anime-face-generation

March 30, 2024

0.1 Import Modules

[ ]:
```
import os
import numpy as np
import matplotlib.pyplot as plt
import warnings
from tqdm.notebook import tqdm

import tensorflow as tf
from tensorflow import keras
from tensorflow.keras.preprocessing.image import load_img, array_to_img
from tensorflow.keras.models import Sequential, Model
from tensorflow.keras import layers
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.losses import BinaryCrossentropy

warnings.filterwarnings('ignore')
```

0.2 Load the files

[ ]:
```
BASE_DIR = '/kaggle/input/anime-faces/data/'
```

[ ]:
```
# load complete image paths to the list
image_paths = []
for image_name in os.listdir(BASE_DIR):
    image_path = os.path.join(BASE_DIR, image_name)
    image_paths.append(image_path)
```

[ ]:
```
image_paths[:5]
```

[ ]:
```
['/kaggle/input/anime-faces/data/21130.png',
 '/kaggle/input/anime-faces/data/9273.png',
 '/kaggle/input/anime-faces/data/18966.png',
 '/kaggle/input/anime-faces/data/14127.png',
 '/kaggle/input/anime-faces/data/18054.png']
```

[ ]:
```
# remove unnecessary file
image_paths.remove('/kaggle/input/anime-faces/data/data')
```

[ ]:
```
len(image_paths)
```

[ ]: 21551

0.3 Visualize the Image Dataset

[ ]:
```
# to display grid of images (7x7)
plt.figure(figsize=(20, 20))
temp_images = image_paths[:49]
index = 1

for image_path in temp_images:
    plt.subplot(7, 7, index)
    # load the image
    img = load_img(image_path)
    # convert to numpy array
    img = np.array(img)
    # show the image
    plt.imshow(img)
    plt.axis('off')
    # increment the index for next image
    index += 1
```

0.4 Preprocess Images

[ ]:
```
# load the image and convert to numpy array
train_images = [np.array(load_img(path)) for path in tqdm(image_paths)]
train_images = np.array(train_images)
```

```
  0%|          | 0/21551 [00:00<?, ?it/s]
```

[ ]:
```
train_images[0].shape
```

[ ]:
```
(64, 64, 3)
```

[ ]:
```
# reshape the array
train_images = train_images.reshape(train_images.shape[0], 64, 64, 3).
 ↪astype('float32')
```

[ ]:
```
# normalize the images
train_images = (train_images - 127.5) / 127.5
```

[ ]:
```
train_images[0]
```

[ ]:
```
array([[[-0.7254902 , -0.90588236, -0.7176471 ],
        [-0.70980394, -0.88235295, -0.6862745 ],
        [-0.7019608 , -1.        , -0.7176471 ],
        …,
        [-0.09019608,  0.01176471,  0.3882353 ],
        [-0.19215687,  0.05882353,  0.4509804 ],
        [-0.34117648, -0.13725491,  0.29411766]],

       [[-0.7254902 , -0.90588236, -0.7176471 ],
        [-0.73333335, -0.8666667 , -0.7019608 ],
        [-0.52156866, -0.8666667 , -0.5686275 ],
        …,
        [-0.29411766,  0.01176471,  0.3019608 ],
        [-0.08235294,  0.15294118,  0.5294118 ],
        [-0.23921569,  0.09019608,  0.45882353]],

       [[-0.7019608 , -0.8901961 , -0.7019608 ],
        [-0.7176471 , -0.8745098 , -0.69411767],
        [-0.5686275 , -0.8509804 , -0.58431375],
        …,
        [-0.22352941,  0.1764706 ,  0.48235294],
        [-0.13725491,  0.1764706 ,  0.4745098 ],
        [-0.06666667,  0.24705882,  0.5058824 ]],

       …,

       [[-0.30980393, -0.6862745 , -0.29411766],
        [-0.34901962, -0.6862745 , -0.37254903],
        [-0.30980393, -0.5372549 , -0.35686275],
        …,
        [-0.79607844, -0.9843137 , -0.77254903],
        [-0.827451  , -0.8745098 , -0.85882354],
        [-0.7647059 , -0.92156863, -0.8039216 ]],

       [[-0.3254902 , -0.6392157 , -0.29411766],
        [-0.44313726, -0.7254902 , -0.43529412],
        [-0.54509807, -0.7882353 , -0.54509807],
        …,
```

```
        [-0.8352941 , -0.9764706 , -0.70980394],
        [-0.7254902 , -0.8745098 , -0.75686276],
        [-0.7411765 , -0.9137255 , -0.69411767]],

       [[-0.5764706 , -0.827451  , -0.54509807],
        [-0.56078434, -0.8666667 , -0.5294118 ],
        [-0.58431375, -0.85882354, -0.5764706 ],
        …,
        [-0.7411765 , -0.8666667 , -0.6156863 ],
        [-0.7254902 , -0.9372549 , -0.70980394],
        [-0.7647059 , -0.92941177, -0.7176471 ]]], dtype=float32)
```

