**This work is referred from the https://colab.research.google.com/github/tensorflow/docs/blob/master/site/en/tutorials/generative/pix2pix.ipynb#scrollTo=DMTm4peo3 (https://colab.research.google.com/github/tensorflow/docs/blob/master/site/en/tutorials/generative/pix2pix.ipynb#scrollTo=DMTm4peo

The used dataset is from http://mmlab.ie.cuhk.edu.hk/archive/sketchdatabase/CUHK/ (http://mmlab.ie.cuhk.edu.hk/archive/sketchdatabase/CUHK/)

The used case application for which we have implemented our project is from sketch to face generation and face to sketch generation

In[1]:

```
from __future__ import absolute_import, division, print_function, unicode_literals
import tensorflow as tf

import os
import time

from matplotlib import pyplot as plt
from IPython import display
import cv2 as cv
```

In[2]:

```
print(tf.__version__)
```

```
2.1.0-rc0
```

Load the Dataset

In[3]:

```
import scipy
# from keras_contrib.layers.normalization.instancenormalization import InstanceNormalization
from tensorflow.keras.layers import Input, Dense, Reshape, Flatten, Dropout, Concatenate,concatenate
from tensorflow.keras.layers import BatchNormalization, Activation, ZeroPadding2D
from tensorflow.keras.layers import LeakyReLU,ReLU
from tensorflow.keras.layers import UpSampling2D, Conv2D,Conv2DTranspose
from tensorflow.keras import Sequential, Model
from keras.optimizers import Adam
import datetime
import sys
# from data_loader import DataLoader
import numpy as np
import os
import cv2 as cv
```

```
Using TensorFlow backend.
```

In[4]:

```
# set Direcotory

#  /root/.keras/datasets/pix2pix/
# cd /root/.keras/datasets/pix2pix/

path ='/kaggle/working'
```

In[5]:

```
!mkdir -p pix2pix/test/concat
!mkdir -p pix2pix/train/concat
```

In[6]:

```
cd pix2pix
```

```
/kaggle/working/pix2pix
```

In[7]:

```
_URL1 = 'http://mmlab.ie.cuhk.edu.hk/archive/sketchdatabase/CUHK/training_88/Cropped_Images/CUHK_training_cropped_sket

_URL2 = 'http://mmlab.ie.cuhk.edu.hk/archive/sketchdatabase/CUHK/training_88/Cropped_Images/CUHK_training_cropped_phot

_URL3 = 'http://mmlab.ie.cuhk.edu.hk/archive/sketchdatabase/CUHK/testing_100/Cropped_Images/CUHK_testing_cropped_sketc

_URL4 = 'http://mmlab.ie.cuhk.edu.hk/archive/sketchdatabase/CUHK/testing_100/Cropped_Images/CUHK_testing_cropped_photc

path_to_zip1 = tf.keras.utils.get_file(path+'/pix2pix/train/CUHK_training_cropped_sketches.zip',
                                       origin=_URL1,archive_format='zip',
                                        cache_subdir=path+'/pix2pix/train',
                                       extract=True)

path_to_zip2 = tf.keras.utils.get_file(path+'/pix2pix/train/CUHK_training_cropped_photos.zip',
                                       origin=_URL2,archive_format='zip',
                                        cache_subdir=path+'/pix2pix/train',
                                       extract=True)

path_to_zip3 = tf.keras.utils.get_file(path+'/pix2pix/test/CUHK_testing_cropped_sketches.zip',
                                        cache_subdir=path+'/pix2pix/test',
                                       origin=_URL3,
                                       extract=True)

path_to_zip4 = tf.keras.utils.get_file(path+'/pix2pix/test/CUHK_testing_cropped_photos.zip',
                                       origin=_URL4,
                                        cache_subdir=path+'/pix2pix/test',
                                       extract=True)
```

```
Downloading data from http://mmlab.ie.cuhk.edu.hk/archive/sketchdatabase/CUHK/training_88/Cropped_Images/CUHK_training_
cropped_sketches.zip (http://mmlab.ie.cuhk.edu.hk/archive/sketchdatabase/CUHK/training_88/Cropped_Images/CUHK_training_
cropped_sketches.zip)
712704/708043 [==============================] - 1s 1us/step
```

```
Downloading data from http://mmlab.ie.cuhk.edu.hk/archive/sketchdatabase/CUHK/training_88/Cropped_Images/CUHK_training_cropped_photos.zip (http://mmlab.ie.cuhk.edu.hk/archive/sketchdatabase/CUHK/training_88/Cropped_Images/CUHK_training_cropped_photos.zip)
688128/683334 [==============================] - 1s 1us/step
Downloading data from http://mmlab.ie.cuhk.edu.hk/archive/sketchdatabase/CUHK/testing_100/Cropped_Images/CUHK_testing_cropped_sketches.zip (http://mmlab.ie.cuhk.edu.hk/archive/sketchdatabase/CUHK/testing_100/Cropped_Images/CUHK_testing_cropped_sketches.zip)
892928/892206 [==============================] - 1s 1us/step
Downloading data from http://mmlab.ie.cuhk.edu.hk/archive/sketchdatabase/CUHK/testing_100/Cropped_Images/CUHK_testing_cropped_photos.zip (http://mmlab.ie.cuhk.edu.hk/archive/sketchdatabase/CUHK/testing_100/Cropped_Images/CUHK_testing_cropped_photos.zip)
778240/771222 [==============================] - 1s 1us/step
```

In[8]:

```
PATH1 = os.path.join(os.path.dirname(path_to_zip1), 'sketches/')

PATH2 = os.path.join(os.path.dirname(path_to_zip2), 'photos/')

PATH3 = os.path.join(os.path.dirname(path_to_zip3), 'sketches/')

PATH4 = os.path.join(os.path.dirname(path_to_zip4), 'photos/')
```

Data Preprocessing

In[9]:

```
def numpyimage(sketch_image_file, original_image):
  image1 = cv.imread(sketch_image_file)
  image2 = cv.imread(original_image)
  return image1, image2
```

In[10]:

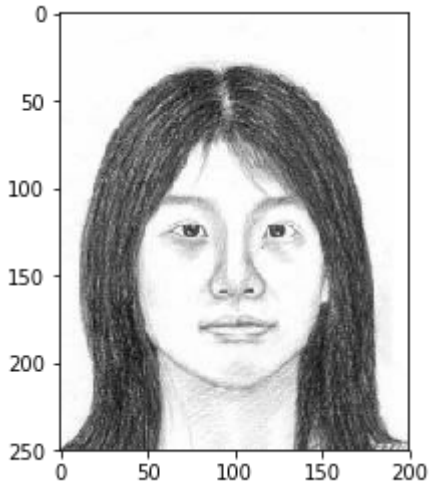
```
def load(sketch_image_file, original_image):
  # image1 = cv.imread(sketch_image_file)
  # image2 = cv.imread(original_image)
  image1 = tf.io.read_file(sketch_image_file)
  image1 = tf.image.decode_jpeg(image1,channels=3)


  image2 = tf.io.read_file(original_image)
  image2 = tf.image.decode_jpeg(image2,channels=3)


  image1 = tf.cast(image1, tf.float32)
  image2 = tf.cast(image2, tf.float32)
  # real_image = image[:, :w, :]
  # input_image = image[:, w:, :]

  # input_image = tf.cast(image1, tf.float32)
  # real_image = tf.cast(image2, tf.float32)

  return image1, image2
```

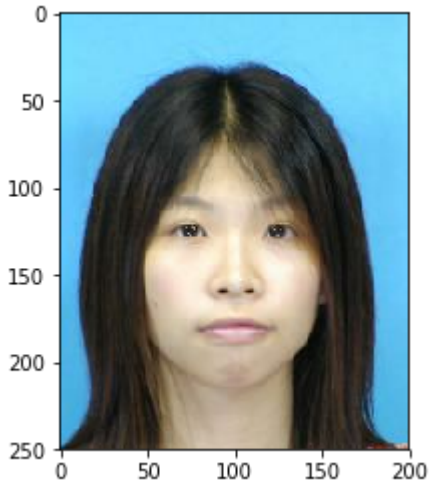
In[11]:

```
inp, re = load(PATH1+'F2-005-01-sz1.jpg', PATH2+'f-005-01.jpg')
# casting to int for matplotlib to show the image
plt.figure()
plt.imshow(inp/255.0)
plt.figure()
plt.imshow(re/255.0)
```

Out[11]:

```
<matplotlib.image.AxesImage at 0x7f327c070320>
```





In[12]:

```
print(re.shape)

print(inp.shape)
```

```
(250, 200, 3)
(250, 200, 3)
```

In[13]:

```
def resize(input_image, real_image, height, width):
  input_image = tf.image.resize(input_image, [height, width],
                                method=tf.image.ResizeMethod.NEAREST_NEIGHBOR)
  real_image = tf.image.resize(real_image, [height, width],
                               method=tf.image.ResizeMethod.NEAREST_NEIGHBOR)

  return input_image, real_image
```

In[14]:

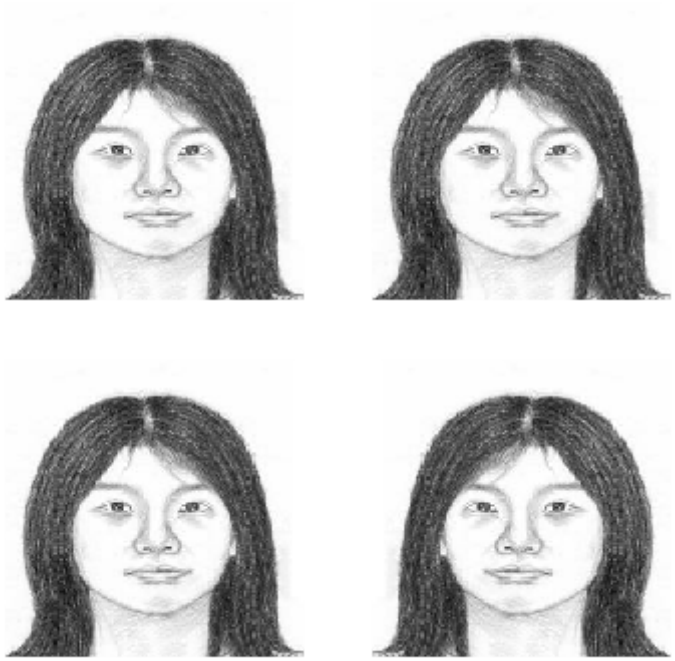
```
def random_jitter(input_image, real_image):
  # resizing to 286 x 286 x 3
  input_image, real_image = resize(input_image, real_image, 256, 256)

  if tf.random.uniform(()) > 0.5:
    # random mirroring
    input_image = tf.image.flip_left_right(input_image)
    real_image = tf.image.flip_left_right(real_image)

  return input_image, real_image
```

In[15]:

```
def normalize(input_image, real_image):
  input_image = (input_image / 127.5) - 1
  real_image = (real_image / 127.5) - 1

  return input_image, real_image
```

In[16]:

```
plt.figure(figsize=(6, 6))
for i in range(4):
  rj_inp, rj_re = random_jitter(inp, re)
  plt.subplot(2, 2, i+1)
  plt.imshow(rj_inp/255)
  plt.axis('off')
plt.show()
```



In[17]:
```
rj_inp.shape
```

Out[17]:
```
TensorShape([256, 256, 3])
```

In[18]:
```
import glob
train_sketch = glob.glob(path+"/pix2pix/train/sketches/*")
train_photo = glob.glob(path+"/pix2pix/train/photos/*")
```

In[19]:
```
test_sketch = glob.glob(path+"/pix2pix/test/sketches/*")
test_photo = glob.glob(path+"/pix2pix/test/photos/*")
```

In[20]:
```
train_sketch = sorted(train_sketch)
train_photo = sorted(train_photo)
```

In[21]:
```
test_sketch = sorted(test_sketch)
test_photo = sorted(test_photo)
```

In[22]:

```
train=[]
for i in range(0,88):
  train.append(train_sketch[i]+' '+train_photo[i])
```

In[23]:

```
test=[]
for i in range(0,100):
  test.append(test_sketch[i]+' '+test_photo[i])
```

In[24]:

```
#mkdir concat make the direcory are location below if not avaiable
# /root/.keras/datasets/pix2pix/train/concat/
# /root/.keras/datasets/pix2pix/test/concat/
```

In[25]:

```
j=0
for i in train:
  im = i.split(' ')
  # print(im)
  im[0],im[1] = numpyimage(im[0], im[1])
  im_v = cv.hconcat([im[0], im[1]])
  cv.imwrite(path+'/pix2pix/train/concat/'+str(j)+'_merged.jpg', im_v)
  # plt.figure()
  # # plt.imshow(im_v/255.0)
  j = j+1
```

In[26]:

```
j=0
for i in test:
  im = i.split(' ')
  # print(im)
  im[0],im[1] = numpyimage(im[0], im[1])
  im_v = cv.hconcat([im[0], im[1]])
  cv.imwrite(path+'/pix2pix/test/concat/'+str(j)+'_merged.jpg', im_v)
  # plt.figure()
  # # plt.imshow(im_v/255.0)
  j = j+1
```

In[27]:

```
BUFFER_SIZE = 400
BATCH_SIZE = 1
IMG_WIDTH = 256
IMG_HEIGHT = 256
```

In[28]:

```
def load2(image_file):
  image = tf.io.read_file(image_file)
  image = tf.image.decode_jpeg(image)

  w = tf.shape(image)[1]

  w = w // 2
  input_image = image[:, :w, :]
  real_image = image[:, w:, :]
  input_image = tf.cast(input_image, tf.float32)
  real_image = tf.cast(real_image, tf.float32)

  return input_image, real_image
```

In[29]:

```
def load_image_train(image_file):
  input_image, real_image = load2(image_file)
  input_image, real_image = random_jitter(input_image, real_image)
  input_image, real_image = normalize(input_image, real_image)

  return input_image, real_image
```

In[30]:

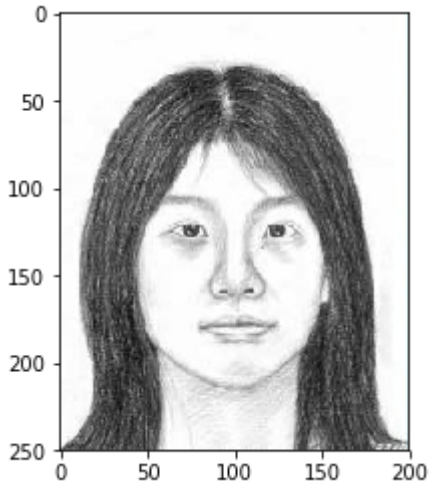
```
def load_image_test(image_file):
  input_image, real_image = load2(image_file)
  input_image, real_image = resize(input_image, real_image,
                                   IMG_HEIGHT, IMG_WIDTH)
  input_image, real_image = normalize(input_image, real_image)

  return input_image, real_image
```

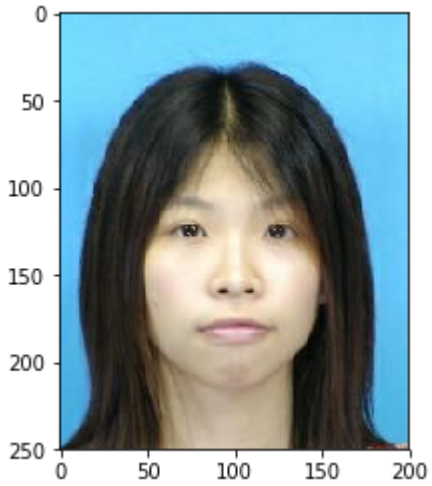
In[31]:

```
inp, re = load2(path+'/pix2pix/train/concat/0_merged.jpg')
# casting to int for matplotlib to show the image
plt.figure()
plt.imshow(inp/255.0)
plt.figure()
plt.imshow(re/255.0)
```

Out[31]:

```
<matplotlib.image.AxesImage at 0x7f326409e860>
```





In[32]:

```
train_dataset = tf.data.Dataset.list_files(path+'/pix2pix/train/concat/*.jpg')
train_dataset = train_dataset.map(load_image_train,
                                  num_parallel_calls=tf.data.experimental.AUTOTUNE)
train_dataset = train_dataset.shuffle(BUFFER_SIZE)
train_dataset = train_dataset.batch(BATCH_SIZE)
```

In[33]:

```
test_dataset = tf.data.Dataset.list_files(path+'/pix2pix/test/concat/*.jpg')
test_dataset = test_dataset.map(load_image_train,
                                  num_parallel_calls=tf.data.experimental.AUTOTUNE)
test_dataset = test_dataset.shuffle(BUFFER_SIZE)
test_dataset = test_dataset.batch(BATCH_SIZE)
```

Build Generator

In[34]:

```
def downsample(filters, size, apply_batchnorm=True):
  initializer = tf.random_normal_initializer(0., 0.02)

  result = Sequential()
  result.add(Conv2D(filters, size, strides=2, padding='same',
                            kernel_initializer=initializer, use_bias=False))
  if apply_batchnorm:
    result.add(BatchNormalization())
  result.add(LeakyReLU())
  return result
```

In[35]:

```
def upsample(filters, size, apply_dropout=False):
  initializer = tf.random_normal_initializer(0., 0.02)
  result = Sequential()
  result.add(Conv2DTranspose(filters, size, strides=2,
                                  padding='same',
                                  kernel_initializer=initializer,
                                  use_bias=False))
  result.add(BatchNormalization())
  if apply_dropout:
      result.add(Dropout(0.5))
  result.add(ReLU())
  return result
```

In[36]:

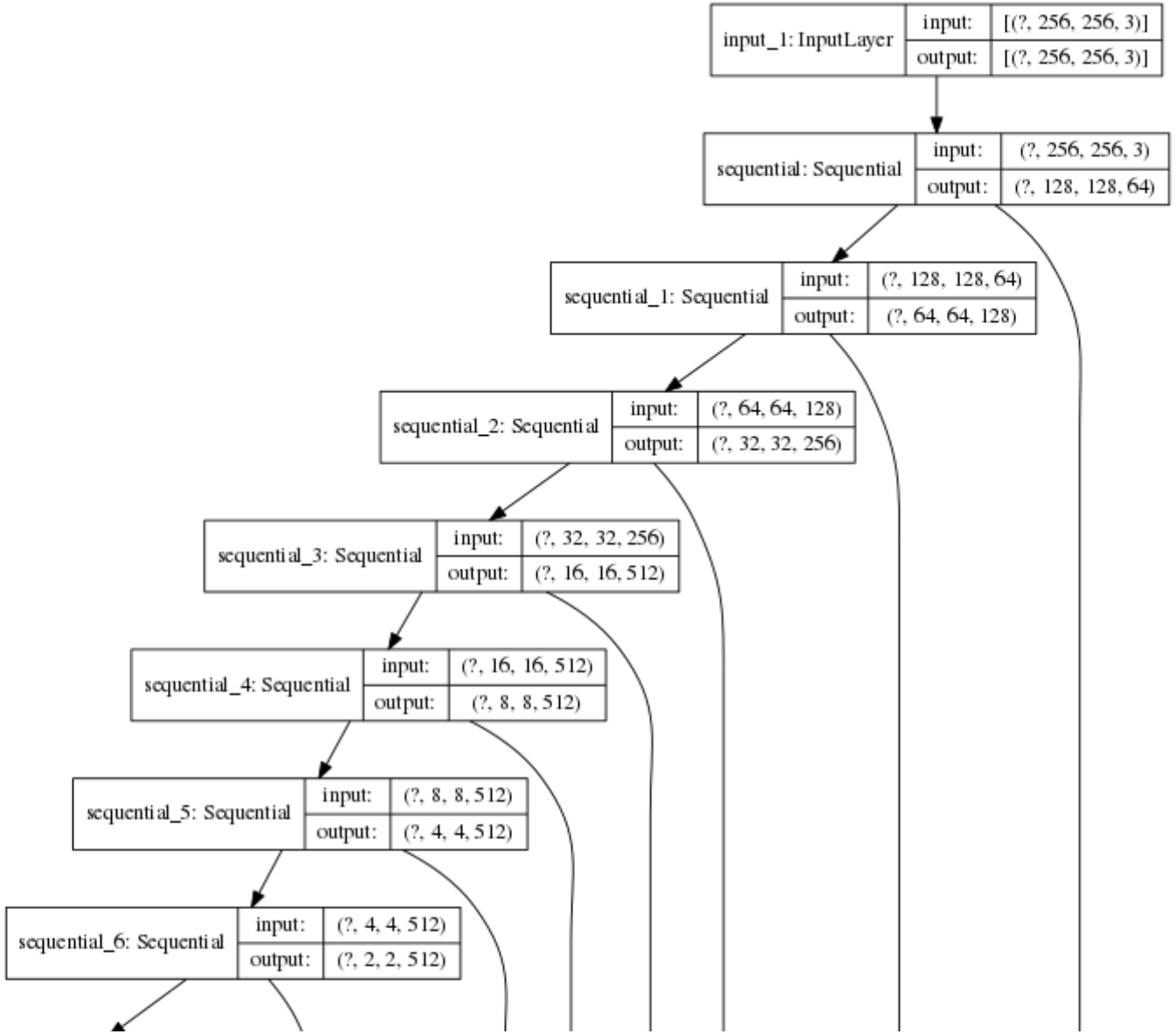
```
def Generator():
  inputs = Input(shape=[256,256,3])
  down_stack = [
    downsample(64, 4, apply_batchnorm=False), # (bs, 128, 128, 64)
    downsample(128, 4), # (bs, 64, 64, 128)
    downsample(256, 4), # (bs, 32, 32, 256)
    downsample(512, 4), # (bs, 16, 16, 512)
    downsample(512, 4), # (bs, 8, 8, 512)
    downsample(512, 4), # (bs, 4, 4, 512)
    downsample(512, 4), # (bs, 2, 2, 512)
    downsample(512, 4), # (bs, 1, 1, 512)
  ]
  up_stack = [
    upsample(512, 4, apply_dropout=True), # (bs, 2, 2, 1024)
    upsample(512, 4, apply_dropout=True), # (bs, 4, 4, 1024)
    upsample(512, 4, apply_dropout=True), # (bs, 8, 8, 1024)
    upsample(512, 4), # (bs, 16, 16, 1024)
    upsample(256, 4), # (bs, 32, 32, 512)
    upsample(128, 4), # (bs, 64, 64, 256)
    upsample(64, 4), # (bs, 128, 128, 128)
  ]

  initializer = tf.random_normal_initializer(0., 0.02)
  last = Conv2DTranspose(OUTPUT_CHANNELS, 4,
                                      strides=2,
                                      padding='same',
                                      kernel_initializer=initializer,
                                      activation='tanh') # (bs, 256, 256, 3)

  x = inputs
  # Downsampling through the model
  skips = []
  for down in down_stack:
    x = down(x)
    skips.append(x)
```

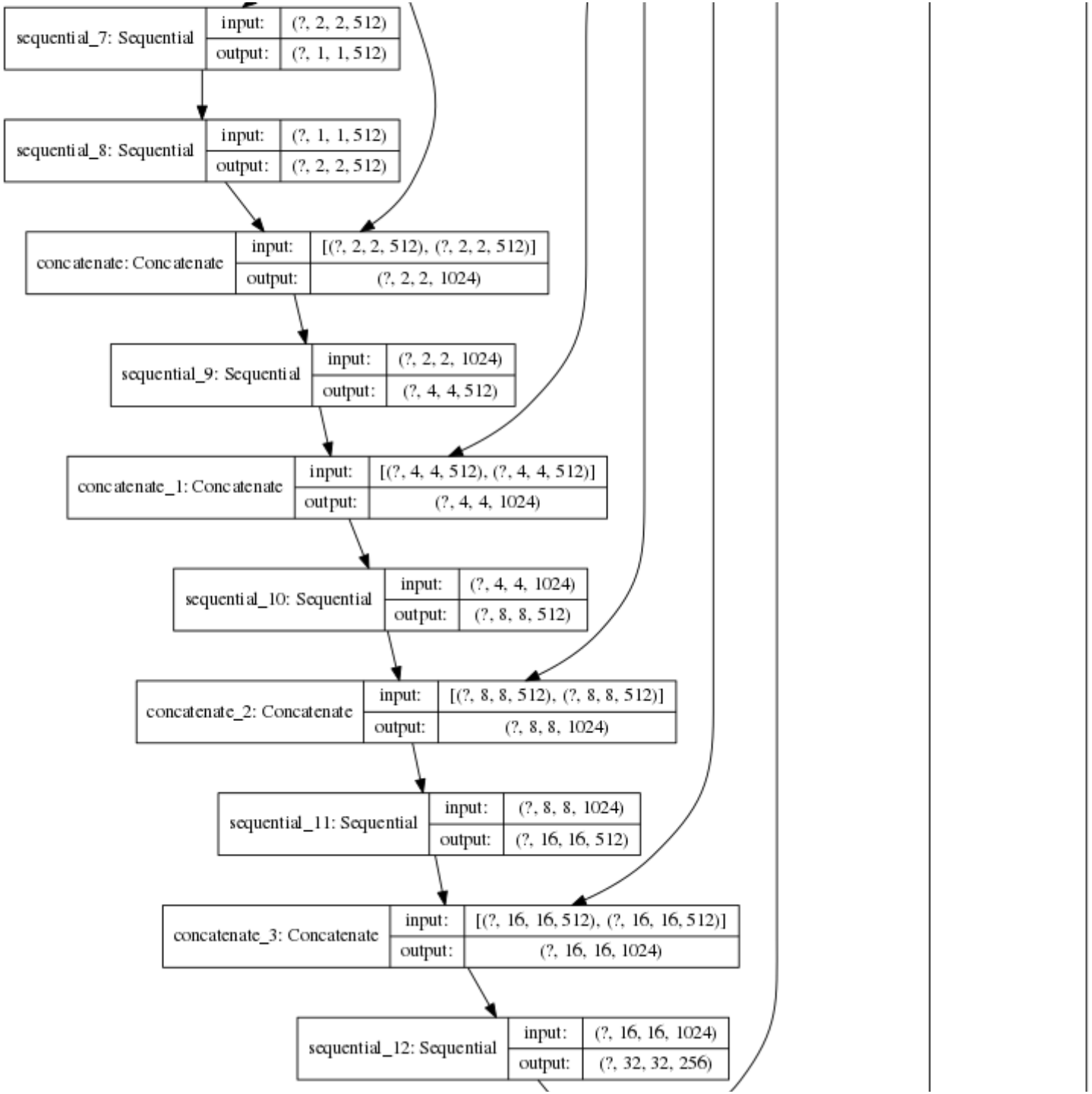
```
    skips = reversed(skips[:-1])

    # Upsampling and establishing the skip connections
    for up, skip in zip(up_stack, skips):
      x = up(x)
      x = Concatenate()([x, skip])
    x = last(x)
    return Model(inputs=inputs, outputs=x)
```

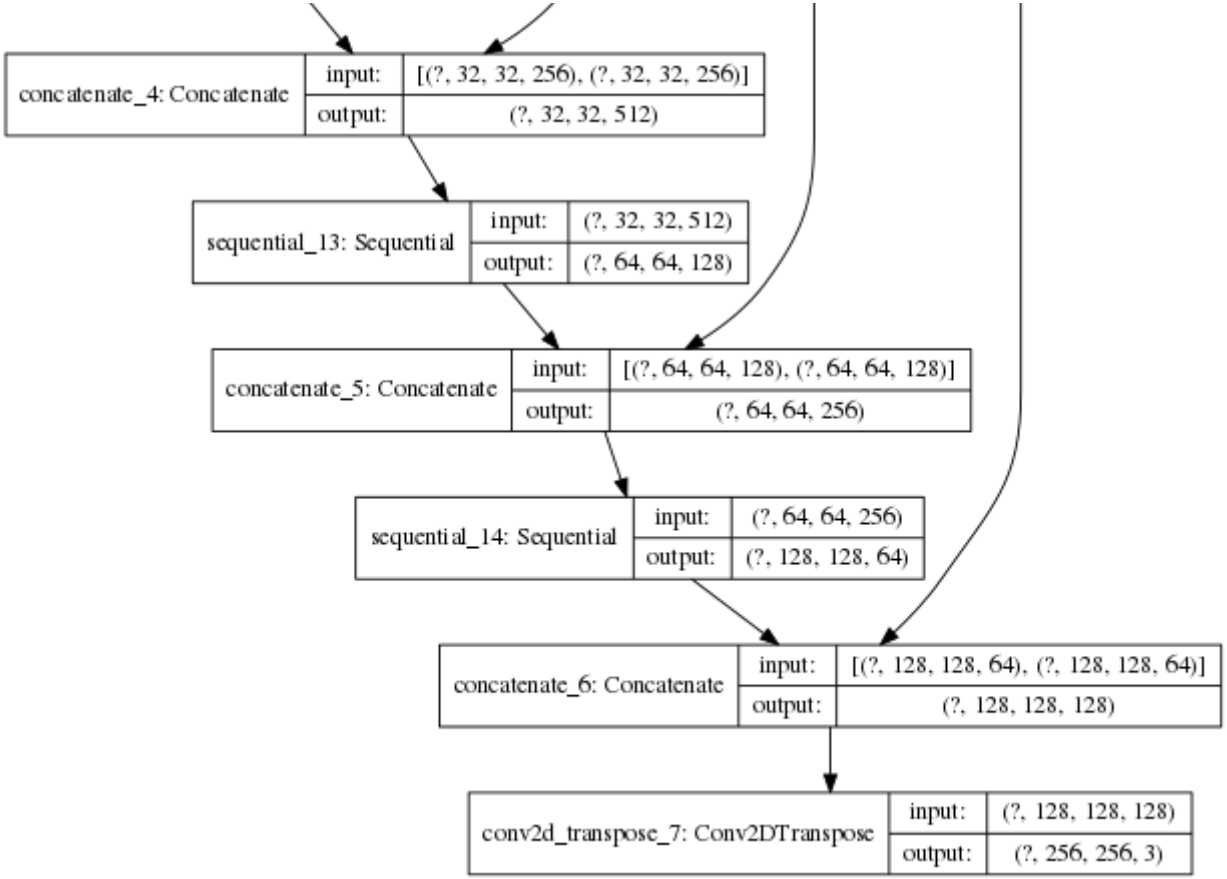
In[37]:

```
OUTPUT_CHANNELS = 3
generator = Generator()
tf.keras.utils.plot_model(generator, show_shapes=True, dpi=64)
```

Out[37]:




sequential_7: Sequential
input: (?, 2, 2, 512)
output: (?, 1, 1, 512)
sequential_8: Sequential
input: (?, 1, 1, 512)
output: (?, 2, 2, 512)
concatenate: Concatenate
input: [(?, 2, 2, 512), (?, 2, 2, 512)]
output: (?, 2, 2, 1024)
sequential_9: Sequential
input: (?, 2, 2, 1024)
output: (?, 4, 4, 512)
concatenate_1: Concatenate
input: [(?, 4, 4, 512), (?, 4, 4, 512)]
output: (?, 4, 4, 1024)
sequential_10: Sequential
input: (?, 4, 4, 1024)
output: (?, 8, 8, 512)
concatenate_2: Concatenate
input: [(?, 8, 8, 512), (?, 8, 8, 512)]
output: (?, 8, 8, 1024)
sequential_11: Sequential
input: (?, 8, 8, 1024)
output: (?, 16, 16, 512)
concatenate_3: Concatenate
input: [(?, 16, 16, 512), (?, 16, 16, 512)]
output: (?, 16, 16, 1024)
sequential_12: Sequential
input: (?, 16, 16, 1024)
output: (?, 32, 32, 256)

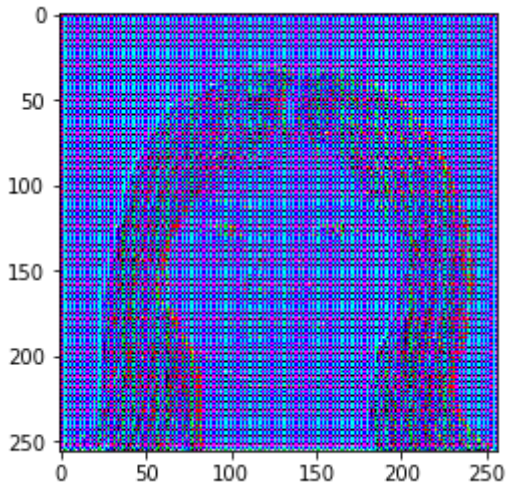

concatenate_4: Concatenate
input: [(?, 32, 32, 256), (?, 32, 32, 256)]
output: (?, 32, 32, 512)
sequential_13: Sequential
input: (?, 32, 32, 512)
output: (?, 64, 64, 128)
concatenate_5: Concatenate
input: [(?, 64, 64, 128), (?, 64, 64, 128)]
output: (?, 64, 64, 256)
sequential_14: Sequential
input: (?, 64, 64, 256)
output: (?, 128, 128, 64)
concatenate_6: Concatenate
input: [(?, 128, 128, 64), (?, 128, 128, 64)]
output: (?, 128, 128, 128)
conv2d_transpose_7: Conv2DTranspose
input: (?, 128, 128, 128)
output: (?, 256, 256, 3)

In[38]:

```
gen_output = generator(rj_inp[tf.newaxis,...])
plt.imshow(gen_output[0,...])
```

Out[38]:

```
<matplotlib.image.AxesImage at 0x7f323e0a9860>
```



In[39]:

```
LAMBDA = 100 # it depends on  how our model is perfroming
# we should try with different value to see the result
```

In[40]:

```
def generator_loss(disc_generated_output, gen_output, target):
  gan_loss = loss_object(tf.ones_like(disc_generated_output), disc_generated_output)

  # mean absolute error
  l1_loss = tf.reduce_mean(tf.abs(target - gen_output))

  total_gen_loss = gan_loss + (LAMBDA * l1_loss)

  return total_gen_loss, gan_loss, l1_loss
```

In[41]:

```
def generator_acc(disc_generated_output, gen_output, target):
  gan_loss = loss_object(tf.ones_like(disc_generated_output), disc_generated_output)

  # mean absolute error
  l1_loss = tf.reduce_mean(tf.abs(target - gen_output))

  total_gen_loss = gan_loss + (LAMBDA * l1_loss)

  return total_gen_loss, gan_loss, l1_loss
```

Build Discriminator

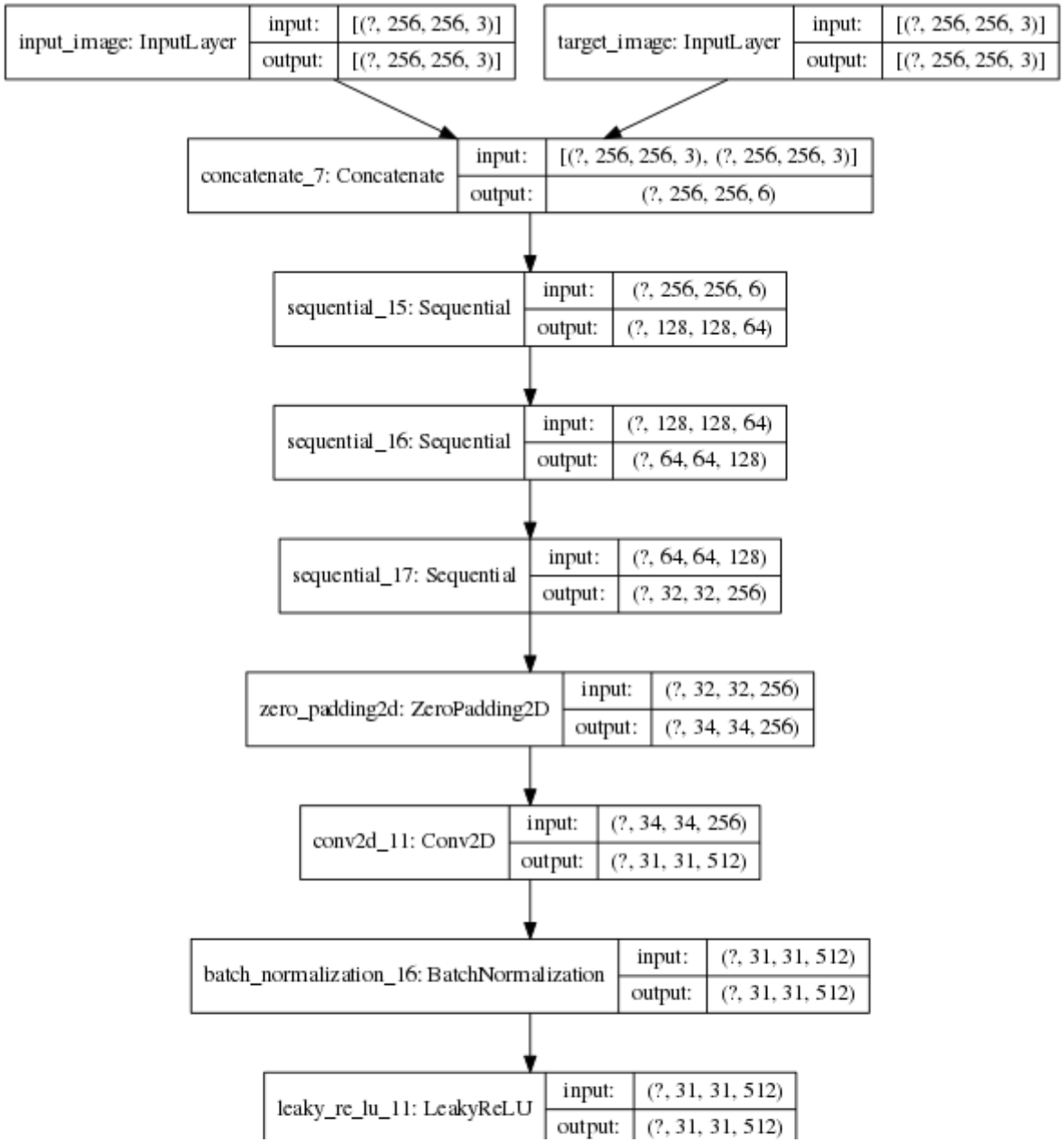
In[42]:

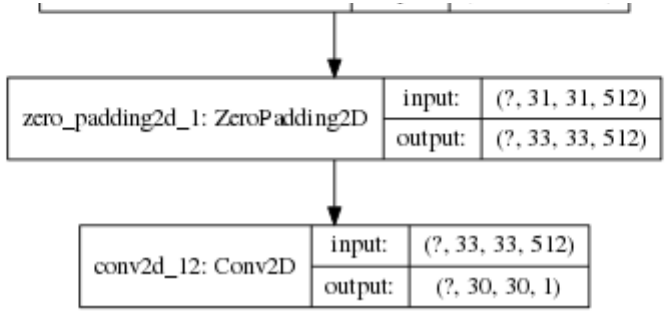
```
def Discriminator():
  initializer = tf.random_normal_initializer(0., 0.02)

  inp = Input(shape=[256, 256, 3], name='input_image')
  tar = Input(shape=[256, 256, 3], name='target_image')

  x = concatenate([inp, tar]) # (bs, 256, 256, channels*2)

  down1 = downsample(64, 4, False)(x) # (bs, 128, 128, 64)
  down2 = downsample(128, 4)(down1) # (bs, 64, 64, 128)
  down3 = downsample(256, 4)(down2) # (bs, 32, 32, 256)

  zero_pad1 = ZeroPadding2D()(down3) # (bs, 34, 34, 256)
  conv = Conv2D(512, 4, strides=1,
                                kernel_initializer=initializer,
                                use_bias=False)(zero_pad1) # (bs, 31, 31, 512)

  batchnorm1 = BatchNormalization()(conv)

  leaky_relu = LeakyReLU()(batchnorm1)

  zero_pad2 = ZeroPadding2D()(leaky_relu) # (bs, 33, 33, 512)

  last = Conv2D(1, 4, strides=1,
                                kernel_initializer=initializer)(zero_pad2) # (bs, 30, 30, 1)

  return Model(inputs=[inp, tar], outputs=last)
```

In[43]:

```
discriminator = Discriminator()
tf.keras.utils.plot_model(discriminator, show_shapes=True, dpi=64)
```

Out[43]:



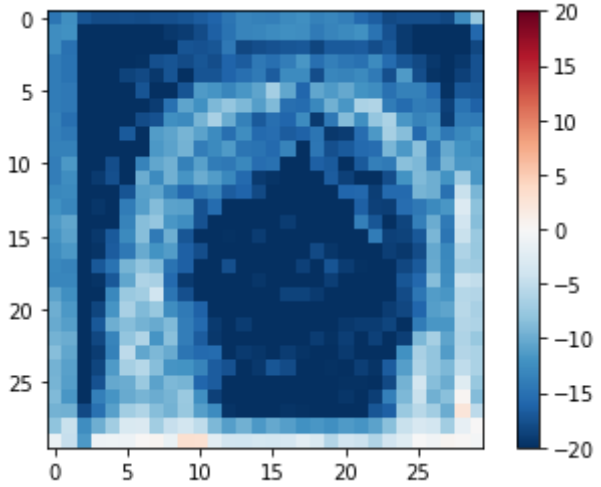


In[44]:

```
disc_out = discriminator([rj_inp[tf.newaxis,...], gen_output], training=False)
plt.imshow(disc_out[0,...,-1], vmin=-20, vmax=20, cmap='RdBu_r')
plt.colorbar()
```

Out[44]:

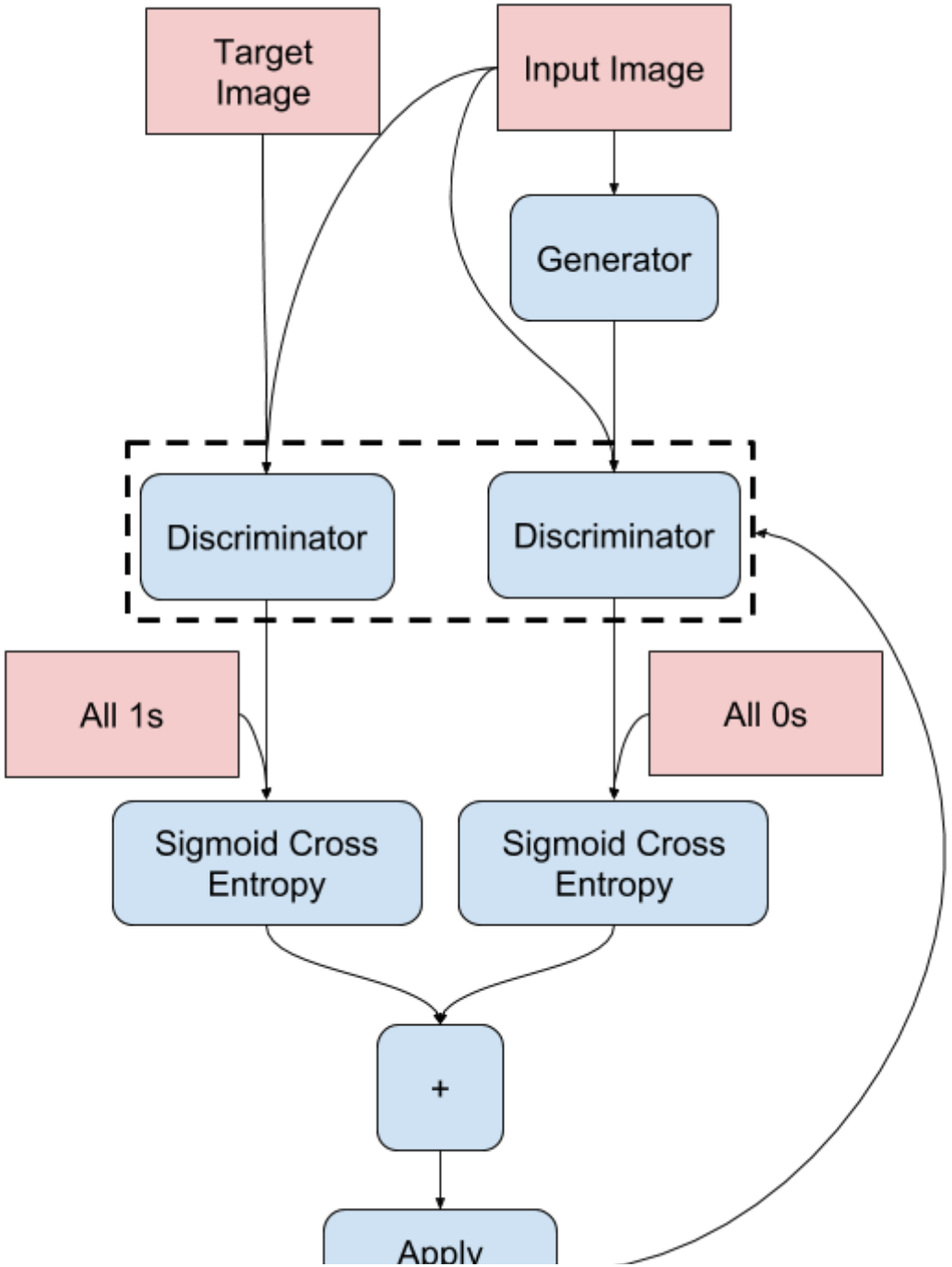
```
<matplotlib.colorbar.Colorbar at 0x7f2e6a67f438>
```

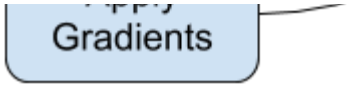


In[45]:

```
loss_object = tf.keras.losses.BinaryCrossentropy(from_logits=True)
def discriminator_loss(disc_real_output, disc_generated_output):
  real_loss = loss_object(tf.ones_like(disc_real_output), disc_real_output)

  generated_loss = loss_object(tf.zeros_like(disc_generated_output), disc_generated_output)

  total_disc_loss = real_loss + generated_loss

  return total_disc_loss
```

Type *Markdown* and LaTeX: α^2


Target Image
Input Image
Generator
Discriminator
Discriminator
All 1s
All 0s
Sigmoid Cross Entropy
Sigmoid Cross Entropy
+
Apply



In[46]:

```
generator_optimizer = tf.keras.optimizers.Adam(2e-4, beta_1=0.5)
discriminator_optimizer = tf.keras.optimizers.Adam(2e-4, beta_1=0.5)
```

In[47]:

```
checkpoint_dir = './training_checkpoints'
checkpoint_prefix = os.path.join(checkpoint_dir, "ckpt")
checkpoint = tf.train.Checkpoint(generator_optimizer=generator_optimizer,
                                 discriminator_optimizer=discriminator_optimizer,
                                 generator=generator,
                                 discriminator=discriminator)
```

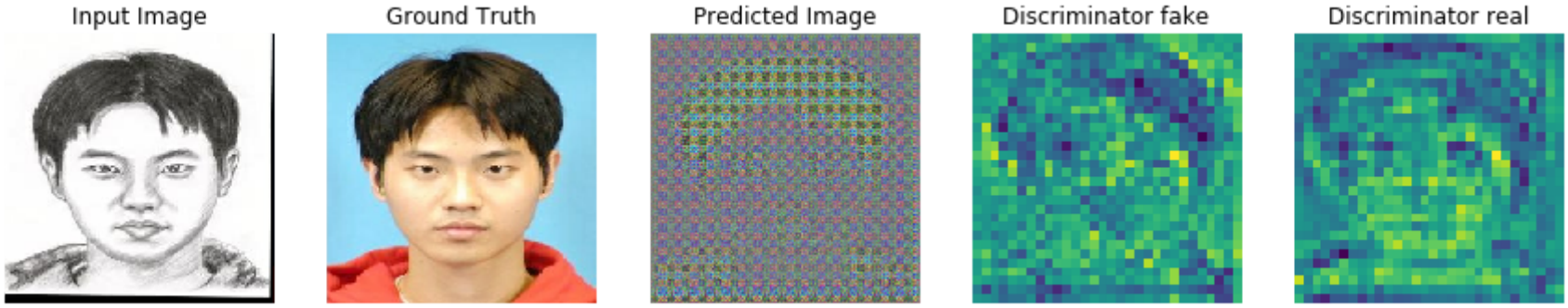
Below function is to see the output of the images from the model

In[48]:

```
def generate_images(model, test_input, tar):
  prediction = model(test_input, training=True)
  disc_out1 = discriminator([test_input[...], prediction], training=True)
  disc_out2 = discriminator([test_input[...], tar], training=True)
  plt.figure(figsize=(15,15))

  display_list = [test_input[0], tar[0], prediction[0],disc_out1[0][...,-1],disc_out2[0][...,-1]]
  title = ['Input Image', 'Ground Truth', 'Predicted Image','Discriminator fake','Discriminator real']

  for i in range(5):
    plt.subplot(1, 5, i+1)
    plt.title(title[i])
    # getting the pixel values between [0, 1] to plot it.
    plt.imshow(display_list[i] * 0.5 + 0.5)
    plt.axis('off')
  plt.show()
```

In[49]:

```
# we predict the image when model is untrained at the begining
for example_input, example_target in test_dataset.take(1):
  generate_images(generator, example_input, example_target)
```



Training

In[50]:

```
EPOCHS = 300
```

In[51]:

```
import datetime
log_dir=path+"/pix2pix/logs/"

summary_writer = tf.summary.create_file_writer(
  log_dir + "fit/" + datetime.datetime.now().strftime("%Y%m%d-%H%M%S"))
```

In[52]:
```
pwd
```

Out[52]:
```
'/kaggle/working/pix2pix'
```

In[53]:

```
@tf.function
def train_step(input_image, target, epoch):
  with tf.GradientTape() as gen_tape, tf.GradientTape() as disc_tape:
    gen_output = generator(input_image, training=True)
    disc_real_output = discriminator([input_image, target], training=True)
    disc_generated_output = discriminator([input_image, gen_output], training=True)

    gen_total_loss, gen_gan_loss, gen_l1_loss = generator_loss(disc_generated_output, gen_output, target)

    disc_loss = discriminator_loss(disc_real_output, disc_generated_output)

  generator_gradients = gen_tape.gradient(gen_total_loss,
                                          generator.trainable_variables)

  discriminator_gradients = disc_tape.gradient(disc_loss,
                                               discriminator.trainable_variables)

  generator_optimizer.apply_gradients(zip(generator_gradients,
                                          generator.trainable_variables))
  discriminator_optimizer.apply_gradients(zip(discriminator_gradients,
                                              discriminator.trainable_variables))

  with summary_writer.as_default():
    tf.summary.scalar('gen_total_loss', gen_total_loss, step=epoch)
    tf.summary.scalar('gen_gan_loss', gen_gan_loss, step=epoch)
    tf.summary.scalar('gen_l1_loss', gen_l1_loss, step=epoch)
    tf.summary.scalar('disc_loss', disc_loss, step=epoch)
```

In[54]:

```
def fit(train_ds, epochs, test_ds):
  for epoch in range(epochs):
    start = time.time()

    display.clear_output(wait=True)

    for example_input, example_target in test_ds.take(1):
      generate_images(generator, example_input, example_target)
    print("Epoch: ", epoch)

    # Train
    for n, (input_image, target) in train_ds.enumerate():
      print('.', end='')
      if (n+1) % 100 == 0:
        print()
      train_step(input_image, target, epoch)
    print()

#     # saving (checkpoint) the model every  epochs
#     if (epoch + 1) % 20 == 0:
#       checkpoint.save(file_prefix = checkpoint_prefix)

#     print ('Time taken for epoch {} is {} sec\n'.format(epoch + 1,
#                                                         time.time()-start))
  checkpoint.save(file_prefix = checkpoint_prefix)
```

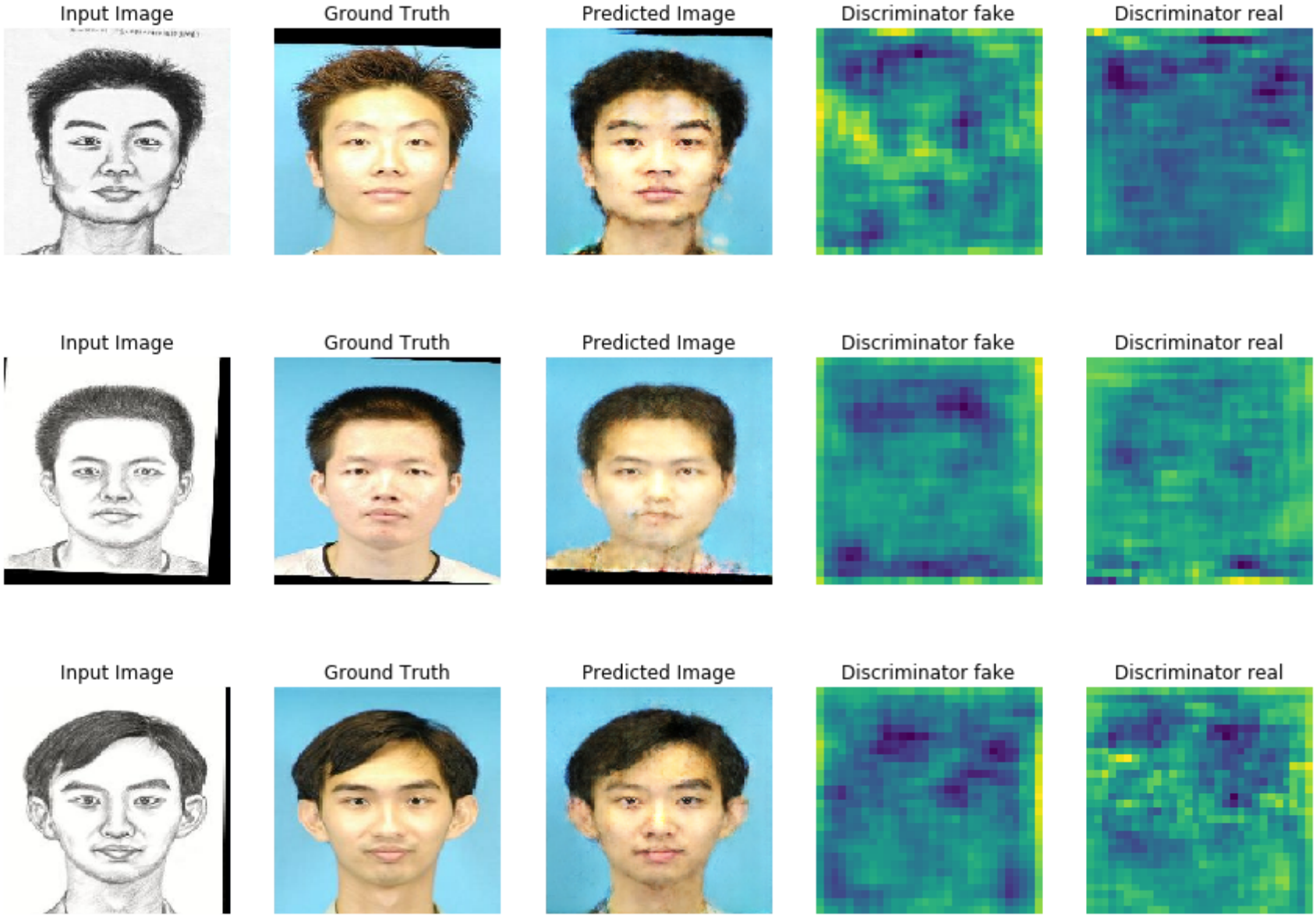
In[55]:

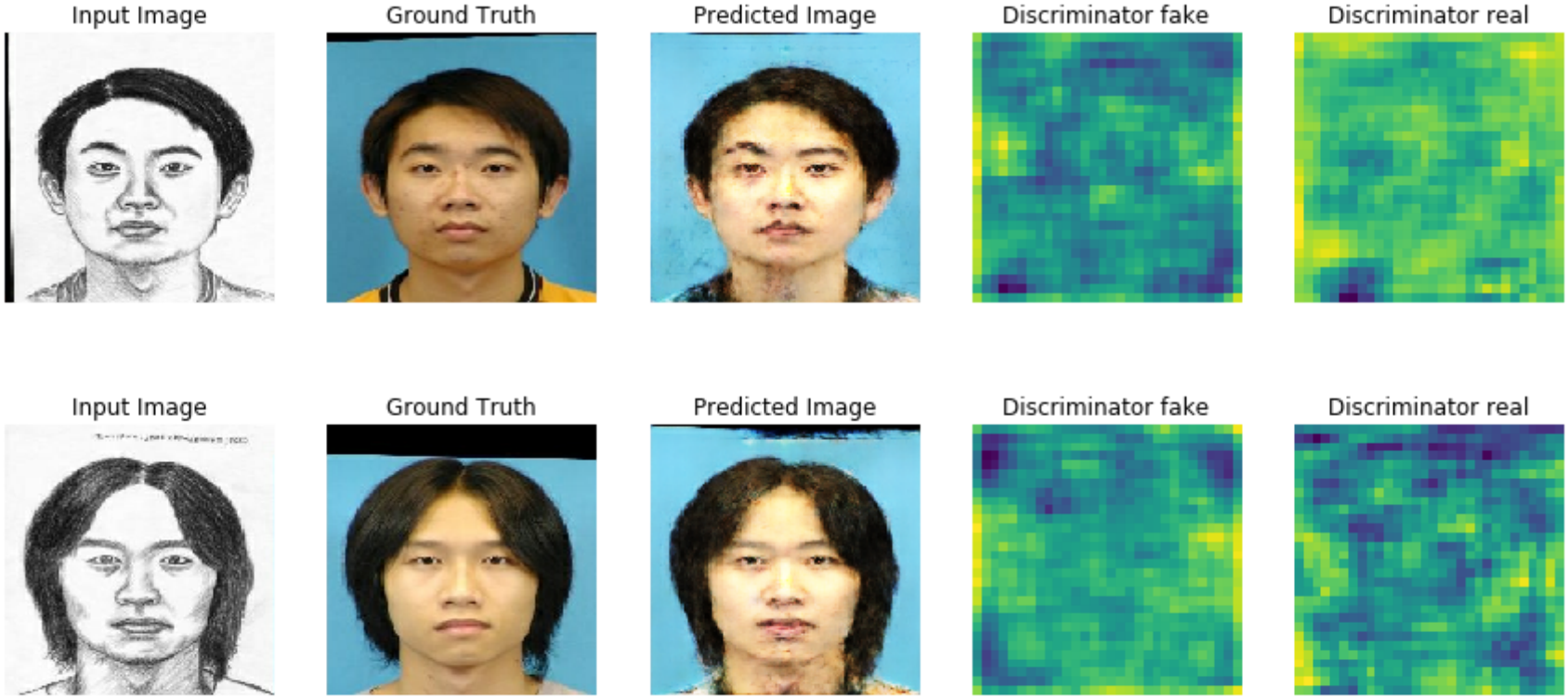
```
# if you are running for less epochs
#put it manually
fit(train_dataset, EPOCHS, test_dataset)
```

Epoch: 299

In[56]:

```
for inp, tar in test_dataset.take(5):
  generate_images(generator, inp, tar)
```





In[57]:

```
tf.saved_model.save(generator, path+"/pix2pix/")
```

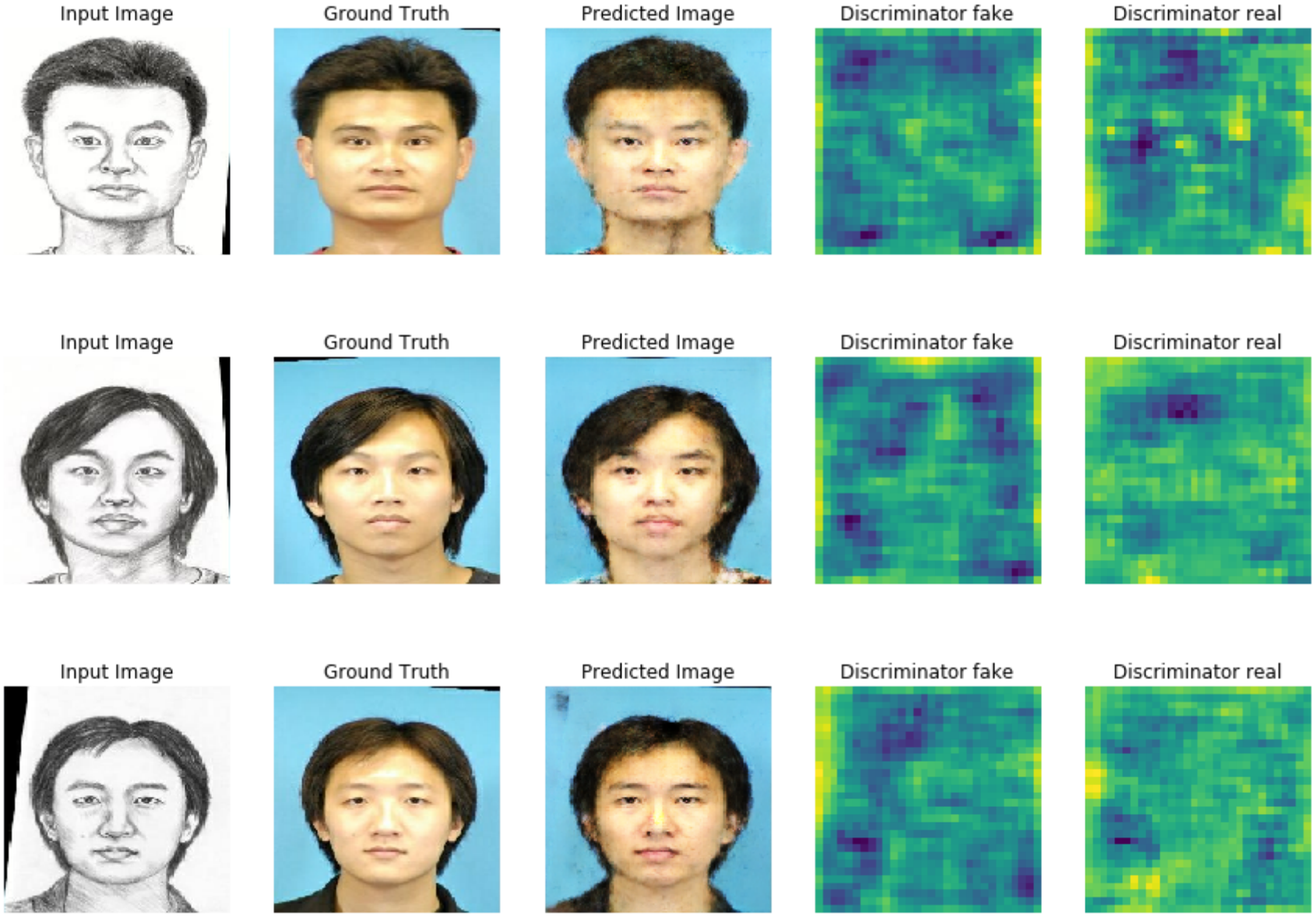
In[58]:

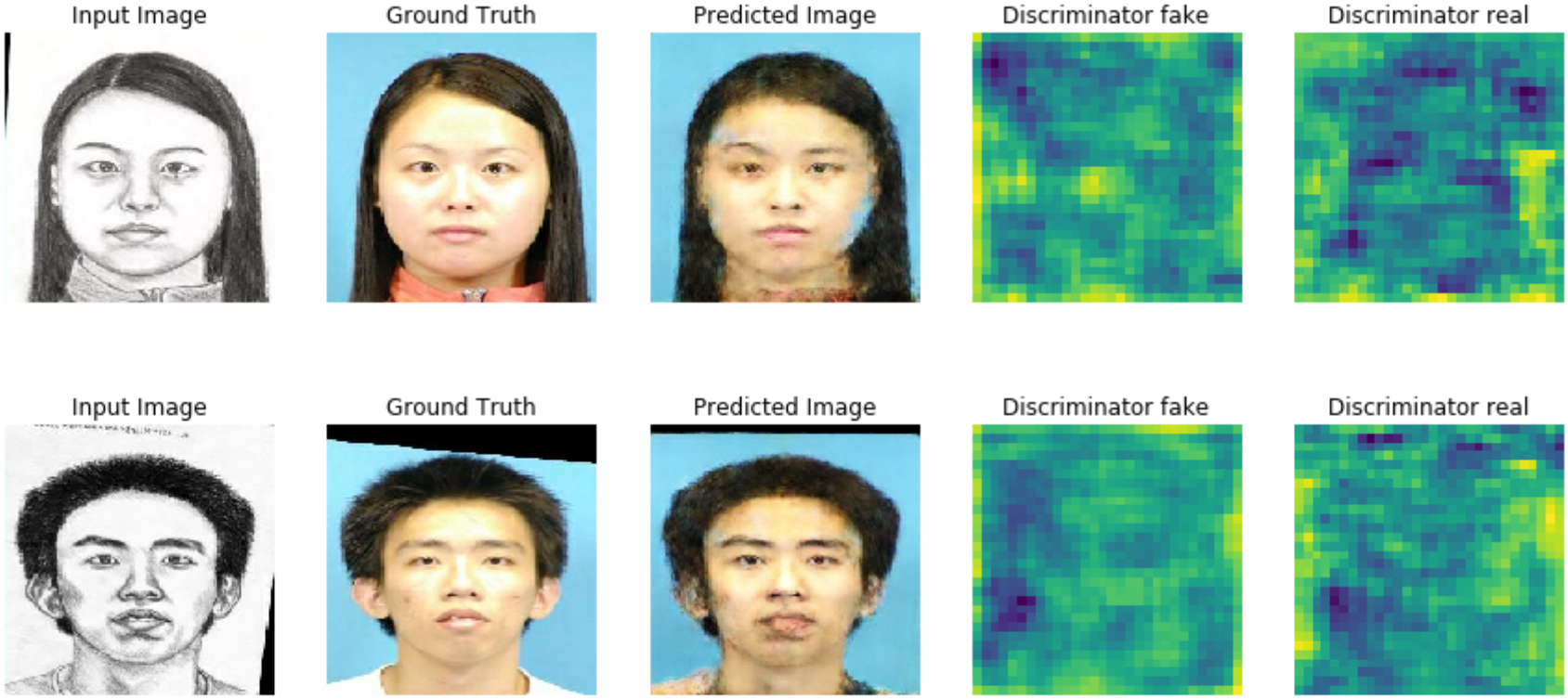
```
loaded = tf.saved_model.load(path+"/pix2pix/")
print(list(loaded.signatures.keys()))  # ["serving_default"]
```

```
['serving_default']
```

In[65]:

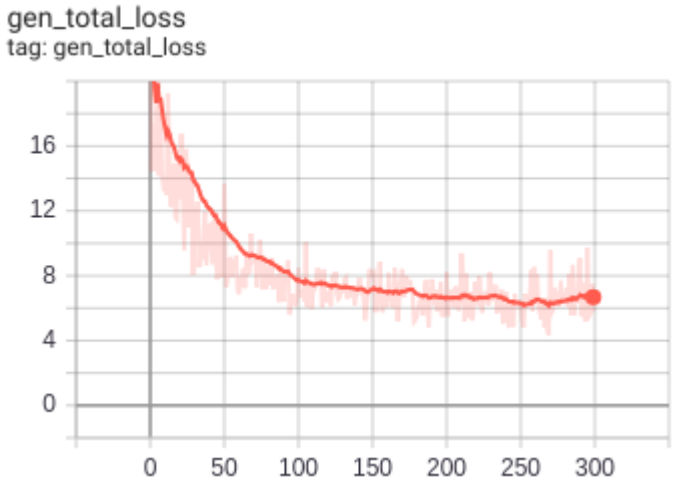
```
for inp, tar in test_dataset.take(5):
  generate_images(loaded, inp, tar)
```



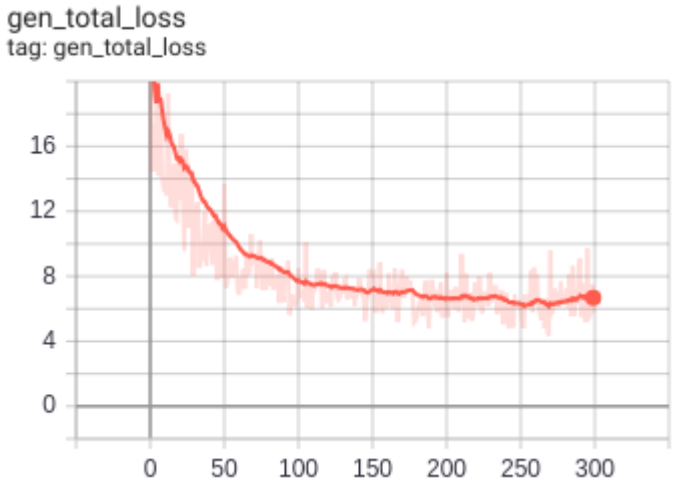


Output of all the loses can be seen on below link

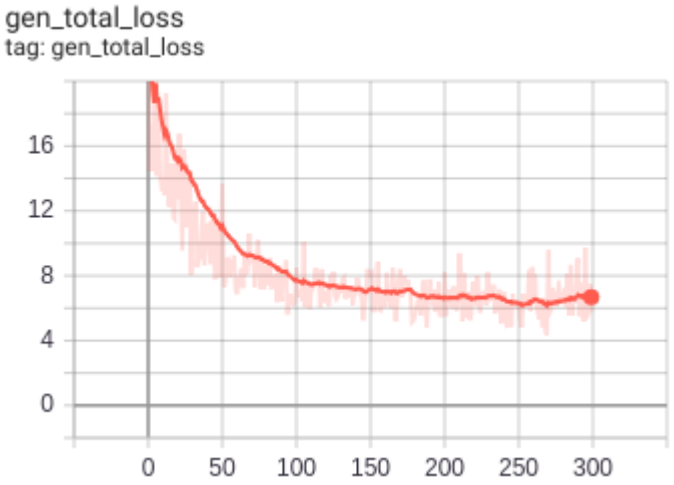
we have ploted three losses for the moment dic loss



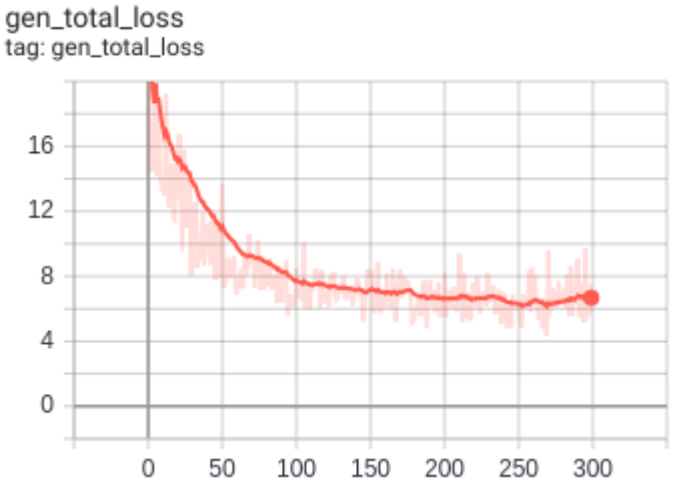
gan loss



l1 loss



total gan loss



https://tensorboard.dev/experiment/kqb3403oQx28K5CBpGRUrg/#scalars&_smoothingWeight=0.945 (https://tensorboard.dev/experiment/kqb3403oQx28K5CBpGRUrg/#scalars&_smoothingWeight=0.945)

Refered from the notebook pix2pix

(https://colab.research.google.com/github/tensorflow/docs/blob/master/site/en/tutorials/generative/pix2pix.ipynb#scrollTo=DMTm4peo
(https://colab.research.google.com/github/tensorflow/docs/blob/master/site/en/tutorials/generative/pix2pix.ipynb#scrollTo=DMTm4peo

Interpreting the logs from a GAN is more subtle than a simple classification or regression model. Things to look for::

** Check that neither model has "won". If either the `gen_gan_loss` or the `disc_loss` gets very low it's an indicator that this model is dominating the other, and you are not successfully training the combined model.*

** The value `log(2) = 0.69` is a good reference point for these losses, as it indicates a perplexity of 2: That the discriminator is on average equally uncertain about the two options.*

** For the `disc_**loss` a value below `0.69` means the discriminator is doing better than random, on the combined set of real+generated images.*

** For the `gen_gan_loss` a value below `0.69` means the generator i doing better than random at fooling the descriminator.*

** As training progresses the `gen_l1_loss` should go down.*

As per the given instruction our disc loss has been descreasing which shows generator was able to fool the descriminator as some extent. however the geneator gan loss has increased with the epochs

over all genloss has decreased with the epochs