In [34]:
```python
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```

In [35]:
```python
# !pip install git+https://github.com/tensorflow/examples.git
# !pip install tensorflow_datasets
```

In [36]:
```python
import tensorflow as tf
```

In [37]:
```python
from __future__ import absolute_import, division, print_function, unicode_li
terals

from tensorflow_examples.models.pix2pix import pix2pix

import tensorflow_datasets as tfds
tfds.disable_progress_bar()

from IPython.display import clear_output
import matplotlib.pyplot as plt


import tensorflow as tf
tf.config.experimental.set_visible_devices([], 'GPU')
```

In [38]:
```python
# Загрузка датасета Oxford-IIIT Pets
dataset, info = tfds.load('oxford_iiit_pet:3.*.*', with_info=True)
```

In [39]:
```python
def normalize(input_image, input_mask):
  input_image = tf.cast(input_image, tf.float32) / 255.0
  input_mask -= 1
  return input_image, input_mask
```

In [40]:
```python
@tf.function
def load_image_train(datapoint):
  input_image = tf.image.resize(datapoint['image'], (128, 128))
  input_mask = tf.image.resize(datapoint['segmentation_mask'], (128, 128))

  if tf.random.uniform(()) > 0.5:
    input_image = tf.image.flip_left_right(input_image)
    input_mask = tf.image.flip_left_right(input_mask)

  input_image, input_mask = normalize(input_image, input_mask)

  return input_image, input_mask
```

In [41]:
```python
def load_image_test(datapoint):
    input_image = tf.image.resize(datapoint['image'], (128, 128))
    input_mask = tf.image.resize(datapoint['segmentation_mask'], (128, 128))

    input_image, input_mask = normalize(input_image, input_mask)

    return input_image, input_mask
```

In [42]:
```python
# Датасет уже содержит необходимые тестовый и тренеровочный сплиты, поэтому
давайте использовать их.
```

In [43]:
```python
TRAIN_LENGTH = info.splits['train'].num_examples
BATCH_SIZE = 128
BUFFER_SIZE = 1000
STEPS_PER_EPOCH = TRAIN_LENGTH // BATCH_SIZE
```

In [44]:
```python
train = dataset['train'].map(load_image_train, num_parallel_calls=tf.data.ex
perimental.AUTOTUNE)
test = dataset['test'].map(load_image_test)
```

In [45]:
```python
train_dataset = train.cache().shuffle(BUFFER_SIZE).batch(BATCH_SIZE).repeat
()
train_dataset = train_dataset.prefetch(buffer_size=tf.data.experimental.AUTO
TUNE)
test_dataset = test.batch(BATCH_SIZE)
```

In [46]:
```python
# Давайте посмотрим на пример изображения из датасета и соотвествующую ему м
аску из датасета.
```

In [47]:
```python
def display(display_list):
    plt.figure(figsize=(15, 15))

    title = ['Input Image', 'True Mask', 'Predicted Mask']

    for i in range(len(display_list)):
        plt.subplot(1, len(display_list), i+1)
        plt.title(title[i])
        plt.imshow(tf.keras.preprocessing.image.array_to_img(display_list[i]))
        plt.axis('off')
    plt.show()
```

In [48]:
```python
for image, mask in train.take(1):
    sample_image, sample_mask = image, mask
display([sample_image, sample_mask])
```
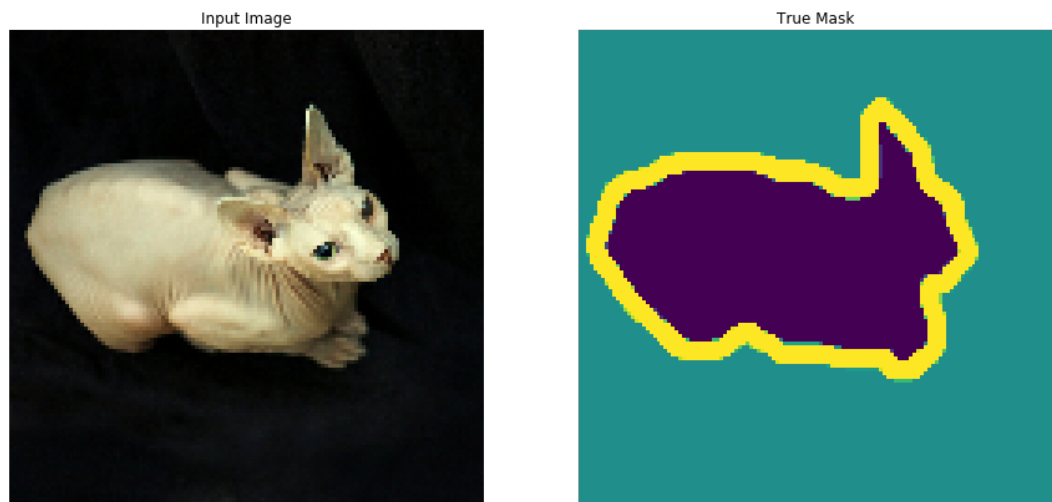


In [49]:
```python
# Определение модели
# энкодером будет предтренированный MobileNetV2
```

In [50]:
```python
OUTPUT_CHANNELS = 3
```

In [51]:
```python
base_model = tf.keras.applications.MobileNetV2(input_shape=[128, 128, 3], include_top=False)