0.5 Create Generator & Discriminator Models

[ ]:
```
# latent dimension for random noise
LATENT_DIM = 100
# weight initializer
WEIGHT_INIT = keras.initializers.RandomNormal(mean=0.0, stddev=0.02)
# no. of channels of the image
CHANNELS = 3 # for gray scale, keep it as 1
```

0.5.1 Generator Model

Generator Model will create new images similar to training data from random noise

[ ]:
```
model = Sequential(name='generator')

# 1d random noise
model.add(layers.Dense(8 * 8 * 512, input_dim=LATENT_DIM))
# model.add(layers.BatchNormalization())
model.add(layers.ReLU())

# convert 1d to 3d
model.add(layers.Reshape((8, 8, 512)))

# upsample to 16x16
model.add(layers.Conv2DTranspose(256, (4, 4), strides=(2, 2), padding='same',␣
 ↪kernel_initializer=WEIGHT_INIT))
# model.add(layers.BatchNormalization())
model.add(layers.ReLU())

# upsample to 32x32
model.add(layers.Conv2DTranspose(128, (4, 4), strides=(2, 2), padding='same',␣
 ↪kernel_initializer=WEIGHT_INIT))
# model.add(layers.BatchNormalization())
model.add(layers.ReLU())
```

```
# upsample to 64x64
model.add(layers.Conv2DTranspose(64, (4, 4), strides=(2, 2), padding='same',␣
 ↪kernel_initializer=WEIGHT_INIT))
# model.add(layers.BatchNormalization())
model.add(layers.ReLU())

model.add(layers.Conv2D(CHANNELS, (4, 4), padding='same', activation='tanh'))

generator = model
generator.summary()
```

```
2023-02-08 02:24:22.261035: I
tensorflow/stream_executor/cuda/cuda_gpu_executor.cc:937] successful NUMA node
read from SysFS had negative value (-1), but there must be at least one NUMA
node, so returning NUMA node zero
2023-02-08 02:24:22.352832: I
tensorflow/stream_executor/cuda/cuda_gpu_executor.cc:937] successful NUMA node
read from SysFS had negative value (-1), but there must be at least one NUMA
node, so returning NUMA node zero
2023-02-08 02:24:22.353639: I
tensorflow/stream_executor/cuda/cuda_gpu_executor.cc:937] successful NUMA node
read from SysFS had negative value (-1), but there must be at least one NUMA
node, so returning NUMA node zero
2023-02-08 02:24:22.355500: I tensorflow/core/platform/cpu_feature_guard.cc:142]
This TensorFlow binary is optimized with oneAPI Deep Neural Network Library
(oneDNN) to use the following CPU instructions in performance-critical
operations:  AVX2 AVX512F FMA
To enable them in other operations, rebuild TensorFlow with the appropriate
compiler flags.
2023-02-08 02:24:22.355865: I
tensorflow/stream_executor/cuda/cuda_gpu_executor.cc:937] successful NUMA node
read from SysFS had negative value (-1), but there must be at least one NUMA
node, so returning NUMA node zero
2023-02-08 02:24:22.356549: I
tensorflow/stream_executor/cuda/cuda_gpu_executor.cc:937] successful NUMA node
read from SysFS had negative value (-1), but there must be at least one NUMA
node, so returning NUMA node zero
2023-02-08 02:24:22.357298: I
tensorflow/stream_executor/cuda/cuda_gpu_executor.cc:937] successful NUMA node
read from SysFS had negative value (-1), but there must be at least one NUMA
node, so returning NUMA
```

```
Model: "generator"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
dense (Dense)                (None, 32768)             3309568
_________________________________________________________________
```

```
re_lu (ReLU)                 (None, 32768)             0
_________________________________________________________________
reshape (Reshape)            (None, 8, 8, 512)         0
_________________________________________________________________
conv2d_transpose (Conv2DTran (None, 16, 16, 256)       2097408
_________________________________________________________________
re_lu_1 (ReLU)               (None, 16, 16, 256)       0
_________________________________________________________________
conv2d_transpose_1 (Conv2DTr (None, 32, 32, 128)       524416
_________________________________________________________________
re_lu_2 (ReLU)               (None, 32, 32, 128)       0
_________________________________________________________________
conv2d_transpose_2 (Conv2DTr (None, 64, 64, 64)        131136
_________________________________________________________________
re_lu_3 (ReLU)               (None, 64, 64, 64)        0
_________________________________________________________________
conv2d (Conv2D)              (None, 64, 64, 3)         3075
=================================================================
Total params: 6,065,603
Trainable params: 6,065,603
Non-trainable params: 0
_________________________________________________________________
node zero
2023-02-08 02:24:24.522023: I
tensorflow/stream_executor/cuda/cuda_gpu_executor.cc:937] successful NUMA node
read from SysFS had negative value (-1), but there must be at least one NUMA
node, so returning NUMA node zero
2023-02-08 02:24:24.523055: I
tensorflow/stream_executor/cuda/cuda_gpu_executor.cc:937] successful NUMA node
read from SysFS had negative value (-1), but there must be at least one NUMA
node, so returning NUMA node zero
2023-02-08 02:24:24.523834: I
tensorflow/stream_executor/cuda/cuda_gpu_executor.cc:937] successful NUMA node
read from SysFS had negative value (-1), but there must be at least one NUMA
node, so returning NUMA node zero
2023-02-08 02:24:24.524488: I
tensorflow/core/common_runtime/gpu/gpu_device.cc:1510] Created device
/job:localhost/replica:0/task:0/device:GPU:0 with 15401 MB memory:  -> device:
0, name: Tesla P100-PCIE-16GB, pci bus id: 0000:00:04.0, compute capability: 6.0
```

0.5.2 Discriminator Model

Discriminator model will classify the image from the generator to check whether it real (or) fake images.

[ ]:
```
model = Sequential(name='discriminator')
input_shape = (64, 64, 3)
```

```
alpha = 0.2

# create conv layers
model.add(layers.Conv2D(64, (4, 4), strides=(2, 2), padding='same',␣
 ↪input_shape=input_shape))
model.add(layers.BatchNormalization())
model.add(layers.LeakyReLU(alpha=alpha))

model.add(layers.Conv2D(128, (4, 4), strides=(2, 2), padding='same',␣
 ↪input_shape=input_shape))
model.add(layers.BatchNormalization())
model.add(layers.LeakyReLU(alpha=alpha))

model.add(layers.Conv2D(128, (4, 4), strides=(2, 2), padding='same',␣
 ↪input_shape=input_shape))
model.add(layers.BatchNormalization())
model.add(layers.LeakyReLU(alpha=alpha))

model.add(layers.Flatten())
model.add(layers.Dropout(0.3))

# output class
model.add(layers.Dense(1, activation='sigmoid'))

discriminator = model
discriminator.summary()
```

```
Model: "discriminator"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d_1 (Conv2D)            (None, 32, 32, 64)        3136
_________________________________________________________________
batch_normalization (BatchNo (None, 32, 32, 64)        256
_________________________________________________________________
leaky_re_lu (LeakyReLU)      (None, 32, 32, 64)        0
_________________________________________________________________
conv2d_2 (Conv2D)            (None, 16, 16, 128)       131200
_________________________________________________________________
batch_normalization_1 (Batch (None, 16, 16, 128)       512
_________________________________________________________________
leaky_re_lu_1 (LeakyReLU)    (None, 16, 16, 128)       0
_________________________________________________________________
conv2d_3 (Conv2D)            (None, 8, 8, 128)         262272
_________________________________________________________________
batch_normalization_2 (Batch (None, 8, 8, 128)         512
_________________________________________________________________
```

```
leaky_re_lu_2 (LeakyReLU)    (None, 8, 8, 128)         0
_________________________________________________________________
flatten (Flatten)            (None, 8192)              0
_________________________________________________________________
dropout (Dropout)            (None, 8192)              0
_________________________________________________________________
dense_1 (Dense)              (None, 1)                 8193
=================================================================
Total params: 406,081
Trainable params: 405,441
Non-trainable params: 640
_________________________________________________________________
```

0.6 Create DCGAN

[ ]:
```python
class DCGAN(keras.Model):
    def __init__(self, generator, discriminator, latent_dim):
        super().__init__()
        self.generator = generator
        self.discriminator = discriminator
        self.latent_dim = latent_dim
        self.g_loss_metric = keras.metrics.Mean(name='g_loss')
        self.d_loss_metric = keras.metrics.Mean(name='d_loss')

    @property
    def metrics(self):
        return [self.g_loss_metric, self.d_loss_metric]

    def compile(self, g_optimizer, d_optimizer, loss_fn):
        super(DCGAN, self).compile()
        self.g_optimizer = g_optimizer
        self.d_optimizer = d_optimizer
        self.loss_fn = loss_fn

    def train_step(self, real_images):
        # get batch size from the data
        batch_size = tf.shape(real_images)[0]
        # generate random noise
        random_noise = tf.random.normal(shape=(batch_size, self.latent_dim))

        # train the discriminator with real (1) and fake (0) images
        with tf.GradientTape() as tape:
            # compute loss on real images
            pred_real = self.discriminator(real_images, training=True)
            # generate real image labels
            real_labels = tf.ones((batch_size, 1))
            # label smoothing
```

```
            real_labels += 0.05 * tf.random.uniform(tf.shape(real_labels))
            d_loss_real = self.loss_fn(real_labels, pred_real)

            # compute loss on fake images
            fake_images = self.generator(random_noise)
            pred_fake = self.discriminator(fake_images, training=True)
            # generate fake labels
            fake_labels = tf.zeros((batch_size, 1))
            d_loss_fake = self.loss_fn(fake_labels, pred_fake)

            # total discriminator loss
            d_loss = (d_loss_real + d_loss_fake) / 2

        # compute discriminator gradients
        gradients = tape.gradient(d_loss, self.discriminator.
↪trainable_variables)
        # update the gradients
        self.d_optimizer.apply_gradients(zip(gradients, self.discriminator.
↪trainable_variables))


        # train the generator model
        labels = tf.ones((batch_size, 1))
        # generator want discriminator to think that fake images are real
        with tf.GradientTape() as tape:
            # generate fake images from generator
            fake_images = self.generator(random_noise, training=True)
            # classify images as real or fake
            pred_fake = self.discriminator(fake_images, training=True)
            # compute loss
            g_loss = self.loss_fn(labels, pred_fake)

        # compute gradients
        gradients = tape.gradient(g_loss, self.generator.trainable_variables)
        # update the gradients
        self.g_optimizer.apply_gradients(zip(gradients, self.generator.
↪trainable_variables))

        # update states for both models
        self.d_loss_metric.update_state(d_loss)
        self.g_loss_metric.update_state(g_loss)

        return {'d_loss': self.d_loss_metric.result(), 'g_loss': self.
↪g_loss_metric.result()}
```

[ ]:
```
class DCGANMonitor(keras.callbacks.Callback):
    def __init__(self, num_imgs=25, latent_dim=100):
        self.num_imgs = num_imgs
        self.latent_dim = latent_dim
        # create random noise for generating images
        self.noise = tf.random.normal([25, latent_dim])

    def on_epoch_end(self, epoch, logs=None):
        # generate the image from noise
        g_img = self.model.generator(self.noise)
        # denormalize the image
        g_img = (g_img * 127.5) + 127.5
        g_img.numpy()

        fig = plt.figure(figsize=(8, 8))
        for i in range(self.num_imgs):
            plt.subplot(5, 5, i+1)
            img = array_to_img(g_img[i])
            plt.imshow(img)
            plt.axis('off')
        # plt.savefig('epoch_{:03d}.png'.format(epoch))
        plt.show()

    def on_train_end(self, logs=None):
        self.model.generator.save('generator.h5')
```

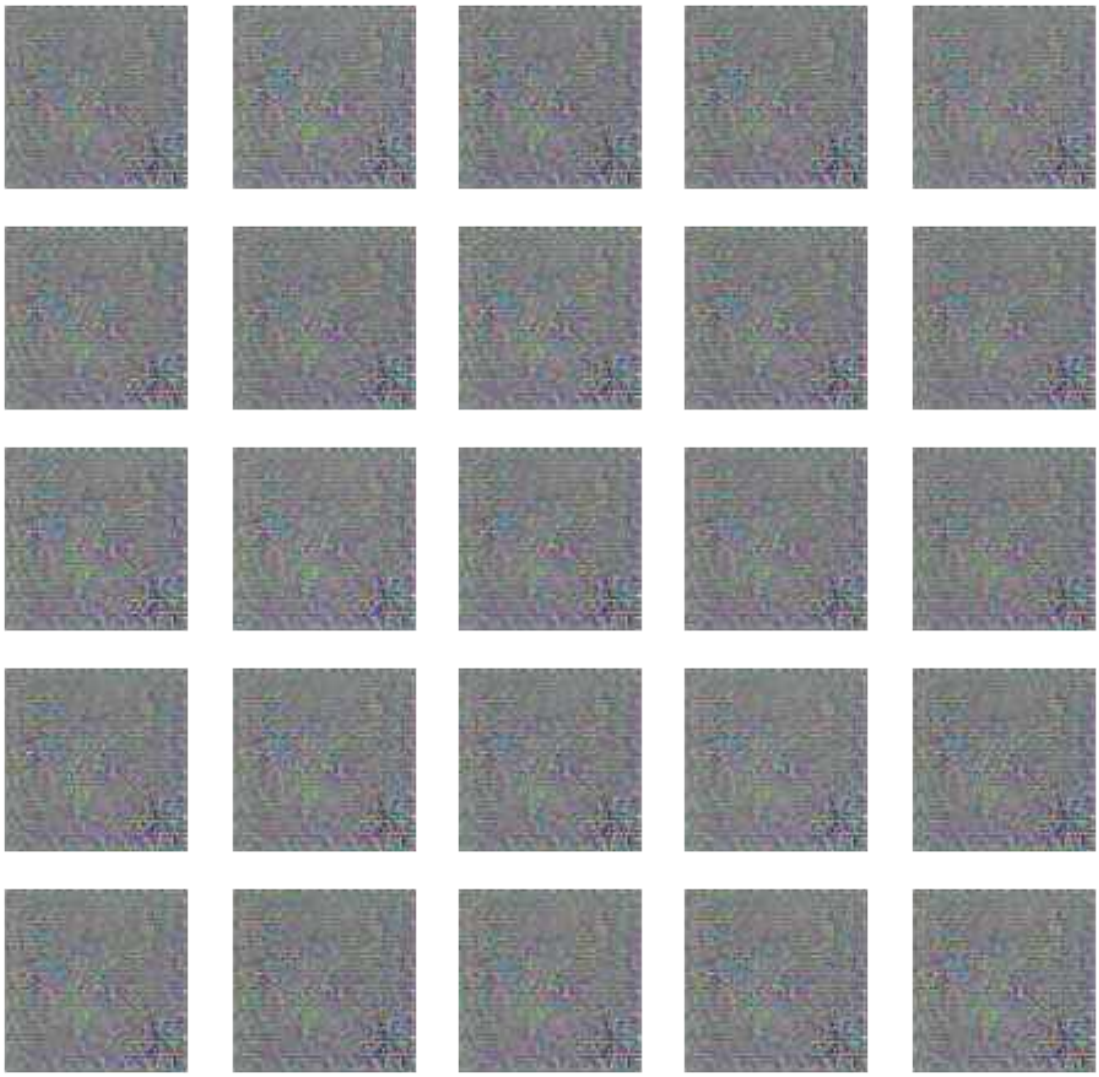
[ ]:
```
dcgan = DCGAN(generator=generator, discriminator=discriminator,␣
 ↪latent_dim=LATENT_DIM)
```

[ ]:
```
D_LR = 0.0001
G_LR = 0.0003
dcgan.compile(g_optimizer=Adam(learning_rate=G_LR, beta_1=0.5),␣
 ↪d_optimizer=Adam(learning_rate=D_LR, beta_1=0.5),␣
 ↪loss_fn=BinaryCrossentropy())
```

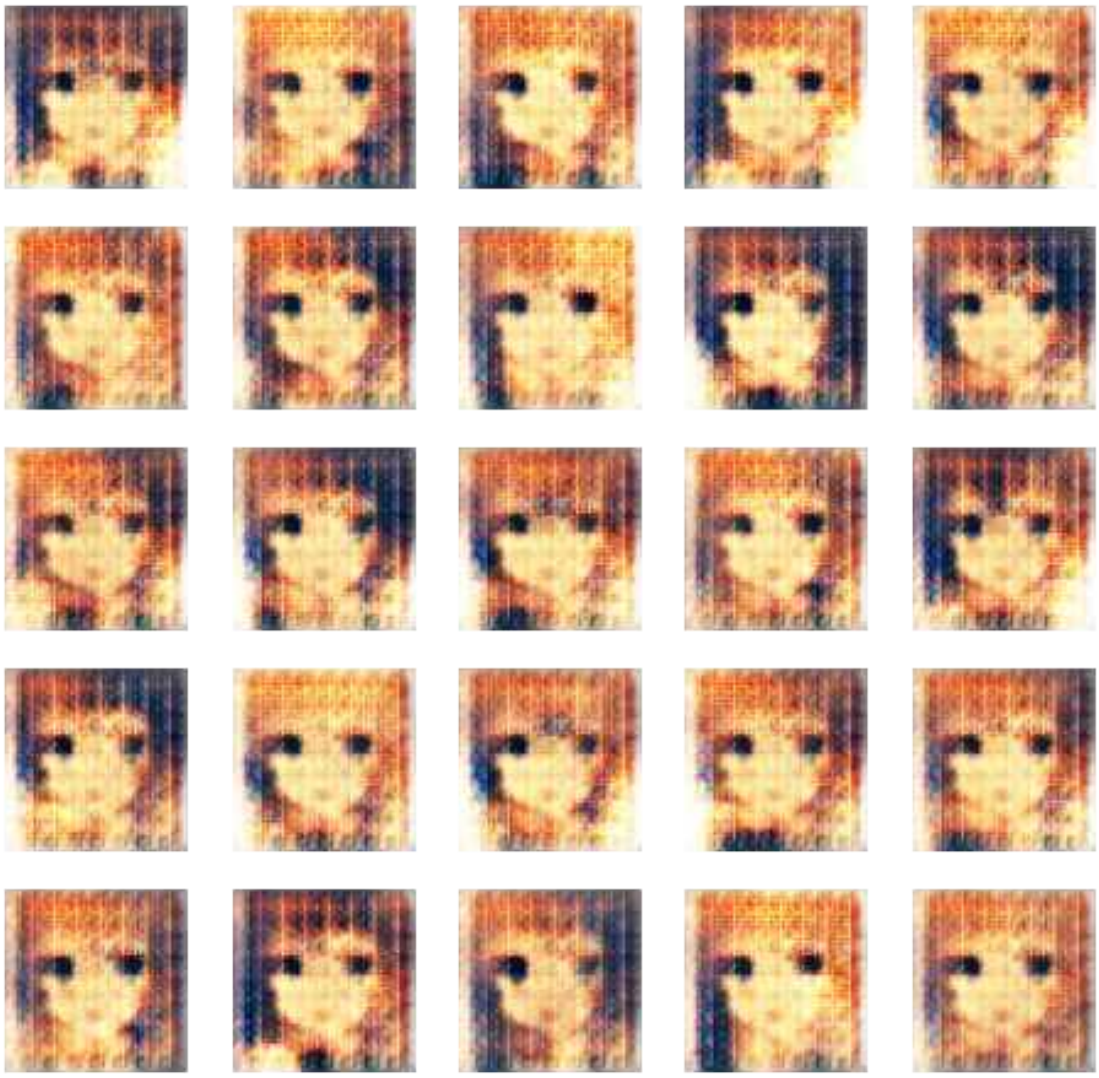
[ ]:
```
N_EPOCHS = 50
dcgan.fit(train_images, epochs=N_EPOCHS, callbacks=[DCGANMonitor()])
```

```
2023-02-08 02:24:25.158449: W
tensorflow/core/framework/cpu_allocator_impl.cc:80] Allocation of 1059274752
exceeds 10% of free system memory.
2023-02-08 02:24:26.332743: W
tensorflow/core/framework/cpu_allocator_impl.cc:80] Allocation of 1059274752
exceeds 10% of free system memory.
2023-02-08 02:24:27.173692: I
tensorflow/compiler/mlir/mlir_graph_optimization_pass.cc:185] None of the MLIR
Optimization Passes are enabled (registered 2)
```

```
Epoch 1/50
2023-02-08 02:24:29.703314: I tensorflow/stream_executor/cuda/cuda_dnn.cc:369]
Loaded cuDNN version 8005
674/674 [==============================] - 36s 41ms/step - d_loss: 0.6092 -
g_loss: 2.7299
```



```
Epoch 2/50
674/674 [==============================] - 27s 41ms/step - d_loss: 0.5241 -
g_loss: 1.9957
```



```
Epoch 3/50
674/674 [==============================] - 27s 41ms/step - d_loss: 0.5738 -
g_loss: 1.8336
```

```
Epoch 4/50
674/674 [==============================] - 27s 41ms/step - d_loss: 0.5997 -
g_loss: 1.7399
```

```
Epoch 5/50
674/674 [==============================] - 27s 41ms/step - d_loss: 0.6196 -
g_loss: 1.6546
```

```
Epoch 6/50
674/674 [==============================] - 27s 41ms/step - d_loss: 0.5933 -
g_loss: 1.5709
```

```
Epoch 7/50
674/674 [==============================] - 27s 41ms/step - d_loss: 0.6225 -
g_loss: 1.3766
```

```
Epoch 8/50
674/674 [==============================] - 27s 41ms/step - d_loss: 0.6364 -
g_loss: 1.2569
```

```
Epoch 9/50
674/674 [==============================] - 27s 41ms/step - d_loss: 0.6491 -
g_loss: 1.1808
```

```
Epoch 10/50
674/674 [==============================] - 27s 40ms/step - d_loss: 0.6962 -
g_loss: 1.0153
```

```
Epoch 11/50
674/674 [==============================] - 27s 41ms/step - d_loss: 0.7165 -
g_loss: 0.9253
```

```
Epoch 12/50
674/674 [==============================] - 27s 41ms/step - d_loss: 0.7209 -
g_loss: 0.8608
```

```
Epoch 13/50
674/674 [==============================] - 28s 41ms/step - d_loss: 0.7201 -
g_loss: 0.8332
```

```
Epoch 14/50
674/674 [==============================] - 28s 41ms/step - d_loss: 0.7134 -
g_loss: 0.8114
```

```
Epoch 15/50
674/674 [==============================] - 28s 41ms/step - d_loss: 0.7064 -
g_loss: 0.8128
```

```
Epoch 16/50
674/674 [==============================] - 27s 41ms/step - d_loss: 0.7044 -
g_loss: 0.8055
```

```
Epoch 17/50
674/674 [==============================] - 28s 41ms/step - d_loss: 0.7050 -
g_loss: 0.7948
```

```
Epoch 18/50
674/674 [==============================] - 27s 41ms/step - d_loss: 0.7024 -
g_loss: 0.7843
```

```
Epoch 19/50
674/674 [==============================] - 27s 41ms/step - d_loss: 0.7033 -
g_loss: 0.7805
```

```
Epoch 20/50
674/674 [==============================] - 27s 41ms/step - d_loss: 0.7027 -
g_loss: 0.7699
```

```
Epoch 21/50
674/674 [==============================] - 28s 41ms/step - d_loss: 0.6987 -
g_loss: 0.7638
```

```
Epoch 22/50
674/674 [==============================] - 27s 41ms/step - d_loss: 0.6996 -
g_loss: 0.7681
```

```
Epoch 23/50
674/674 [==============================] - 27s 41ms/step - d_loss: 0.6940 -
g_loss: 0.7724
```

```
Epoch 24/50
674/674 [==============================] - 27s 40ms/step - d_loss: 0.6930 -
g_loss: 0.7711
```

```
Epoch 25/50
674/674 [==============================] - 27s 41ms/step - d_loss: 0.6907 -
g_loss: 0.7773
```

```
Epoch 26/50
674/674 [==============================] - 27s 41ms/step - d_loss: 0.6867 -
g_loss: 0.7815
```

```
Epoch 27/50
674/674 [==============================] - 27s 40ms/step - d_loss: 0.6836 -
g_loss: 0.7940
```

```
Epoch 28/50
674/674 [==============================] - 27s 41ms/step - d_loss: 0.6790 -
g_loss: 0.8047
```

```
Epoch 29/50
674/674 [==============================] - 28s 41ms/step - d_loss: 0.6776 -
g_loss: 0.8097
```

```
Epoch 30/50
674/674 [==============================] - 28s 41ms/step - d_loss: 0.6717 -
g_loss: 0.8222
```

```
Epoch 31/50
674/674 [==============================] - 28s 41ms/step - d_loss: 0.6688 -
g_loss: 0.8341
```

```
Epoch 32/50
674/674 [==============================] - 27s 41ms/step - d_loss: 0.6618 -
g_loss: 0.8468
```

```
Epoch 33/50
674/674 [==============================] - 28s 41ms/step - d_loss: 0.6582 -
g_loss: 0.8615
```

```
Epoch 34/50
674/674 [==============================] - 27s 40ms/step - d_loss: 0.6516 -
g_loss: 0.8705
```

```
Epoch 35/50
674/674 [==============================] - 28s 41ms/step - d_loss: 0.6470 -
g_loss: 0.8930
```

```
Epoch 36/50
674/674 [==============================] - 27s 41ms/step - d_loss: 0.6424 -
g_loss: 0.9033
```

```
Epoch 37/50
674/674 [==============================] - 27s 41ms/step - d_loss: 0.6357 -
g_loss: 0.9156
```

```
Epoch 38/50
674/674 [==============================] - 27s 41ms/step - d_loss: 0.6375 -
g_loss: 0.9255
```

```
Epoch 39/50
674/674 [==============================] - 28s 41ms/step - d_loss: 0.6327 -
g_loss: 0.9445
```

```
Epoch 40/50
674/674 [==============================] - 27s 40ms/step - d_loss: 0.6304 -
g_loss: 0.9496
```

```
Epoch 41/50
674/674 [==============================] - 28s 41ms/step - d_loss: 0.6237 -
g_loss: 0.9649
```

```
Epoch 42/50
674/674 [==============================] - 27s 40ms/step - d_loss: 0.6227 -
g_loss: 0.9827
```

```
Epoch 43/50
674/674 [==============================] - 27s 41ms/step - d_loss: 0.6221 -
g_loss: 0.9904
```

```
Epoch 44/50
674/674 [==============================] - 27s 40ms/step - d_loss: 0.6144 -
g_loss: 0.9968
```

```
Epoch 45/50
674/674 [==============================] - 28s 41ms/step - d_loss: 0.6125 -
g_loss: 1.0184
```

```
Epoch 46/50
674/674 [==============================] - 27s 41ms/step - d_loss: 0.6076 -
g_loss: 1.0264
```

```
Epoch 47/50
674/674 [==============================] - 27s 41ms/step - d_loss: 0.6028 -
g_loss: 1.0532
```

```
Epoch 48/50
674/674 [==============================] - 27s 40ms/step - d_loss: 0.5999 -
g_loss: 1.0589
```

```
Epoch 49/50
674/674 [==============================] - 27s 41ms/step - d_loss: 0.5981 -
g_loss: 1.0709
```

```
Epoch 50/50
674/674 [==============================] - 27s 40ms/step - d_loss: 0.5894 -
g_loss: 1.0865
```

[ ]: <keras.callbacks.History at 0x7f2f96148c10>

0.7 Generate New Anime Image

[ ]:
```
noise = tf.random.normal([1, 100])
fig = plt.figure(figsize=(3, 3))
# generate the image from noise
g_img = dcgan.generator(noise)
# denormalize the image
g_img = (g_img * 127.5) + 127.5
g_img.numpy()
img = array_to_img(g_img[0])
plt.imshow(img)
```

```
plt.axis('off')
# plt.savefig('epoch_{:03d}.png'.format(epoch))
plt.show()
```

[ ]:

[ ]: