss: 0.4382 - val_mean_iou: 0.7836
Epoch 13/30
76/76 [==============================] - 22s 294ms/step - loss: 0.0695 -
mean_iou: 0.8937 - val_loss: 0.0748 - val_mean_iou: 0.8893
```

```
Epoch 14/30
76/76 [==============================] - 22s 291ms/step - loss: 0.0693 -
mean_iou: 0.8924 - val_loss: 0.0771 - val_mean_iou: 0.8951
Epoch 15/30
76/76 [==============================] - 22s 289ms/step - loss: 0.0734 -
mean_iou: 0.8884 - val_loss: 0.5585 - val_mean_iou: 0.7932
Epoch 16/30
76/76 [==============================] - 22s 293ms/step - loss: 0.0691 -
mean_iou: 0.8945 - val_loss: 0.1398 - val_mean_iou: 0.8390
Epoch 17/30
76/76 [==============================] - 22s 293ms/step - loss: 0.0696 -
mean_iou: 0.8929 - val_loss: 0.1735 - val_mean_iou: 0.8172
Epoch 18/30
76/76 [==============================] - 22s 293ms/step - loss: 0.0685 -
mean_iou: 0.8943 - val_loss: 0.1042 - val_mean_iou: 0.8703
Epoch 19/30
76/76 [==============================] - 22s 291ms/step - loss: 0.0632 -
mean_iou: 0.9003 - val_loss: 0.1549 - val_mean_iou: 0.8508
Epoch 20/30
76/76 [==============================] - 23s 296ms/step - loss: 0.0606 -
mean_iou: 0.9043 - val_loss: 0.2205 - val_mean_iou: 0.7688
Epoch 21/30
76/76 [==============================] - 23s 295ms/step - loss: 0.0623 -
mean_iou: 0.9010 - val_loss: 0.0738 - val_mean_iou: 0.8933
Epoch 22/30
76/76 [==============================] - 23s 297ms/step - loss: 0.0609 -
mean_iou: 0.9029 - val_loss: 0.0965 - val_mean_iou: 0.8540
Epoch 23/30
76/76 [==============================] - 22s 291ms/step - loss: 0.0595 -
mean_iou: 0.9048 - val_loss: 0.1178 - val_mean_iou: 0.8473
Epoch 24/30
76/76 [==============================] - 22s 292ms/step - loss: 0.0575 -
mean_iou: 0.9070 - val_loss: 0.0719 - val_mean_iou: 0.8822
Epoch 25/30
76/76 [==============================] - 23s 295ms/step - loss: 0.0589 -
mean_iou: 0.9065 - val_loss: 0.0774 - val_mean_iou: 0.8812
Epoch 26/30
76/76 [==============================] - 22s 294ms/step - loss: 0.0561 -
mean_iou: 0.9092 - val_loss: 0.0644 - val_mean_iou: 0.9034
Epoch 27/30
76/76 [==============================] - 23s 298ms/step - loss: 0.0569 -
mean_iou: 0.9077 - val_loss: 0.1343 - val_mean_iou: 0.7942
Epoch 28/30
76/76 [==============================] - 22s 289ms/step - loss: 0.0546 -
mean_iou: 0.9112 - val_loss: 0.1397 - val_mean_iou: 0.8083
Epoch 29/30
76/76 [==============================] - 22s 292ms/step - loss: 0.0527 -
mean_iou: 0.9144 - val_loss: 0.0667 - val_mean_iou: 0.8983
```

```
Epoch 30/30
76/76 [==============================] - 22s 288ms/step - loss: 0.0505 -
mean_iou: 0.9166 - val_loss: 0.0676 - val_mean_iou: 0.8950
```

[64]:
```
initial_epoch = int(sorted(os.listdir('model_save'))[-1].split('.')[0].
 ↪split('-')[-1])
history = model.fit(train_ds,
                    initial_epoch = initial_epoch,
                    epochs=60,
                    callbacks=callbacks_list,
                    validation_data=val_ds)
```

```
Epoch 27/60
76/76 [==============================] - 25s 332ms/step - loss: 0.0502 -
mean_iou: 0.9171 - val_loss: 0.0608 - val_mean_iou: 0.9077
Epoch 28/60
76/76 [==============================] - 22s 291ms/step - loss: 0.0475 -
mean_iou: 0.9212 - val_loss: 0.0717 - val_mean_iou: 0.8994
Epoch 29/60
76/76 [==============================] - 22s 289ms/step - loss: 0.0486 -
mean_iou: 0.9207 - val_loss: 0.0635 - val_mean_iou: 0.9059
Epoch 30/60
76/76 [==============================] - 22s 294ms/step - loss: 0.0469 -
mean_iou: 0.9227 - val_loss: 0.0811 - val_mean_iou: 0.8719
Epoch 31/60
76/76 [==============================] - 23s 298ms/step - loss: 0.0470 -
mean_iou: 0.9220 - val_loss: 0.1497 - val_mean_iou: 0.8395
Epoch 32/60
76/76 [==============================] - 22s 287ms/step - loss: 0.0470 -
mean_iou: 0.9220 - val_loss: 0.1512 - val_mean_iou: 0.8349
Epoch 33/60
76/76 [==============================] - 22s 293ms/step - loss: 0.0459 -
mean_iou: 0.9233 - val_loss: 0.0735 - val_mean_iou: 0.8900
Epoch 34/60
76/76 [==============================] - 22s 294ms/step - loss: 0.0460 -
mean_iou: 0.9235 - val_loss: 0.0694 - val_mean_iou: 0.8977
Epoch 35/60
76/76 [==============================] - 23s 299ms/step - loss: 0.0455 -
mean_iou: 0.9245 - val_loss: 0.0637 - val_mean_iou: 0.9020
Epoch 36/60
76/76 [==============================] - 22s 285ms/step - loss: 0.0431 -
mean_iou: 0.9281 - val_loss: 0.1270 - val_mean_iou: 0.8275
Epoch 37/60
76/76 [==============================] - 23s 300ms/step - loss: 0.0425 -
mean_iou: 0.9285 - val_loss: 0.1428 - val_mean_iou: 0.8398
Epoch 38/60
76/76 [==============================] - 22s 288ms/step - loss: 0.0420 -
mean_iou: 0.9293 - val_loss: 0.0851 - val_mean_iou: 0.8753
```

```
Epoch 39/60
76/76 [==============================] - 22s 290ms/step - loss: 0.0428 -
mean_iou: 0.9282 - val_loss: 0.0729 - val_mean_iou: 0.8883
Epoch 40/60
76/76 [==============================] - 22s 292ms/step - loss: 0.0396 -
mean_iou: 0.9334 - val_loss: 0.3640 - val_mean_iou: 0.8195
Epoch 41/60
76/76 [==============================] - 23s 298ms/step - loss: 0.0400 -
mean_iou: 0.9328 - val_loss: 0.0736 - val_mean_iou: 0.8980
Epoch 42/60
76/76 [==============================] - 22s 288ms/step - loss: 0.0377 -
mean_iou: 0.9361 - val_loss: 0.0842 - val_mean_iou: 0.8792
Epoch 43/60
76/76 [==============================] - 22s 290ms/step - loss: 0.0381 -
mean_iou: 0.9353 - val_loss: 0.0761 - val_mean_iou: 0.8862
Epoch 44/60
76/76 [==============================] - 22s 294ms/step - loss: 0.0382 -
mean_iou: 0.9352 - val_loss: 0.0679 - val_mean_iou: 0.8988
Epoch 45/60
76/76 [==============================] - 23s 298ms/step - loss: 0.0357 -
mean_iou: 0.9390 - val_loss: 0.0696 - val_mean_iou: 0.9040
Epoch 46/60
76/76 [==============================] - 22s 290ms/step - loss: 0.0343 -
mean_iou: 0.9412 - val_loss: 0.0710 - val_mean_iou: 0.9025
Epoch 47/60
76/76 [==============================] - 22s 284ms/step - loss: 0.0337 -
mean_iou: 0.9422 - val_loss: 0.0715 - val_mean_iou: 0.9087
Epoch 48/60
76/76 [==============================] - 23s 298ms/step - loss: 0.0327 -
mean_iou: 0.9435 - val_loss: 0.1064 - val_mean_iou: 0.8439
Epoch 49/60
76/76 [==============================] - 22s 285ms/step - loss: 0.0321 -
mean_iou: 0.9446 - val_loss: 0.0880 - val_mean_iou: 0.8877
Epoch 50/60
76/76 [==============================] - 23s 300ms/step - loss: 0.0325 -
mean_iou: 0.9439 - val_loss: 0.0720 - val_mean_iou: 0.8954
Epoch 51/60
76/76 [==============================] - 22s 289ms/step - loss: 0.0321 -
mean_iou: 0.9446 - val_loss: 0.0750 - val_mean_iou: 0.8976
Epoch 52/60
76/76 [==============================] - 23s 298ms/step - loss: 0.0312 -
mean_iou: 0.9461 - val_loss: 0.0695 - val_mean_iou: 0.9077
Epoch 53/60
76/76 [==============================] - 22s 289ms/step - loss: 0.0300 -
mean_iou: 0.9480 - val_loss: 0.0841 - val_mean_iou: 0.8984
Epoch 54/60
76/76 [==============================] - 22s 289ms/step - loss: 0.0304 -
mean_iou: 0.9473 - val_loss: 0.0724 - val_mean_iou: 0.9040
```

```
Epoch 55/60
76/76 [==============================] - 22s 287ms/step - loss: 0.0289 -
mean_iou: 0.9498 - val_loss: 0.0768 - val_mean_iou: 0.8979
Epoch 56/60
76/76 [==============================] - 23s 295ms/step - loss: 0.0278 -
mean_iou: 0.9517 - val_loss: 0.0734 - val_mean_iou: 0.9022
Epoch 57/60
76/76 [==============================] - 23s 299ms/step - loss: 0.0269 -
mean_iou: 0.9530 - val_loss: 0.0894 - val_mean_iou: 0.8795
Epoch 58/60
76/76 [==============================] - 22s 292ms/step - loss: 0.0263 -
mean_iou: 0.9541 - val_loss: 0.0756 - val_mean_iou: 0.9040
Epoch 59/60
76/76 [==============================] - 23s 296ms/step - loss: 0.0250 -
mean_iou: 0.9563 - val_loss: 0.1016 - val_mean_iou: 0.8968
Epoch 60/60
76/76 [==============================] - 22s 288ms/step - loss: 0.0280 -
mean_iou: 0.9515 - val_loss: 0.0872 - val_mean_iou: 0.8966
```

6.5 Tensorboard

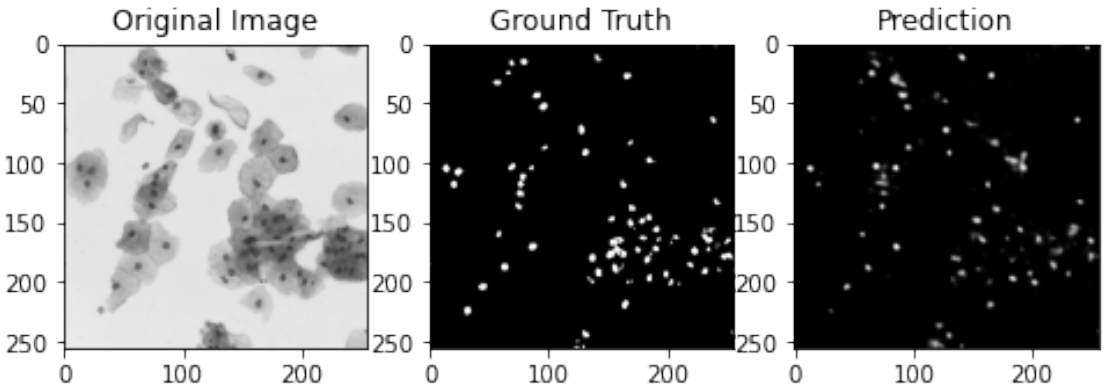
[65]:
```
%tensorboard --logdir model
```

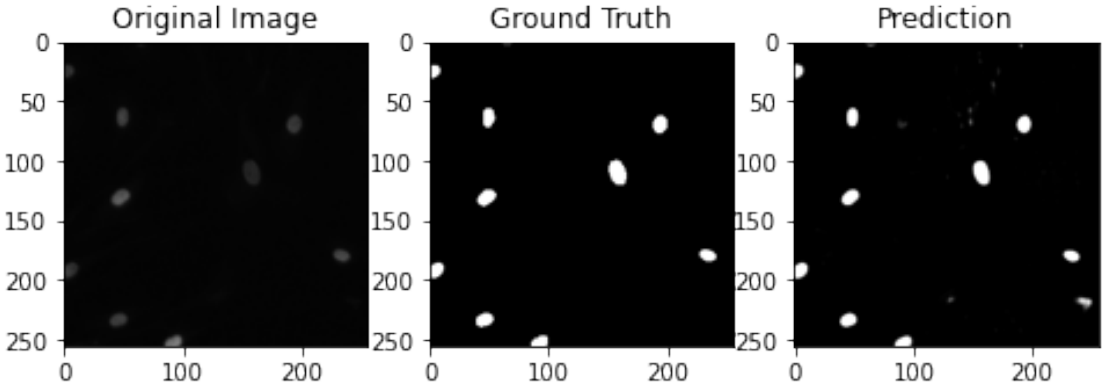
```
<IPython.core.display.Javascript object>
```

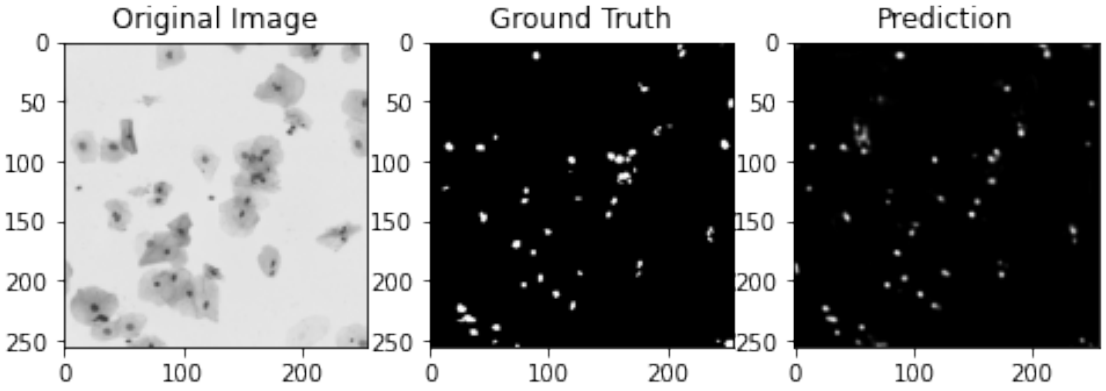
6.6 Inference

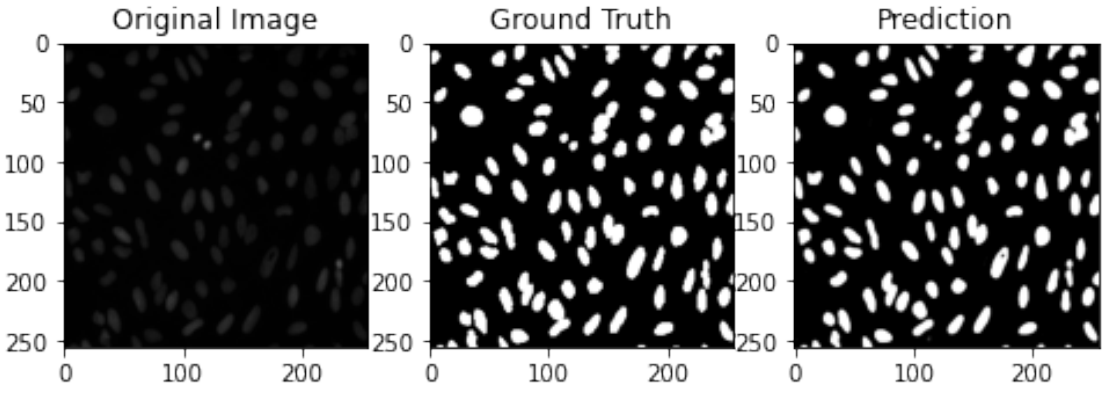
[66]:
```
for image, mask in val_ds.take(1):
    for i in range(BATCH_SIZE):
        #plt.figure(figsize=(8,4))
        #plt.subplot(131)
        #plt.imshow(image[i])
        #plt.subplot(132)
        #plt.imshow(mask[i][:,:,0], cmap = 'gray')

        pred_mask  = model.predict(image[i][np.newaxis,:,:,:])
        #plt.subplot(133)
        #plt.imshow(pred_mask[0,:,:,0], cmap = 'gray')
        #plt.show()

        fig = plt.figure(figsize=(8,4))
        ax1 = fig.add_subplot(131)
        ax1.title.set_text('Original Image')
        ax1.imshow(image[i])
        ax2 = fig.add_subplot(132)
        ax2.title.set_text('Ground Truth')
        ax2.imshow(mask[i][:,:,0], cmap='gray')
```

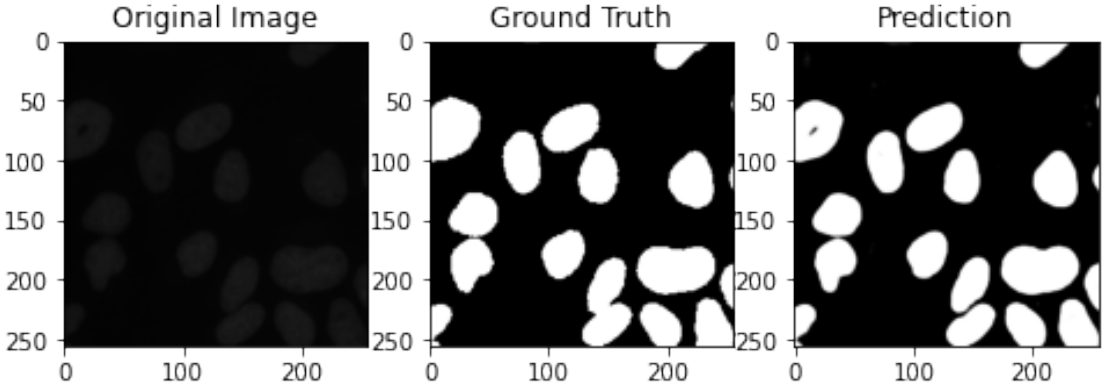
```
    ax3 = fig.add_subplot(133)
    ax3.title.set_text('Prediction')
    ax3.imshow(pred_mask[0,:,:,0], cmap='gray')
    plt.show()
```

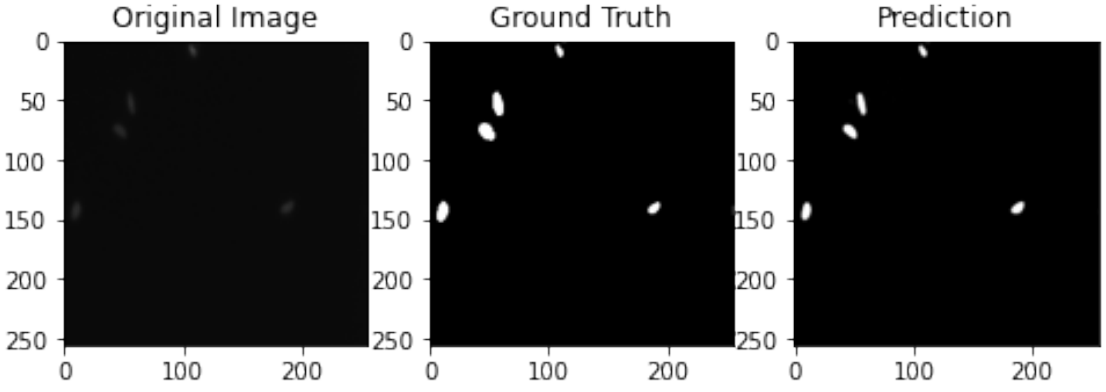


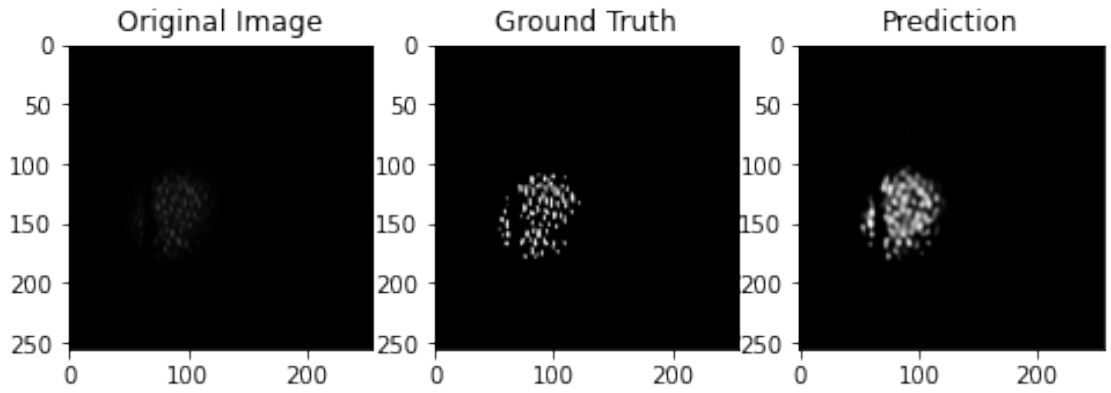


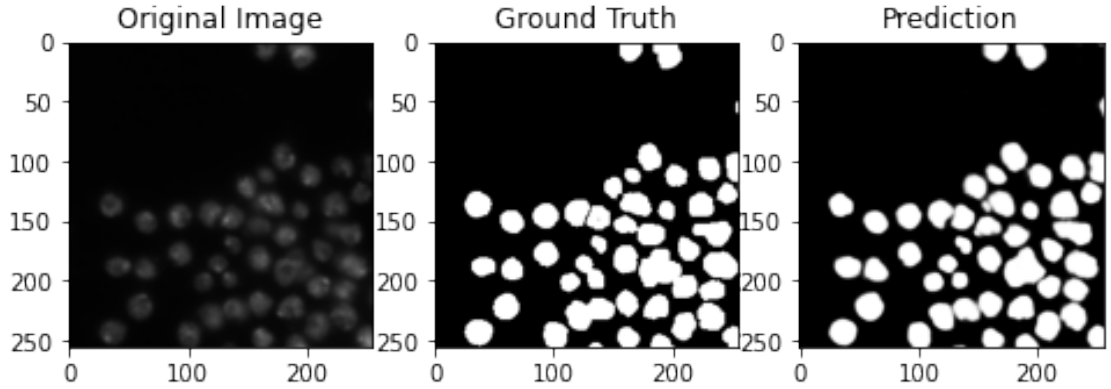



Original Image
Ground Truth
Prediction
0
50
100
150
200
250
0
100
200


Original Image
Ground Truth
Prediction
0
50
100
150
200
250
0
100
200

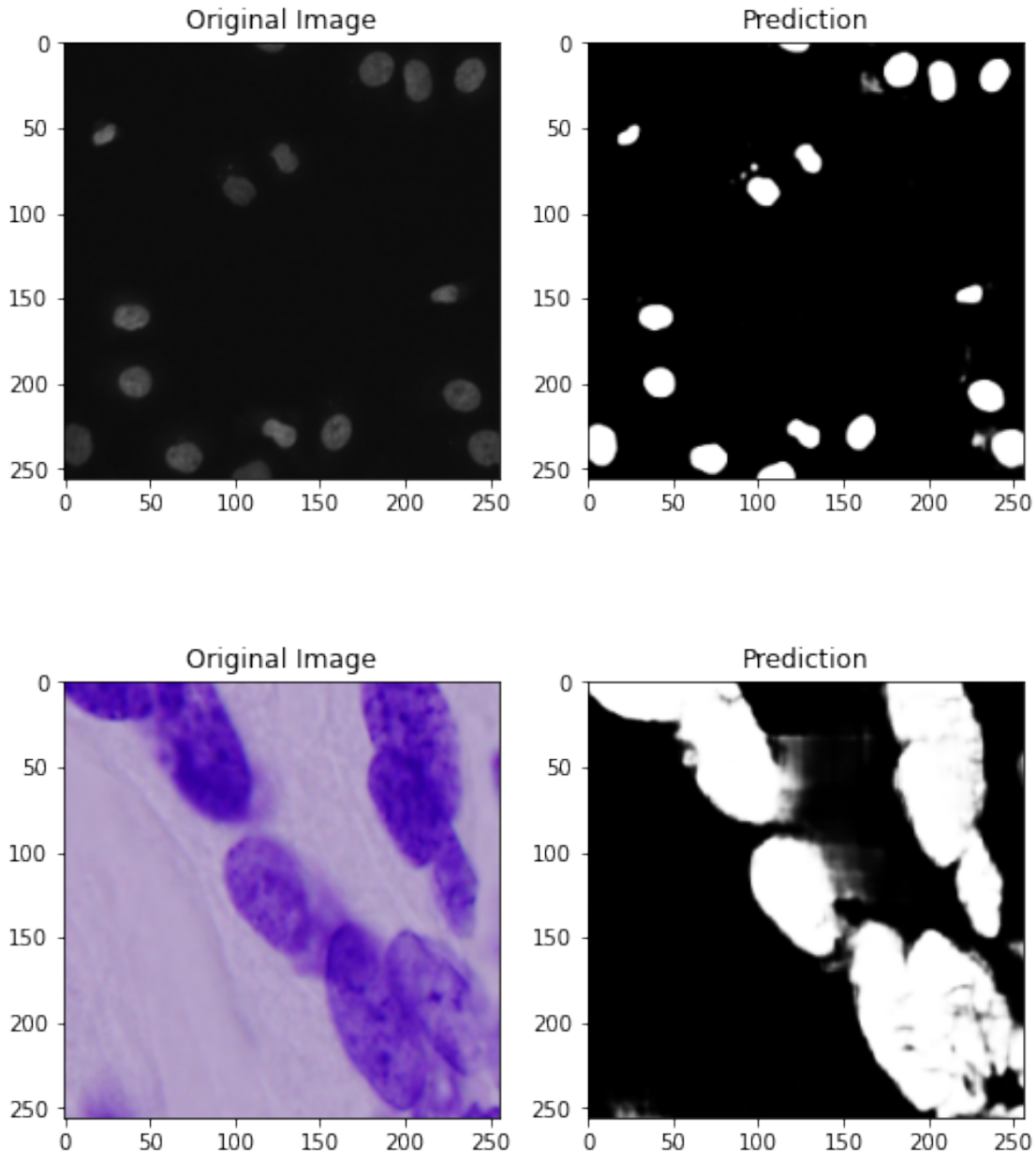

Original Image
Ground Truth
Prediction
0
50
100
150
200
250
0
100
200

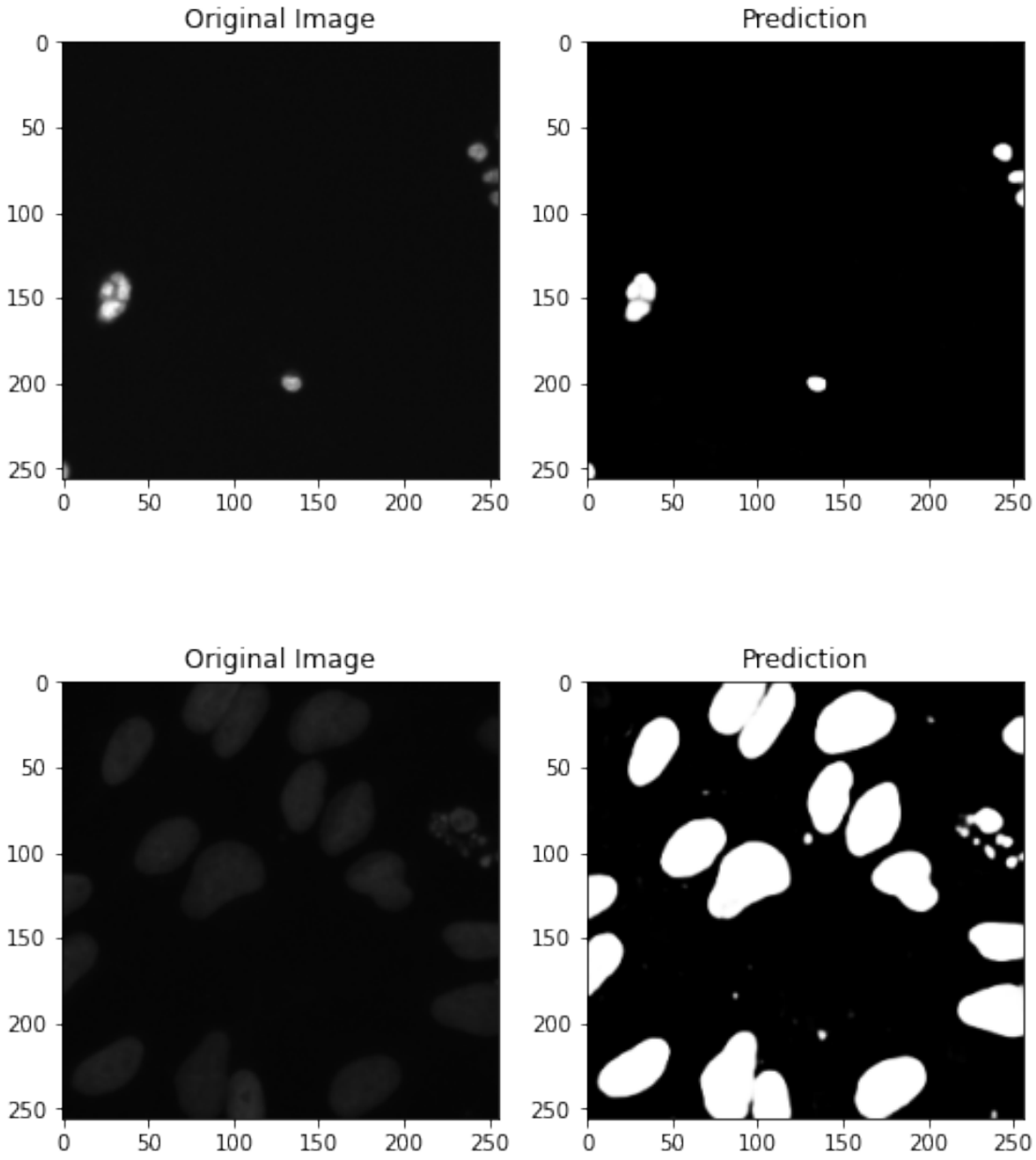


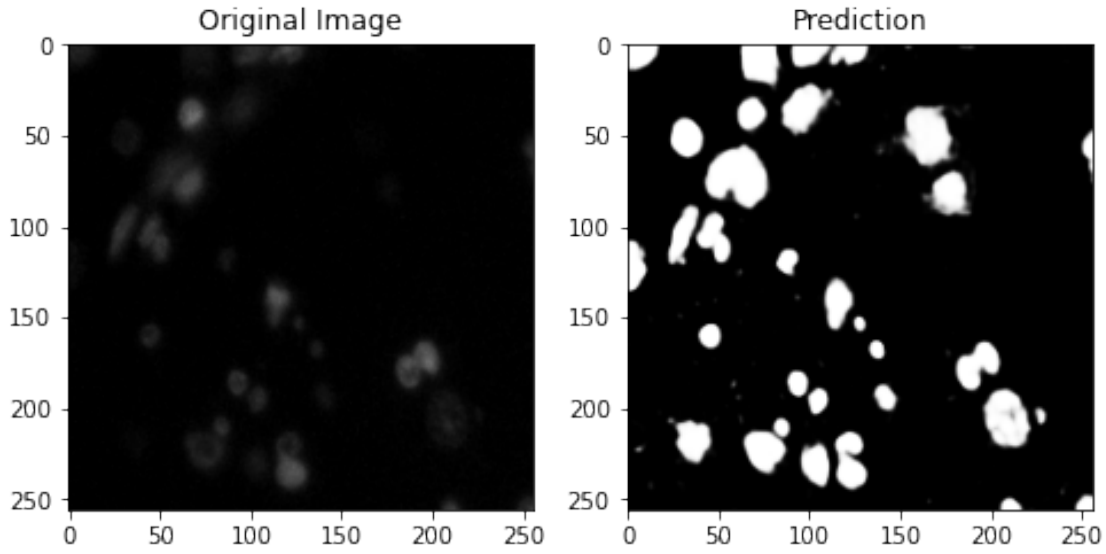


[67]:
```
test_filenames = test_df['files']
for filename in test_filenames[:5]:
    file_path = os.path.join(filename,'images')
    image_path = os.path.join(file_path,os.listdir(file_path)[0])
    image_string = tf.io.read_file(image_path)
    image = tf.image.decode_png(image_string, channels=IMG_CHANNELS)#
    image = tf.image.convert_image_dtype(image, tf.float32)
    image = tf.image.resize(image, [IMG_HEIGHT, IMG_WIDTH]) # height x width

    pred_mask  = model.predict(image[np.newaxis,:,:,:])

    #plt.figure(figsize=(10,6))
    #plt.subplot(121)
    #plt.imshow(image)
    #plt.subplot(122)
    #plt.imshow(pred_mask[0,:,:,0], cmap='gray')
    #plt.show()
```

```
    fig = plt.figure(figsize=(8,4))
    ax1 = fig.add_subplot(121)
    ax1.title.set_text('Original Image')
    ax1.imshow(image)
    ax2 = fig.add_subplot(122)
    ax2.title.set_text('Prediction')
    ax2.imshow(pred_mask[0,:,:,0], cmap='gray')
    plt.show()
```




Original Image
Prediction
Original Image
Prediction
0
50
100
150
200
250



7 EDA

[68]:
```
# Function to create a dataframe with iou_scores and image and mask paths.
def metric_df(data):
    iou_scores = []
    m = MeanIoU(2, 0.4)
    for i in range(len(data)):
        image_path = data['images'].iloc[i]
        mask_path = data['masks'].iloc[i]
        image_string = tf.io.read_file(image_path)
        image = tf.image.decode_png(image_string, channels=IMG_CHANNELS)#
        image = tf.image.convert_image_dtype(image, tf.float32)
        image = tf.image.resize(image, [IMG_HEIGHT, IMG_WIDTH]) # height x width

        mask_string = tf.io.read_file(mask_path)
        mask = tf.image.decode_png(mask_string, channels=CLASSES)#
        mask = tf.image.convert_image_dtype(mask, tf.float32)
        mask = tf.image.resize(mask, [IMG_HEIGHT, IMG_WIDTH])

        pred_mask = model.predict(image[np.newaxis,:,:,:])
        m.update_state(mask, pred_mask)
        iou_score = m.result().numpy()
        iou_scores.append(iou_score)
    data['iou_scores'] = iou_scores
    return data
```

[69]:
```
df = X_train.copy()
df = metric_df(df)
df = df.sort_values('iou_scores')
df.head()
```

[69]:

```
                                                                images  …
iou_scores
133  ./train/6c67b78e8164801059375ed9a607f61e67a7ae347e92e36a7f20514224541d56/im
ages/6c67b78e8164801059375ed9a607f61e67a7ae347e92e36a7f20514224541d56.png  …
0.884343
30   ./train/0bda515e370294ed94efd36bd53782288acacb040c171df2ed97fd691fc9d8fe/im
ages/0bda515e370294ed94efd36bd53782288acacb040c171df2ed97fd691fc9d8fe.png  …
0.891180
69   ./train/623cf6987b3fac8f384c09f40d98c5e739c097aa9a9627054542aa27f7d38db1/im
ages/623cf6987b3fac8f384c09f40d98c5e739c097aa9a9627054542aa27f7d38db1.png  …
0.899990
292  ./train/c75139ef0546d2240b37afb3219eb74a06b7977818697d5c3138796472483af3/im
ages/c75139ef0546d2240b37afb3219eb74a06b7977818697d5c3138796472483af3.png  …
0.900523
395  ./train/c1afe66cd139f996fd984f5f2622903730ec2f1192d90608154f07f7ef6cdb4b/im
ages/c1afe66cd139f996fd984f5f2622903730ec2f1192d90608154f07f7ef6cdb4b.png  …
0.903477

[5 rows x 3 columns]
```

[70]:
```
df.tail()
```

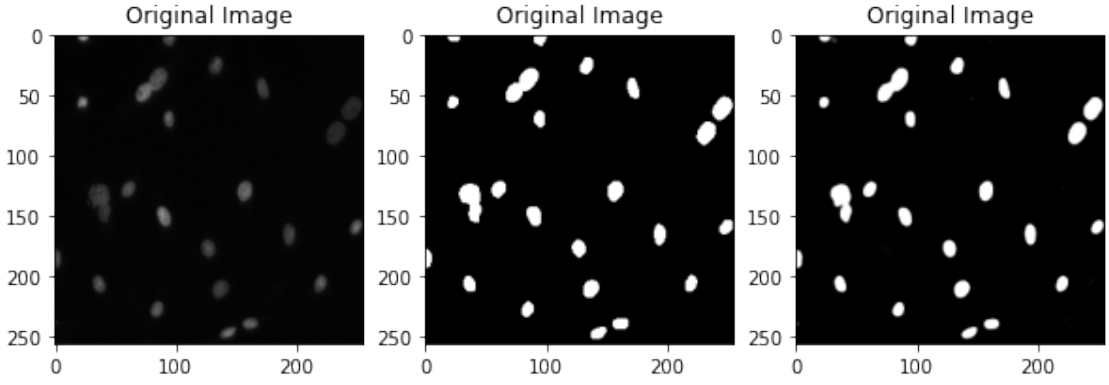
[70]:

```
                                                                images  …
iou_scores
526  ./train/54fe2d3416951cbc48f8718624c86a7ae58b6022a7fa75591b13f625cf53658b/im
ages/54fe2d3416951cbc48f8718624c86a7ae58b6022a7fa75591b13f625cf53658b.png  …
0.938505
350  ./train/b7a86f4968071e0f963fa87ef314fdd1b6c73a66355431cc53a37e193ba6be9b/im
ages/b7a86f4968071e0f963fa87ef314fdd1b6c73a66355431cc53a37e193ba6be9b.png  …
0.938551
192  ./train/1023509cf8d4c155467800f89508690be9513431992f470594281cd37dbd020d/im
ages/1023509cf8d4c155467800f89508690be9513431992f470594281cd37dbd020d.png  …
0.939031
456  ./train/23830d0e51245fc0c9e410efa4c17d2a7d83a0104a3777130119ab892de47a4e/im
ages/23830d0e51245fc0c9e410efa4c17d2a7d83a0104a3777130119ab892de47a4e.png  …
0.939193
108  ./train/62570c4ff1c5ab6d9d383aba9f25e604768520b4266afd40fdf4734a694c8bc3/im
ages/62570c4ff1c5ab6d9d383aba9f25e604768520b4266afd40fdf4734a694c8bc3.png  …
0.939272

[5 rows x 3 columns]
```

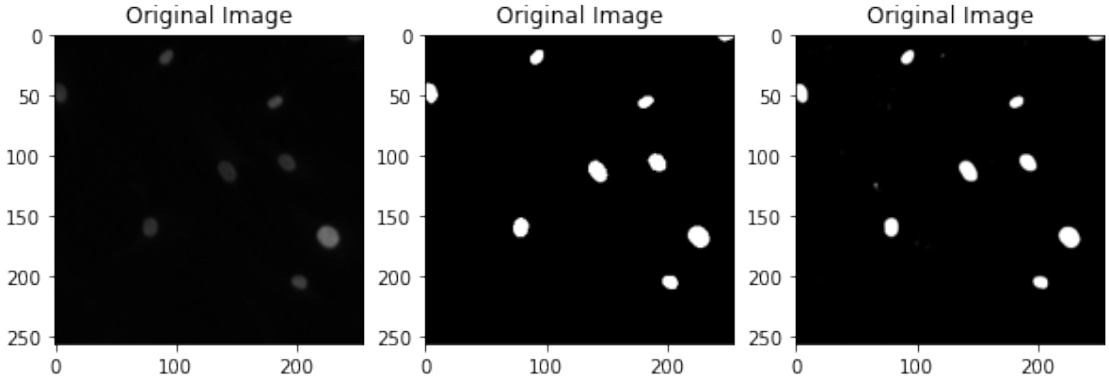
7.1 Best Output samples

[71]:
```
d1 = df.tail()
for i in range(5):
    image_path = d1['images'].iloc[i]
    mask_path = d1['masks'].iloc[i]
    image_string = tf.io.read_file(image_path)
    image = tf.image.decode_png(image_string, channels=IMG_CHANNELS)#
    image = tf.image.convert_image_dtype(image, tf.float32)
    image = tf.image.resize(image, [IMG_HEIGHT, IMG_WIDTH]) # height x width

    mask_string = tf.io.read_file(mask_path)
    mask = tf.image.decode_png(mask_string, channels=CLASSES)#
    mask = tf.image.convert_image_dtype(mask, tf.float32)
    mask = tf.image.resize(mask, [IMG_HEIGHT, IMG_WIDTH])

    pred_mask  = model.predict(image[np.newaxis,:,:,:])

    fig = plt.figure(figsize=(10,6))

    ax1 = fig.add_subplot(131)
    ax1.title.set_text('Original Image')
    ax1.imshow(image)
    ax2 = fig.add_subplot(132)
    ax2.title.set_text('Original Image')
    ax2.imshow(mask[:,:,0], cmap='gray')
    ax3 = fig.add_subplot(133)
    ax3.title.set_text('Original Image')

    ax3.imshow(pred_mask[0,:,:,0], cmap='gray')
    fig.suptitle('IoU Score: ' + str(d1['iou_scores'].iloc[i]))
    plt.show()
```

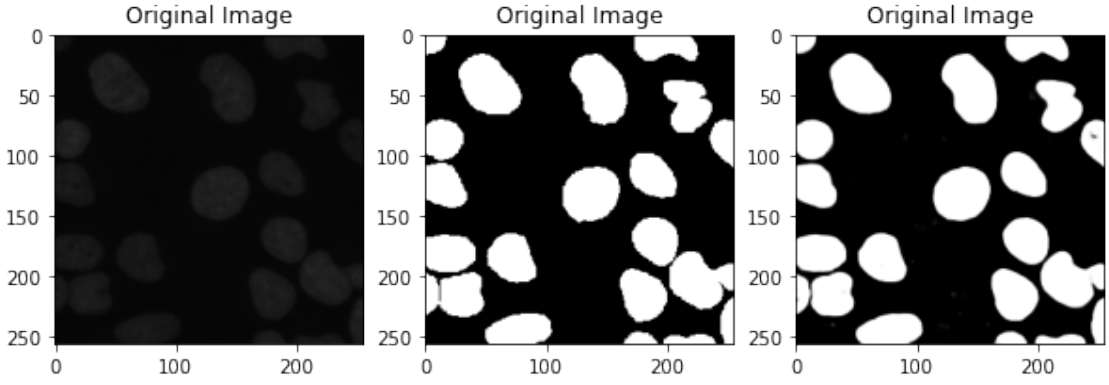
IoU Score: 0.938504695892334



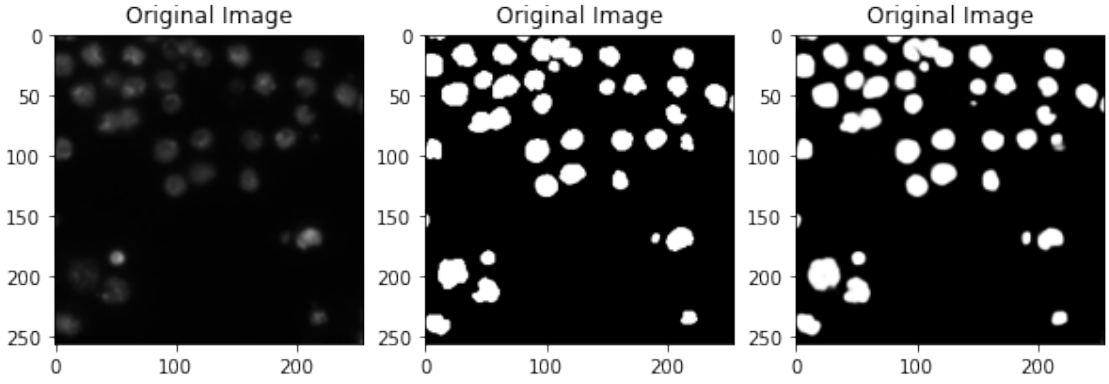
IoU Score: 0.938550591468811

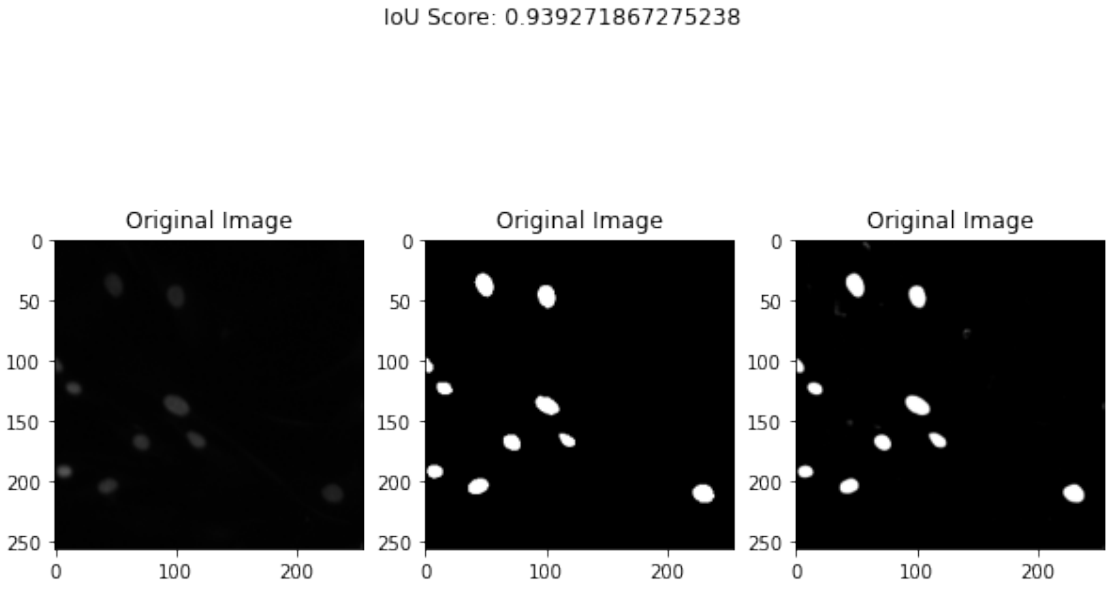


IoU Score: 0.9390305280685425



IoU Score: 0.9391932487487793



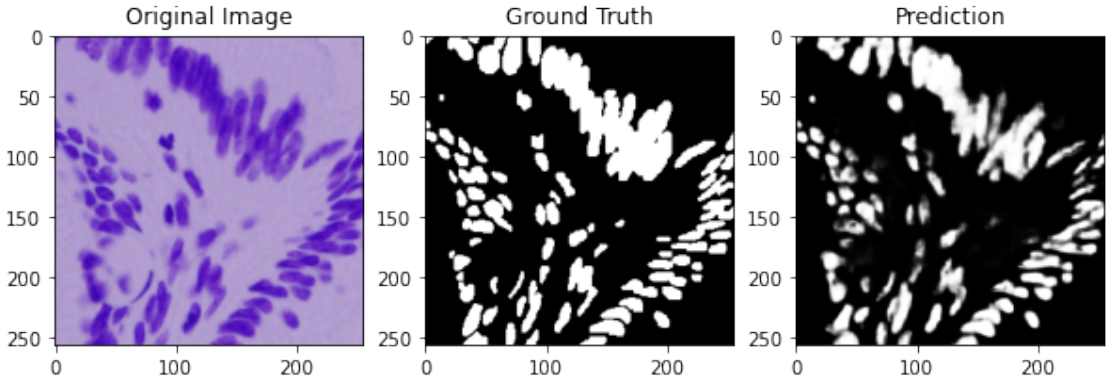


7.2 Worst Output Samples

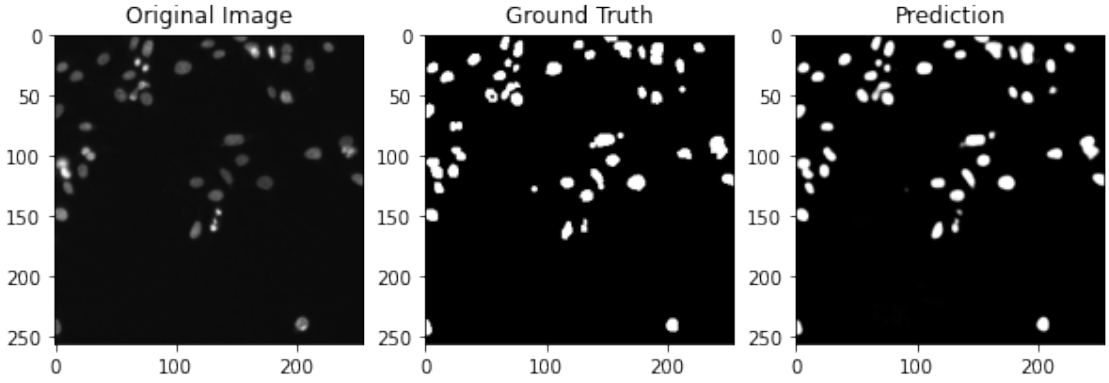
[72]:
```
d2 = df.head()
for i in range(5):
    image_path = d2['images'].iloc[i]
    mask_path = d2['masks'].iloc[i]
    image_string = tf.io.read_file(image_path)
    image = tf.image.decode_png(image_string, channels=IMG_CHANNELS)#
    image = tf.image.convert_image_dtype(image, tf.float32)
    image = tf.image.resize(image, [IMG_HEIGHT, IMG_WIDTH]) # height x width

    mask_string = tf.io.read_file(mask_path)
    mask = tf.image.decode_png(mask_string, channels=CLASSES)#
    mask = tf.image.convert_image_dtype(mask, tf.float32)
    mask = tf.image.resize(mask, [IMG_HEIGHT, IMG_WIDTH])

    pred_mask  = model.predict(image[np.newaxis,:,:,:])

    fig = plt.figure(figsize=(10,6))
    fig.suptitle('IoU Score: '+str(d2['iou_scores'].iloc[i]))
    ax1 = fig.add_subplot(131)
    ax1.title.set_text('Original Image')
    ax1.imshow(image)
    ax2 = fig.add_subplot(132)
    ax2.title.set_text('Ground Truth')
    ax2.imshow(mask[:,:,0], cmap='gray')
    ax3 = fig.add_subplot(133)
```

```
    ax3.title.set_text('Prediction')
    ax3.imshow(pred_mask[0,:,:,0], cmap='gray')
    plt.show()
```

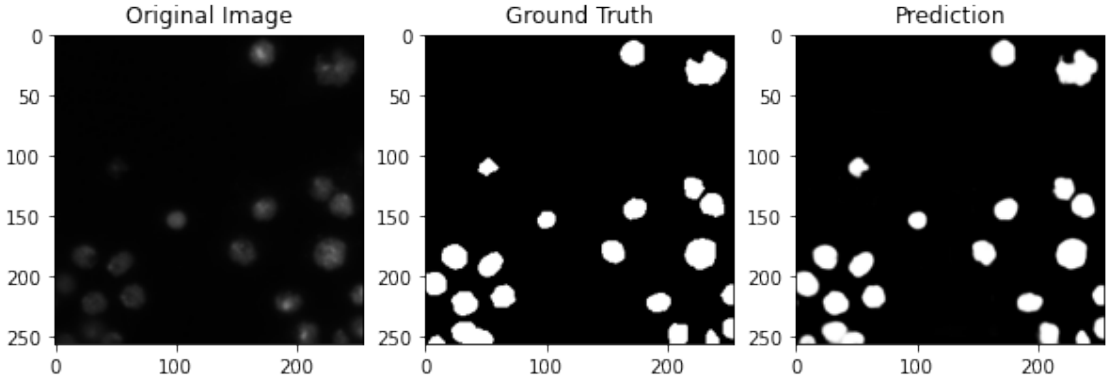
IoU Score: 0.884343147277832



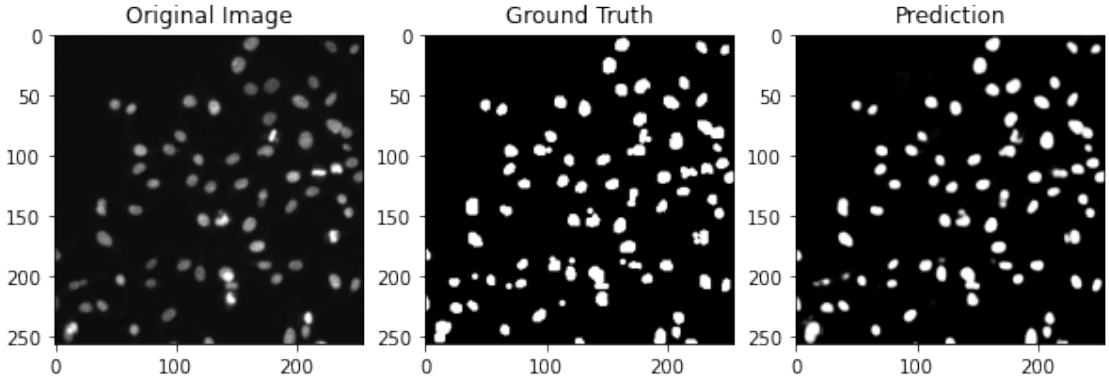
IoU Score: 0.8911800384521484



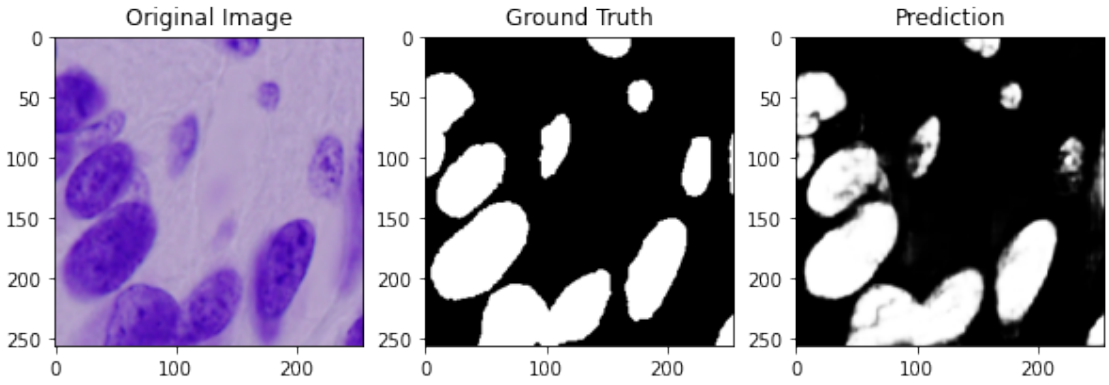
IoU Score: 0.8999901413917542



IoU Score: 0.9005234837532043



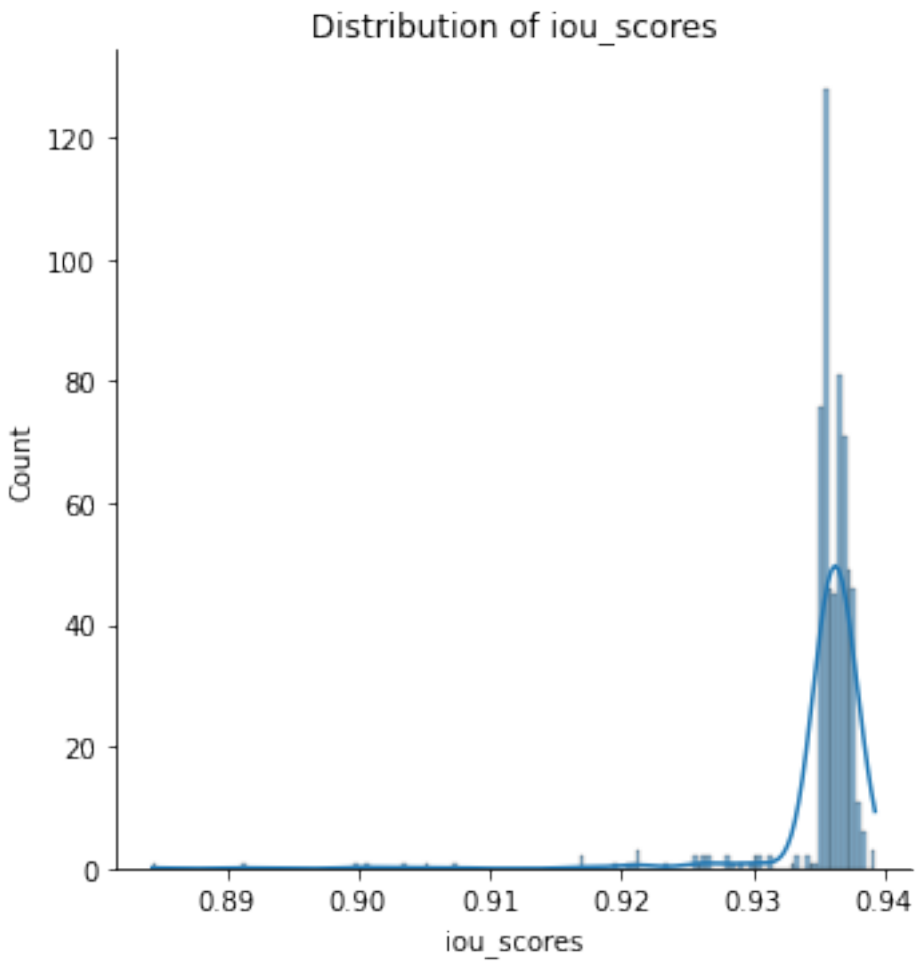
IoU Score: 0.9034774899482727



7.3 Distribution of 'iou_scores'

[74]:
```
sns.displot(data=df, x="iou_scores", kde=True)
plt.title('Distribution of iou_scores')
```

[74]:
```
Text(0.5, 1.0, 'Distribution of iou_scores')
```



- It can be seen from the plot that the distribution of the iou scores is almost normal distribution.
- It is centered towards 0.94.
- This is the expected behaviour.