# Use the activations of these layers
layer_names = [
    'block_1_expand_relu',    # 64x64
    'block_3_expand_relu',    # 32x32
    'block_6_expand_relu',    # 16x16
    'block_13_expand_relu',   # 8x8
    'block_16_project',       # 4x4
]
layers = [base_model.get_layer(name).output for name in layer_names]

# Create the feature extraction model
down_stack = tf.keras.Model(inputs=base_model.input, outputs=layers)

down_stack.trainable = False
```

In [52]:
```python
# Декодер/апсемплер это просто серия апсемпл блоков имплементированны в TensorFlow examples.
```

In [53]:
```python
up_stack = [
    pix2pix.upsample(512, 3),    # 4x4 -> 8x8
    pix2pix.upsample(256, 3),    # 8x8 -> 16x16
    pix2pix.upsample(128, 3),    # 16x16 -> 32x32
    pix2pix.upsample(64, 3),     # 32x32 -> 64x64
]
```

In [54]:
```python
def unet_model(output_channels):
  inputs = tf.keras.layers.Input(shape=[128, 128, 3])
  x = inputs

  # Downsampling through the model
  skips = down_stack(x)
  x = skips[-1]
  skips = reversed(skips[:-1])

  # Upsampling and establishing the skip connections
  for up, skip in zip(up_stack, skips):
    x = up(x)
    concat = tf.keras.layers.Concatenate()
    x = concat([x, skip])

  # This is the last layer of the model
  last = tf.keras.layers.Conv2DTranspose(
      output_channels, 3, strides=2,
      padding='same')  #64x64 -> 128x128

  x = last(x)

  return tf.keras.Model(inputs=inputs, outputs=x)
```
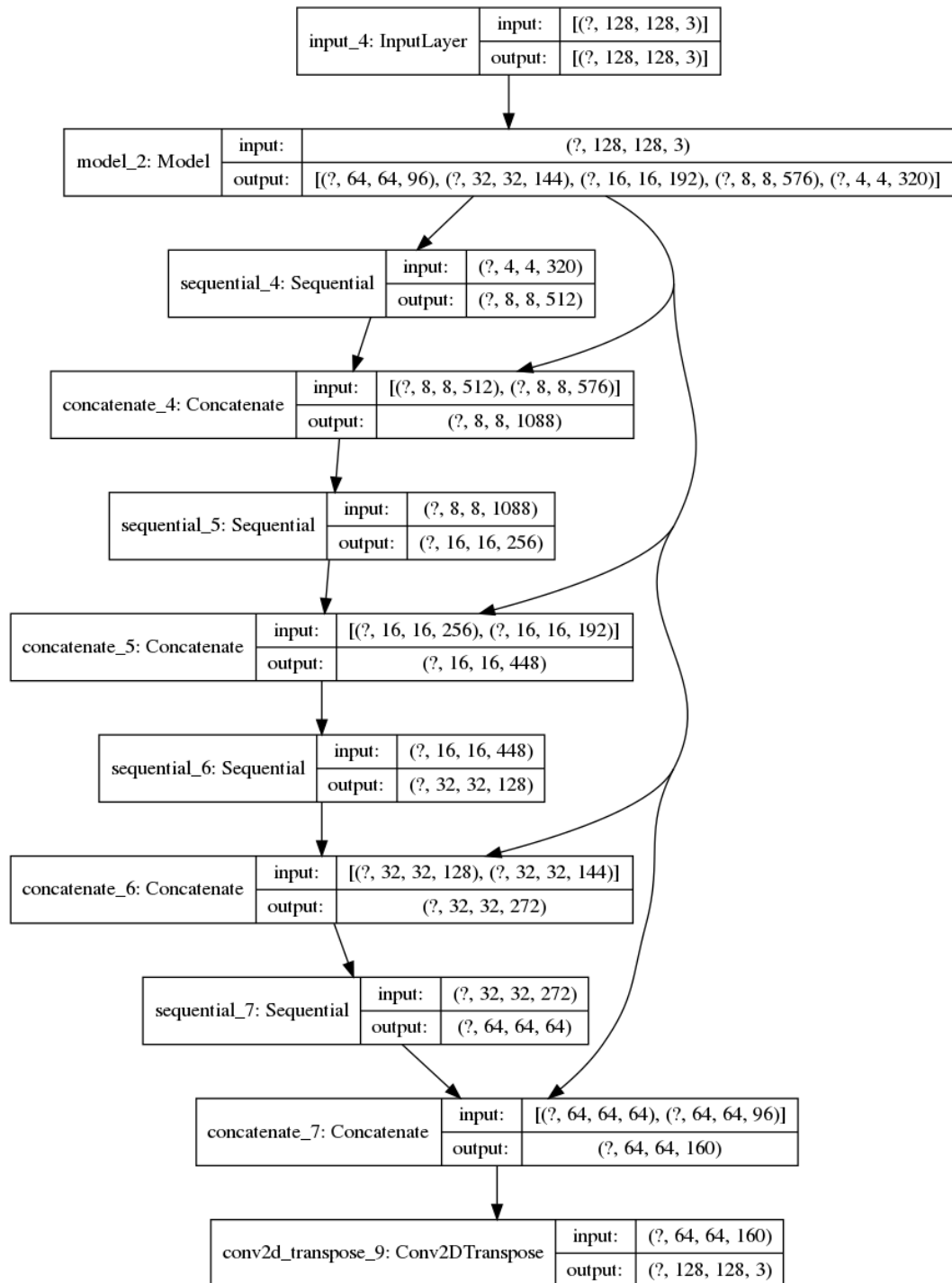
In [55]:
```python
# Тренировка модели
```

In [56]:
```python
model = unet_model(OUTPUT_CHANNELS)
model.compile(optimizer='adam',
              loss=tf.keras.losses.SparseCategoricalCrossentropy(from_logits
=True),
              metrics=['accuracy'])
```

In [57]: `tf.keras.utils.plot_model(model, show_shapes=True)`

Out[57]:

| input_4: InputLayer | input: | [(?, 128, 128, 3)] |
|---|---|---|
| | output: | [(?, 128, 128, 3)] |

| model_2: Model | input: | (?, 128, 128, 3) |
|---|---|---|
| | output: | [(?, 64, 64, 96), (?, 32, 32, 144), (?, 16, 16, 192), (?, 8, 8, 576), (?, 4, 4, 320)] |

| sequential_4: Sequential | input: | (?, 4, 4, 320) |
|---|---|---|
| | output: | (?, 8, 8, 512) |

| concatenate_4: Concatenate | input: | [(?, 8, 8, 512), (?, 8, 8, 576)] |
|---|---|---|
| | output: | (?, 8, 8, 1088) |

| sequential_5: Sequential | input: | (?, 8, 8, 1088) |
|---|---|---|
| | output: | (?, 16, 16, 256) |

| concatenate_5: Concatenate | input: | [(?, 16, 16, 256), (?, 16, 16, 192)] |
|---|---|---|
| | output: | (?, 16, 16, 448) |

| sequential_6: Sequential | input: | (?, 16, 16, 448) |
|---|---|---|
| | output: | (?, 32, 32, 128) |

| concatenate_6: Concatenate | input: | [(?, 32, 32, 128), (?, 32, 32, 144)] |
|---|---|---|
| | output: | (?, 32, 32, 272) |

| sequential_7: Sequential | input: | (?, 32, 32, 272) |
|---|---|---|
| | output: | (?, 64, 64, 64) |

| concatenate_7: Concatenate | input: | [(?, 64, 64, 64), (?, 64, 64, 96)] |
|---|---|---|
| | output: | (?, 64, 64, 160) |

| conv2d_transpose_9: Conv2DTranspose | input: | (?, 64, 64, 160) |
|---|---|---|
| | output: | (?, 128, 128, 3) |

In [58]:
```python
def create_mask(pred_mask):
    pred_mask = tf.argmax(pred_mask, axis=-1)
    pred_mask = pred_mask[..., tf.newaxis]
    return pred_mask[0]
```

In [59]:
```python
def show_predictions(dataset=None, num=1):
  if dataset:
    for image, mask in dataset.take(num):
      pred_mask = model.predict(image)
      display([image[0], mask[0], create_mask(pred_mask)])
  else:
    display([sample_image, sample_mask,
             create_mask(model.predict(sample_image[tf.newaxis, ...]))])
```

In [60]:
```python
show_predictions()
```
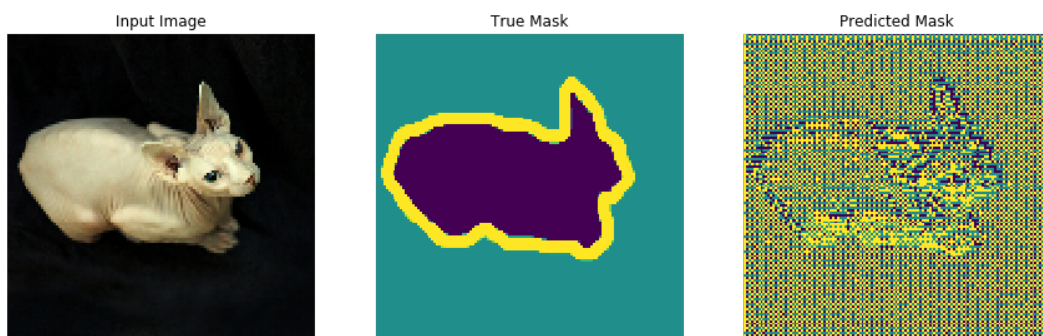


In [61]:
```python
# Давайте осуществлять мониторинг того как улучшается работа модели в процес
се обучения. Для завершения этой задачи callback функция определена ниже.
```

In [62]:
```python
class DisplayCallback(tf.keras.callbacks.Callback):
  def on_epoch_end(self, epoch, logs=None):
    clear_output(wait=True)
    show_predictions()
    print ('\nSample Prediction after epoch {}\n'.format(epoch+1))
```

In [63]:
```python
EPOCHS = 5 # увеличьте при необходимости
VAL_SUBSPLITS = 5
VALIDATION_STEPS = info.splits['test'].num_examples//BATCH_SIZE//VAL_SUBSPLITS

model_history = model.fit(train_dataset, epochs=EPOCHS,
                          steps_per_epoch=STEPS_PER_EPOCH,
                          validation_steps=VALIDATION_STEPS,
                          validation_data=test_dataset,
                          callbacks=[DisplayCallback()])
```
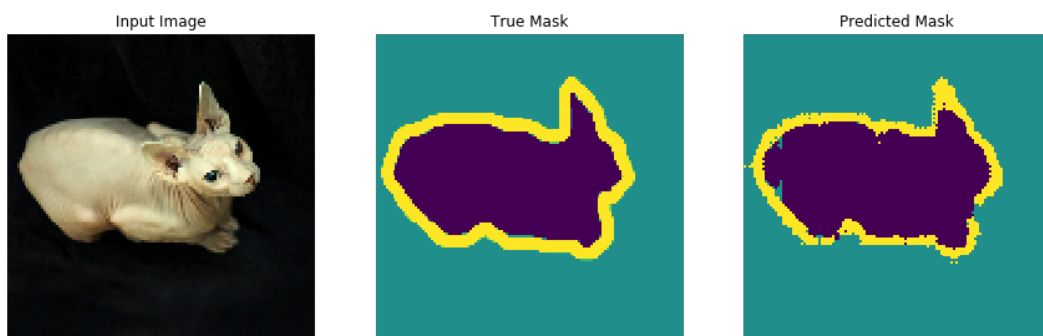


```
Sample Prediction after epoch 5

28/28 [==============================] - 304s 11s/step - loss: 0.2649 - accur
acy: 0.8894 - val_loss: 0.3231 - val_accuracy: 0.8683
```

In [64]:
```python
loss = model_history.history['loss']
val_loss = model_history.history['val_loss']

epochs = range(EPOCHS)

plt.figure()
plt.plot(epochs, loss, 'r', label='Training loss')
plt.plot(epochs, val_loss, 'bo', label='Validation loss')
plt.title('Training and Validation Loss')
plt.xlabel('Epoch')
plt.ylabel('Loss Value')
plt.ylim([0, 1])
plt.legend()
plt.show()
```
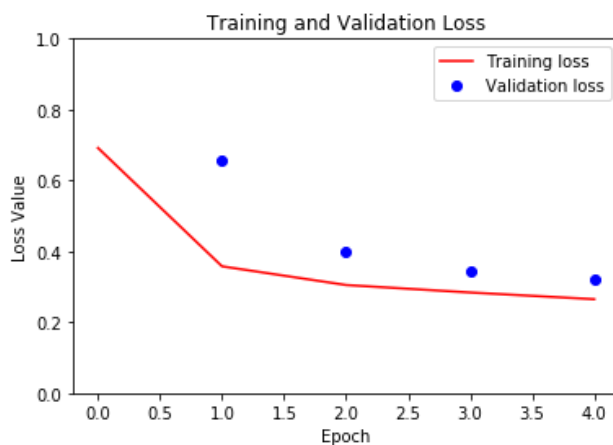


In [32]:
```python
# Make predictions
```

In [33]: `show_predictions(test_dataset, 5)`

In [ ]: