



```
In [ ]: import numpy as np
import matplotlib.pyplot as plt
from tensorflow.keras.datasets import cifar10
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Reshape, Flatten, Conv2D, Conv2DTranspose
from tensorflow.keras.optimizers import Adam

(x_train, _), (_, _) = cifar10.load_data()
x_train = (x_train.astype('float32') - 127.5) / 127.5
latent_dim = 100

def build_generator():
    model = Sequential()
    model.add(Dense(8*8*256, input_dim=latent_dim))
    model.add(LeakyReLU(0.2))
    model.add(Reshape((8, 8, 256)))
    model.add(Conv2DTranspose(128, (4,4), strides=(2,2), padding='same'))
    model.add(LeakyReLU(0.2))
    model.add(Conv2DTranspose(64, (4,4), strides=(2,2), padding='same'))
    model.add(LeakyReLU(0.2))
    model.add(Conv2DTranspose(3, (3,3), activation='tanh', padding='same'))
    return model

def build_discriminator():
    model = Sequential()
    model.add(Conv2D(64, (3,3), strides=(2,2), padding='same', input_shape=(32, 32, 3)))
    model.add(LeakyReLU(0.2))
    model.add(Dropout(0.3))
    model.add(Conv2D(128, (3,3), strides=(2,2), padding='same'))
    model.add(LeakyReLU(0.2))
    model.add(Dropout(0.3))
    model.add(Flatten())
    model.add(Dense(1, activation='sigmoid'))
    opt = Adam(0.0002, 0.5)
    model.compile(loss='binary_crossentropy', optimizer=opt, metrics=['accuracy'])
    return model

discriminator = build_discriminator()
generator = build_generator()

discriminator.trainable = False
gan = Sequential([generator, discriminator])
gan.compile(loss='binary_crossentropy', optimizer=Adam(0.0002, 0.5))

def train(epochs=5000, batch_size=128, save_interval=1000):
    half = int(batch_size / 2)
    for epoch in range(epochs):
        idx = np.random.randint(0, x_train.shape[0], half)
        imgs = x_train[idx]
        noise = np.random.normal(0, 1, (half, latent_dim))
        gen_imgs = generator.predict(noise)

        d_loss_real = discriminator.train_on_batch(imgs, np.ones((half, 1)))
```

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d_loss_fake = discriminator.train_on_batch(gen_imgs, np.zeros((batch_size, 1)))
noise = np.random.normal(0, 1, (batch_size, latent_dim))
valid_y = np.ones((batch_size, 1))
g_loss = gan.train_on_batch(noise, valid_y)

if epoch % save_interval == 0:
    print(f"{epoch} [D loss: {0.5 * np.add(d_loss_real[0], d_loss_fake)}]
    sample_images(epoch)

def sample_images(epoch):
    r, c = 5, 5
    noise = np.random.normal(0, 1, (r * c, latent_dim))
    gen_imgs = generator.predict(noise)
    gen_imgs = 0.5 * gen_imgs + 0.5
    fig, axs = plt.subplots(r, c, figsize=(5,5))
    cnt = 0
    for i in range(r):
        for j in range(c):
            axs[i,j].imshow(gen_imgs[cnt])
            axs[i,j].axis('off')
            cnt += 1
    plt.suptitle(f"Generated Images at Epoch {epoch}")
    plt.show()

train(epochs=3000, batch_size=128, save_interval=500)

```

Downloading data from <https://www.cs.toronto.edu/~kriz/cifar-10-python.tar.gz>
170498071/170498071 ————— **6s** 0us/step

/usr/local/lib/python3.12/dist-packages/keras/src/layers/convolutional/base_conv.py:113: UserWarning: Do not pass an `input_shape`/`input_dim` argument to a layer. When using Sequential models, prefer using an `Input(shape)` object as the first layer in the model instead.

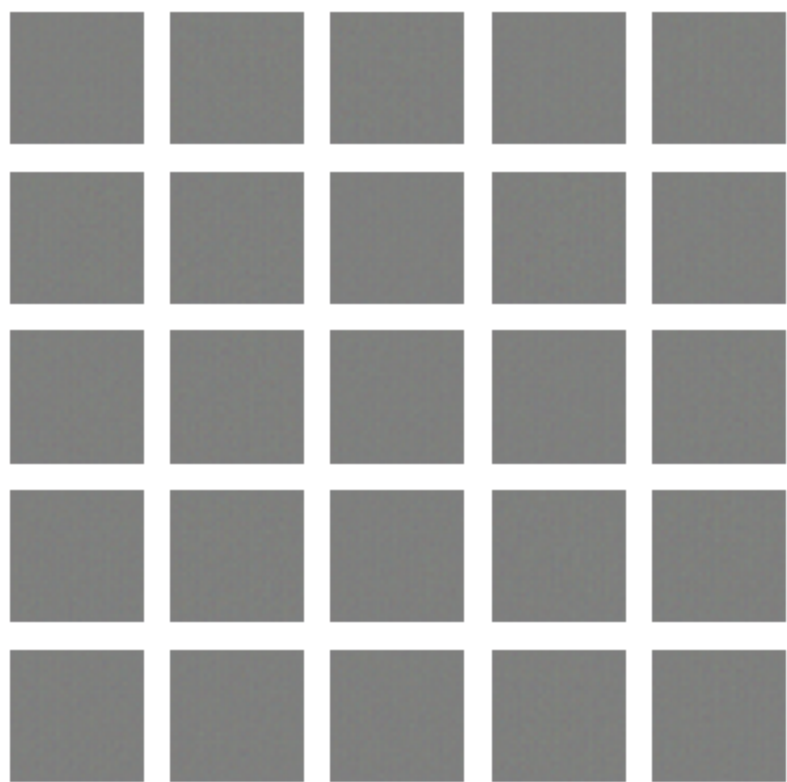
super().__init__(activity_regularizer=activity_regularizer, **kwargs)
/usr/local/lib/python3.12/dist-packages/keras/src/layers/core/dense.py:93: UserWarning: Do not pass an `input_shape`/`input_dim` argument to a layer. When using Sequential models, prefer using an `Input(shape)` object as the first layer in the model instead.

super().__init__(activity_regularizer=activity_regularizer, **kwargs)
2/2 ————— **0s** 178ms/step

/usr/local/lib/python3.12/dist-packages/keras/src/backend/tensorflow/trainer.py:83: UserWarning: The model does not have any trainable weights.
warnings.warn("The model does not have any trainable weights.")

0 [D loss: 0.7021650671958923] [G loss: 0.6945041418075562]
1/1 ————— **0s** 281ms/step

Generated Images at Epoch 0



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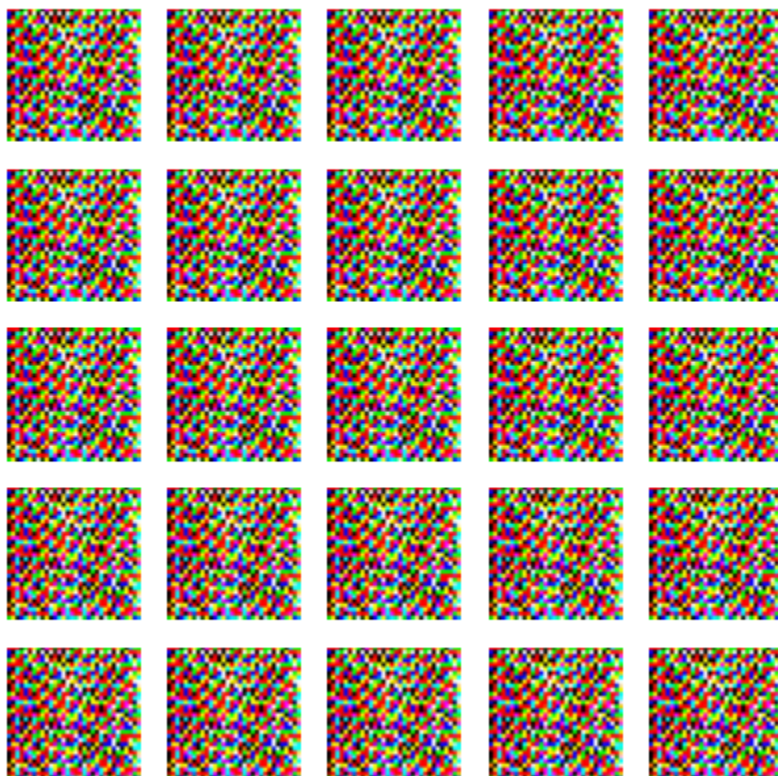
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2/2 ————— 0s 182ms/step
2/2 ————— 0s 229ms/step
2/2 ————— 0s 195ms/step
2/2 ————— 0s 188ms/step
2/2 ————— 0s 181ms/step
500 [D loss: 1.6923561096191406] [G loss: 0.11616962403059006]
1/1 ————— 0s 164ms/step

Generated Images at Epoch 500



2/2	0s	189ms/step
2/2	0s	184ms/step
2/2	0s	191ms/step
2/2	0s	182ms/step
2/2	0s	185ms/step
2/2	0s	189ms/step
2/2	1s	288ms/step
2/2	0s	185ms/step
2/2	0s	183ms/step
2/2	0s	190ms/step
2/2	0s	189ms/step
2/2	0s	309ms/step
2/2	0s	181ms/step
2/2	0s	188ms/step
2/2	0s	184ms/step
2/2	0s	189ms/step
2/2	0s	184ms/step
2/2	1s	284ms/step
2/2	0s	216ms/step
2/2	0s	187ms/step
2/2	0s	188ms/step
2/2	0s	182ms/step
2/2	0s	206ms/step
2/2	1s	279ms/step
2/2	0s	192ms/step
2/2	0s	184ms/step
2/2	0s	184ms/step
2/2	0s	186ms/step
2/2	0s	185ms/step
2/2	1s	284ms/step
2/2	0s	182ms/step
2/2	0s	185ms/step
2/2	0s	187ms/step
2/2	0s	183ms/step
2/2	0s	185ms/step
2/2	1s	233ms/step
2/2	0s	189ms/step
2/2	0s	183ms/step
2/2	0s	184ms/step
2/2	0s	177ms/step
2/2	1s	288ms/step
2/2	0s	184ms/step
2/2	0s	200ms/step
2/2	0s	206ms/step
2/2	0s	179ms/step
2/2	0s	190ms/step
2/2	1s	288ms/step
2/2	0s	186ms/step
2/2	0s	177ms/step
2/2	0s	184ms/step
2/2	0s	182ms/step
2/2	0s	274ms/step
2/2	0s	198ms/step
2/2	0s	192ms/step

2/2	0s	193ms/step
2/2	0s	208ms/step
2/2	0s	193ms/step
2/2	1s	287ms/step
2/2	0s	190ms/step
2/2	0s	178ms/step
2/2	0s	186ms/step
2/2	0s	186ms/step
2/2	0s	183ms/step
2/2	1s	309ms/step
2/2	0s	186ms/step
2/2	0s	185ms/step
2/2	0s	185ms/step
2/2	0s	182ms/step
2/2	0s	203ms/step
2/2	0s	232ms/step
2/2	0s	203ms/step
2/2	0s	208ms/step
2/2	0s	185ms/step
2/2	0s	186ms/step
2/2	1s	291ms/step
2/2	0s	186ms/step
2/2	0s	179ms/step
2/2	0s	187ms/step
2/2	0s	185ms/step
2/2	0s	200ms/step
2/2	1s	300ms/step
2/2	0s	179ms/step
2/2	0s	180ms/step
2/2	0s	181ms/step
2/2	0s	179ms/step
2/2	0s	256ms/step
2/2	0s	181ms/step
2/2	0s	191ms/step
2/2	0s	182ms/step
2/2	0s	178ms/step
2/2	0s	179ms/step
2/2	1s	284ms/step
2/2	0s	186ms/step
2/2	0s	187ms/step
2/2	0s	180ms/step
2/2	0s	182ms/step
2/2	0s	179ms/step
2/2	0s	200ms/step
2/2	0s	214ms/step
2/2	0s	185ms/step
2/2	0s	181ms/step
2/2	0s	179ms/step
2/2	1s	295ms/step
2/2	0s	194ms/step
2/2	0s	183ms/step
2/2	0s	195ms/step
2/2	0s	185ms/step
2/2	0s	245ms/step

2/2	0s	182ms/step
2/2	0s	203ms/step
2/2	0s	186ms/step
2/2	0s	187ms/step
2/2	0s	182ms/step
2/2	1s	274ms/step
2/2	0s	185ms/step
2/2	0s	185ms/step
2/2	0s	185ms/step
2/2	0s	193ms/step
2/2	1s	287ms/step
2/2	0s	193ms/step
2/2	0s	186ms/step
2/2	0s	184ms/step
2/2	0s	188ms/step
2/2	0s	195ms/step
2/2	1s	281ms/step
2/2	0s	180ms/step
2/2	0s	178ms/step
2/2	0s	205ms/step
2/2	0s	185ms/step
2/2	0s	188ms/step
2/2	0s	184ms/step
2/2	0s	190ms/step
2/2	0s	185ms/step
2/2	0s	189ms/step
2/2	0s	202ms/step
2/2	1s	299ms/step
2/2	0s	190ms/step
2/2	0s	239ms/step
2/2	0s	188ms/step
2/2	0s	191ms/step
2/2	0s	185ms/step
2/2	1s	268ms/step
2/2	0s	185ms/step
2/2	0s	179ms/step
2/2	0s	189ms/step
2/2	0s	188ms/step
2/2	1s	281ms/step
2/2	0s	193ms/step
2/2	0s	206ms/step
2/2	0s	210ms/step
2/2	0s	190ms/step
2/2	0s	185ms/step
2/2	1s	298ms/step
2/2	0s	185ms/step
2/2	0s	191ms/step
2/2	0s	193ms/step
2/2	0s	199ms/step
2/2	0s	196ms/step
2/2	1s	274ms/step
2/2	0s	191ms/step
2/2	0s	193ms/step
2/2	0s	191ms/step

2/2	0s	192ms/step
2/2	0s	196ms/step
2/2	0s	182ms/step
2/2	0s	185ms/step
2/2	0s	184ms/step
2/2	0s	181ms/step
2/2	0s	185ms/step
2/2	1s	271ms/step
2/2	0s	198ms/step
2/2	0s	189ms/step
2/2	0s	189ms/step
2/2	0s	184ms/step
2/2	0s	184ms/step
2/2	1s	296ms/step
2/2	0s	223ms/step
2/2	0s	202ms/step
2/2	0s	203ms/step
2/2	0s	189ms/step
2/2	0s	221ms/step
2/2	1s	230ms/step
2/2	0s	203ms/step
2/2	0s	200ms/step
2/2	0s	192ms/step
2/2	0s	186ms/step
2/2	1s	288ms/step
2/2	0s	183ms/step
2/2	0s	221ms/step
2/2	0s	185ms/step
2/2	0s	191ms/step
2/2	0s	185ms/step
2/2	1s	283ms/step
2/2	0s	189ms/step
2/2	0s	189ms/step
2/2	0s	194ms/step
2/2	0s	187ms/step
2/2	0s	186ms/step
2/2	1s	303ms/step
2/2	0s	192ms/step
2/2	0s	190ms/step
2/2	0s	191ms/step
2/2	0s	193ms/step
2/2	0s	279ms/step
2/2	0s	206ms/step
2/2	0s	192ms/step
2/2	0s	190ms/step
2/2	0s	189ms/step
2/2	0s	193ms/step
2/2	1s	284ms/step
2/2	0s	208ms/step
2/2	0s	213ms/step
2/2	0s	207ms/step
2/2	0s	195ms/step
2/2	0s	184ms/step
2/2	1s	307ms/step

2/2	0s	186ms/step
2/2	0s	181ms/step
2/2	0s	190ms/step
2/2	0s	200ms/step
2/2	0s	296ms/step
2/2	0s	186ms/step
2/2	0s	182ms/step
2/2	0s	182ms/step
2/2	0s	185ms/step
2/2	0s	205ms/step
2/2	1s	282ms/step
2/2	0s	194ms/step
2/2	0s	198ms/step
2/2	0s	203ms/step
2/2	0s	191ms/step
2/2	0s	190ms/step
2/2	1s	310ms/step
2/2	0s	190ms/step
2/2	0s	190ms/step
2/2	0s	182ms/step
2/2	0s	182ms/step
2/2	0s	200ms/step
2/2	0s	190ms/step
2/2	0s	196ms/step
2/2	0s	200ms/step
2/2	0s	192ms/step
2/2	0s	184ms/step
2/2	1s	316ms/step
2/2	0s	193ms/step
2/2	0s	190ms/step
2/2	0s	187ms/step
2/2	0s	190ms/step
2/2	0s	186ms/step
2/2	1s	298ms/step
2/2	0s	181ms/step
2/2	0s	187ms/step
2/2	0s	184ms/step
2/2	0s	183ms/step
2/2	1s	333ms/step
2/2	0s	196ms/step
2/2	0s	209ms/step
2/2	0s	190ms/step
2/2	0s	187ms/step
2/2	0s	188ms/step
2/2	1s	228ms/step
2/2	0s	183ms/step
2/2	0s	186ms/step
2/2	0s	188ms/step
2/2	0s	187ms/step
2/2	1s	285ms/step
2/2	0s	182ms/step
2/2	0s	193ms/step
2/2	0s	189ms/step
2/2	0s	188ms/step

2/2	0s	185ms/step
2/2	1s	280ms/step
2/2	0s	195ms/step
2/2	0s	192ms/step
2/2	0s	188ms/step
2/2	0s	198ms/step
2/2	1s	280ms/step
2/2	0s	183ms/step
2/2	0s	186ms/step
2/2	0s	188ms/step
2/2	0s	186ms/step
2/2	0s	182ms/step
2/2	1s	305ms/step
2/2	0s	191ms/step
2/2	0s	185ms/step
2/2	0s	193ms/step
2/2	0s	192ms/step
2/2	0s	192ms/step
2/2	0s	213ms/step
2/2	0s	186ms/step
2/2	0s	191ms/step
2/2	0s	189ms/step
2/2	0s	187ms/step
2/2	1s	298ms/step
2/2	0s	245ms/step
2/2	0s	204ms/step
2/2	0s	193ms/step
2/2	0s	184ms/step
2/2	0s	183ms/step
2/2	0s	191ms/step
2/2	0s	189ms/step
2/2	0s	181ms/step
2/2	0s	188ms/step
2/2	0s	192ms/step
2/2	1s	312ms/step
2/2	0s	193ms/step
2/2	0s	205ms/step
2/2	0s	188ms/step
2/2	0s	185ms/step
2/2	0s	194ms/step
2/2	1s	298ms/step
2/2	0s	186ms/step
2/2	0s	195ms/step
2/2	0s	184ms/step
2/2	0s	208ms/step
2/2	1s	291ms/step
2/2	0s	205ms/step
2/2	1s	302ms/step
2/2	1s	311ms/step
2/2	0s	252ms/step
2/2	0s	184ms/step
2/2	0s	192ms/step
2/2	0s	187ms/step
2/2	0s	190ms/step

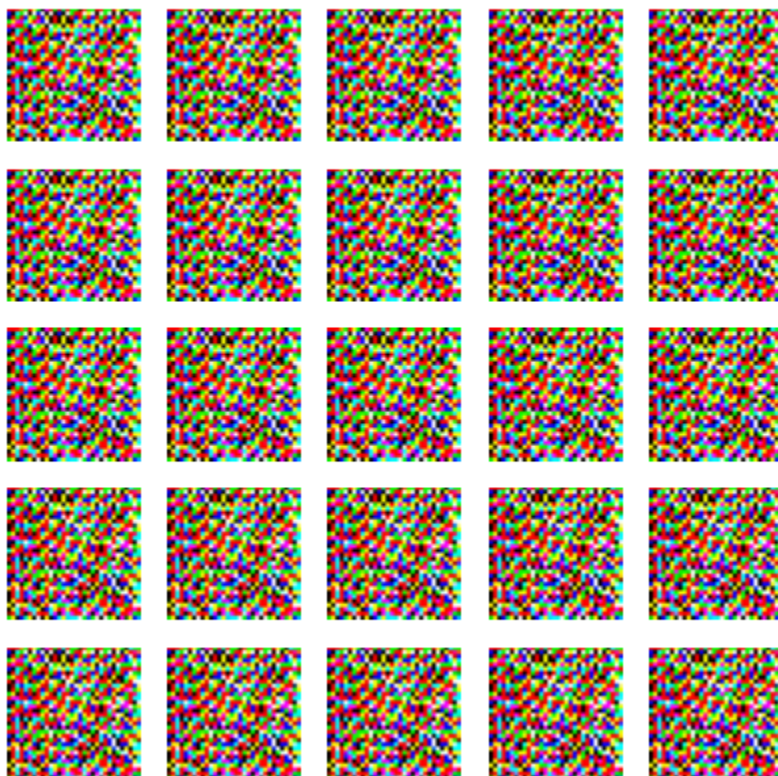
2/2	0s	192ms/step
2/2	1s	297ms/step
2/2	0s	187ms/step
2/2	0s	190ms/step
2/2	0s	205ms/step
2/2	0s	187ms/step
2/2	1s	298ms/step
2/2	0s	201ms/step
2/2	0s	204ms/step
2/2	0s	209ms/step
2/2	0s	204ms/step
2/2	0s	183ms/step
2/2	1s	305ms/step
2/2	0s	197ms/step
2/2	0s	184ms/step
2/2	0s	191ms/step
2/2	0s	188ms/step
2/2	0s	187ms/step
2/2	0s	187ms/step
2/2	0s	194ms/step
2/2	0s	193ms/step
2/2	0s	187ms/step
2/2	0s	187ms/step
2/2	1s	290ms/step
2/2	0s	188ms/step
2/2	0s	204ms/step
2/2	0s	190ms/step
2/2	0s	187ms/step
2/2	0s	233ms/step
2/2	0s	190ms/step
2/2	0s	210ms/step
2/2	0s	191ms/step
2/2	0s	217ms/step
2/2	0s	197ms/step
2/2	1s	270ms/step
2/2	0s	192ms/step
2/2	0s	190ms/step
2/2	0s	194ms/step
2/2	0s	191ms/step
2/2	1s	302ms/step
2/2	0s	212ms/step
2/2	0s	191ms/step
2/2	0s	195ms/step
2/2	0s	188ms/step
2/2	0s	192ms/step
2/2	1s	298ms/step
2/2	0s	185ms/step
2/2	0s	205ms/step
2/2	0s	206ms/step
2/2	0s	198ms/step
2/2	0s	185ms/step
2/2	0s	187ms/step
2/2	0s	191ms/step
2/2	0s	190ms/step

2/2	0s	189ms/step
2/2	0s	207ms/step
2/2	1s	292ms/step
2/2	0s	195ms/step
2/2	0s	183ms/step
2/2	0s	208ms/step
2/2	0s	204ms/step
2/2	0s	193ms/step
2/2	0s	187ms/step
2/2	0s	208ms/step
2/2	0s	188ms/step
2/2	0s	187ms/step
2/2	0s	183ms/step
2/2	1s	305ms/step
2/2	0s	201ms/step
2/2	0s	204ms/step
2/2	0s	182ms/step
2/2	0s	184ms/step
2/2	0s	191ms/step
2/2	1s	300ms/step
2/2	0s	210ms/step
2/2	0s	192ms/step
2/2	0s	187ms/step
2/2	0s	184ms/step
2/2	1s	287ms/step
2/2	0s	213ms/step
2/2	0s	178ms/step
2/2	0s	184ms/step
2/2	0s	190ms/step
2/2	0s	190ms/step
2/2	0s	191ms/step
2/2	0s	189ms/step
2/2	0s	218ms/step
2/2	0s	188ms/step
2/2	0s	207ms/step
2/2	1s	309ms/step
2/2	0s	194ms/step
2/2	0s	187ms/step
2/2	0s	189ms/step
2/2	0s	186ms/step
2/2	1s	297ms/step
2/2	0s	194ms/step
2/2	0s	198ms/step
2/2	0s	187ms/step
2/2	0s	189ms/step
2/2	0s	200ms/step
2/2	1s	296ms/step
2/2	0s	187ms/step
2/2	0s	195ms/step
2/2	0s	206ms/step
2/2	0s	191ms/step
2/2	1s	309ms/step
2/2	0s	189ms/step
2/2	0s	187ms/step

2/2	0s	202ms/step
2/2	0s	214ms/step
2/2	0s	227ms/step
2/2	0s	206ms/step
2/2	0s	208ms/step
2/2	0s	198ms/step
2/2	0s	208ms/step
2/2	0s	196ms/step
2/2	1s	317ms/step
2/2	0s	191ms/step
2/2	0s	191ms/step
2/2	0s	187ms/step
2/2	0s	188ms/step
2/2	1s	301ms/step
2/2	0s	211ms/step
2/2	0s	195ms/step
2/2	0s	221ms/step
2/2	0s	192ms/step
2/2	0s	202ms/step
2/2	0s	222ms/step
2/2	0s	190ms/step
2/2	0s	190ms/step
2/2	0s	189ms/step
2/2	0s	210ms/step
2/2	1s	309ms/step
2/2	0s	194ms/step
2/2	0s	200ms/step
2/2	0s	202ms/step
2/2	0s	194ms/step
2/2	0s	194ms/step
2/2	1s	307ms/step
2/2	0s	202ms/step
2/2	0s	221ms/step
2/2	0s	193ms/step
2/2	0s	190ms/step
2/2	0s	203ms/step
2/2	1s	226ms/step
2/2	0s	186ms/step
2/2	0s	188ms/step
2/2	0s	193ms/step
2/2	0s	271ms/step
2/2	1s	295ms/step
2/2	0s	235ms/step
2/2	0s	215ms/step
2/2	0s	217ms/step
2/2	0s	199ms/step
2/2	1s	308ms/step
2/2	0s	199ms/step
2/2	0s	195ms/step
2/2	0s	188ms/step
2/2	0s	191ms/step
2/2	0s	195ms/step
2/2	1s	294ms/step
2/2	0s	204ms/step

2/2 ————— 0s 206ms/step
2/2 ————— 0s 216ms/step
2/2 ————— 0s 223ms/step
2/2 ————— 1s 324ms/step
2/2 ————— 0s 197ms/step
2/2 ————— 0s 196ms/step
2/2 ————— 0s 185ms/step
2/2 ————— 0s 187ms/step
2/2 ————— 1s 283ms/step
2/2 ————— 0s 216ms/step
2/2 ————— 0s 206ms/step
2/2 ————— 0s 188ms/step
2/2 ————— 0s 191ms/step
2/2 ————— 0s 189ms/step
1000 [D loss: 1.9609029293060303] [G loss: 0.07023009657859802]
1/1 ————— 0s 267ms/step

Generated Images at Epoch 1000



2/2	0s	198ms/step
2/2	0s	198ms/step
2/2	0s	196ms/step
2/2	0s	193ms/step
2/2	0s	203ms/step
2/2	1s	290ms/step
2/2	0s	212ms/step
2/2	0s	194ms/step
2/2	0s	194ms/step
2/2	0s	191ms/step
2/2	1s	302ms/step
2/2	0s	202ms/step
2/2	0s	201ms/step
2/2	0s	191ms/step
2/2	0s	192ms/step
2/2	0s	190ms/step
2/2	1s	306ms/step
2/2	0s	194ms/step
2/2	0s	198ms/step
2/2	0s	192ms/step
2/2	0s	200ms/step
2/2	0s	200ms/step
2/2	1s	252ms/step
2/2	0s	194ms/step
2/2	0s	192ms/step
2/2	0s	217ms/step
2/2	0s	194ms/step
2/2	1s	313ms/step
2/2	0s	188ms/step
2/2	0s	192ms/step
2/2	0s	195ms/step
2/2	0s	194ms/step
2/2	0s	190ms/step
2/2	0s	213ms/step
2/2	0s	240ms/step
2/2	0s	190ms/step
2/2	0s	190ms/step
2/2	0s	194ms/step
2/2	1s	329ms/step
2/2	0s	221ms/step
2/2	0s	219ms/step
2/2	0s	191ms/step
2/2	0s	222ms/step
2/2	1s	316ms/step
2/2	0s	208ms/step
2/2	0s	210ms/step
2/2	0s	219ms/step
2/2	0s	214ms/step
2/2	0s	202ms/step
2/2	0s	197ms/step
2/2	0s	196ms/step
2/2	0s	207ms/step
2/2	0s	199ms/step
2/2	0s	207ms/step

2/2	1s	306ms/step
2/2	0s	209ms/step
2/2	0s	195ms/step
2/2	0s	191ms/step
2/2	0s	190ms/step
2/2	0s	206ms/step
2/2	0s	197ms/step
2/2	0s	191ms/step
2/2	0s	201ms/step
2/2	0s	230ms/step
2/2	0s	218ms/step
2/2	1s	300ms/step
2/2	0s	190ms/step
2/2	0s	205ms/step
2/2	0s	207ms/step
2/2	0s	211ms/step
2/2	0s	215ms/step
2/2	1s	294ms/step
2/2	0s	212ms/step
2/2	0s	194ms/step
2/2	0s	192ms/step
2/2	0s	189ms/step
2/2	1s	335ms/step
2/2	0s	220ms/step
2/2	0s	211ms/step
2/2	0s	192ms/step
2/2	0s	196ms/step
2/2	0s	190ms/step
2/2	1s	290ms/step
2/2	0s	191ms/step
2/2	0s	215ms/step
2/2	0s	221ms/step
2/2	0s	215ms/step
2/2	0s	245ms/step
2/2	0s	194ms/step
2/2	0s	210ms/step
2/2	0s	196ms/step
2/2	0s	199ms/step
2/2	0s	200ms/step
2/2	1s	299ms/step
2/2	0s	202ms/step
2/2	0s	189ms/step
2/2	0s	207ms/step
2/2	0s	213ms/step
2/2	0s	201ms/step
2/2	1s	296ms/step
2/2	0s	189ms/step
2/2	0s	191ms/step
2/2	0s	222ms/step
2/2	0s	213ms/step
2/2	1s	292ms/step
2/2	0s	189ms/step
2/2	0s	186ms/step
2/2	0s	194ms/step

2/2	0s	192ms/step
2/2	0s	197ms/step
2/2	1s	310ms/step
2/2	0s	214ms/step
2/2	0s	198ms/step
2/2	0s	191ms/step
2/2	0s	189ms/step
2/2	1s	322ms/step
2/2	0s	198ms/step
2/2	0s	200ms/step
2/2	0s	189ms/step
2/2	0s	215ms/step
2/2	0s	198ms/step
2/2	0s	180ms/step
2/2	0s	192ms/step
2/2	0s	194ms/step
2/2	0s	194ms/step
2/2	0s	198ms/step
2/2	1s	314ms/step
2/2	0s	189ms/step
2/2	0s	192ms/step
2/2	0s	199ms/step
2/2	0s	194ms/step
2/2	0s	193ms/step
2/2	1s	249ms/step
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2/2	0s	190ms/step
2/2	0s	190ms/step
2/2	0s	185ms/step
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2/2	0s	199ms/step
2/2	0s	192ms/step
2/2	0s	193ms/step
2/2	0s	221ms/step
2/2	1s	296ms/step
2/2	0s	200ms/step
2/2	0s	196ms/step
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2/2	0s	197ms/step
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2/2	0s	197ms/step
2/2	1s	296ms/step
2/2	0s	225ms/step
2/2	0s	209ms/step
2/2	0s	209ms/step
2/2	0s	213ms/step
2/2	0s	197ms/step
2/2	1s	292ms/step
2/2	0s	209ms/step

2/2	0s	192ms/step
2/2	0s	194ms/step
2/2	0s	191ms/step
2/2	0s	309ms/step
2/2	0s	196ms/step
2/2	0s	199ms/step
2/2	0s	220ms/step
2/2	0s	231ms/step
2/2	0s	196ms/step
2/2	1s	308ms/step
2/2	0s	195ms/step
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2/2	0s	197ms/step
2/2	0s	200ms/step
2/2	1s	297ms/step
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2/2	0s	195ms/step
2/2	0s	197ms/step
2/2	0s	198ms/step
2/2	0s	187ms/step
2/2	0s	197ms/step
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2/2	0s	191ms/step
2/2	0s	201ms/step
2/2	0s	194ms/step
2/2	0s	212ms/step
2/2	0s	216ms/step
2/2	1s	294ms/step
2/2	0s	199ms/step
2/2	0s	194ms/step
2/2	0s	201ms/step
2/2	0s	186ms/step
2/2	0s	189ms/step
2/2	1s	251ms/step
2/2	0s	204ms/step
2/2	0s	192ms/step
2/2	0s	197ms/step
2/2	0s	200ms/step
2/2	1s	298ms/step

2/2	0s	201ms/step
2/2	0s	193ms/step
2/2	0s	193ms/step
2/2	0s	199ms/step
2/2	0s	196ms/step
2/2	1s	315ms/step
2/2	0s	198ms/step
2/2	0s	188ms/step
2/2	0s	195ms/step
2/2	0s	186ms/step
2/2	1s	314ms/step
2/2	0s	203ms/step
2/2	0s	195ms/step
2/2	0s	210ms/step
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2/2	0s	192ms/step
2/2	0s	192ms/step
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2/2	0s	196ms/step
2/2	0s	182ms/step
2/2	0s	193ms/step
2/2	1s	303ms/step
2/2	0s	200ms/step
2/2	0s	200ms/step
2/2	0s	207ms/step
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2/2	0s	200ms/step
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2/2	0s	208ms/step
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2/2	0s	199ms/step
2/2	0s	192ms/step
2/2	0s	216ms/step
2/2	0s	192ms/step
2/2	0s	188ms/step
2/2	0s	192ms/step
2/2	0s	196ms/step
2/2	0s	194ms/step
2/2	1s	306ms/step
2/2	0s	204ms/step
2/2	0s	192ms/step
2/2	0s	190ms/step
2/2	0s	192ms/step

2/2	0s	206ms/step
2/2	0s	214ms/step
2/2	0s	188ms/step
2/2	0s	190ms/step
2/2	0s	187ms/step
2/2	0s	190ms/step
2/2	1s	320ms/step
2/2	0s	190ms/step
2/2	0s	202ms/step
2/2	0s	191ms/step
2/2	0s	190ms/step
2/2	0s	191ms/step
2/2	1s	286ms/step
2/2	0s	198ms/step
2/2	0s	202ms/step
2/2	0s	194ms/step
2/2	0s	188ms/step
2/2	0s	189ms/step
2/2	0s	212ms/step
2/2	0s	205ms/step
2/2	0s	194ms/step
2/2	0s	198ms/step
2/2	0s	186ms/step
2/2	1s	291ms/step
2/2	0s	198ms/step
2/2	0s	199ms/step
2/2	0s	199ms/step
2/2	0s	205ms/step
2/2	1s	312ms/step
2/2	0s	191ms/step
2/2	0s	196ms/step
2/2	0s	193ms/step
2/2	0s	191ms/step
2/2	0s	209ms/step
2/2	1s	290ms/step
2/2	0s	199ms/step
2/2	0s	190ms/step
2/2	0s	198ms/step
2/2	0s	200ms/step
2/2	0s	196ms/step
2/2	1s	252ms/step
2/2	0s	192ms/step
2/2	0s	188ms/step
2/2	0s	199ms/step
2/2	0s	214ms/step
2/2	1s	285ms/step
2/2	0s	212ms/step
2/2	0s	208ms/step
2/2	0s	195ms/step
2/2	0s	192ms/step
2/2	0s	192ms/step
2/2	1s	311ms/step
2/2	0s	201ms/step
2/2	0s	198ms/step

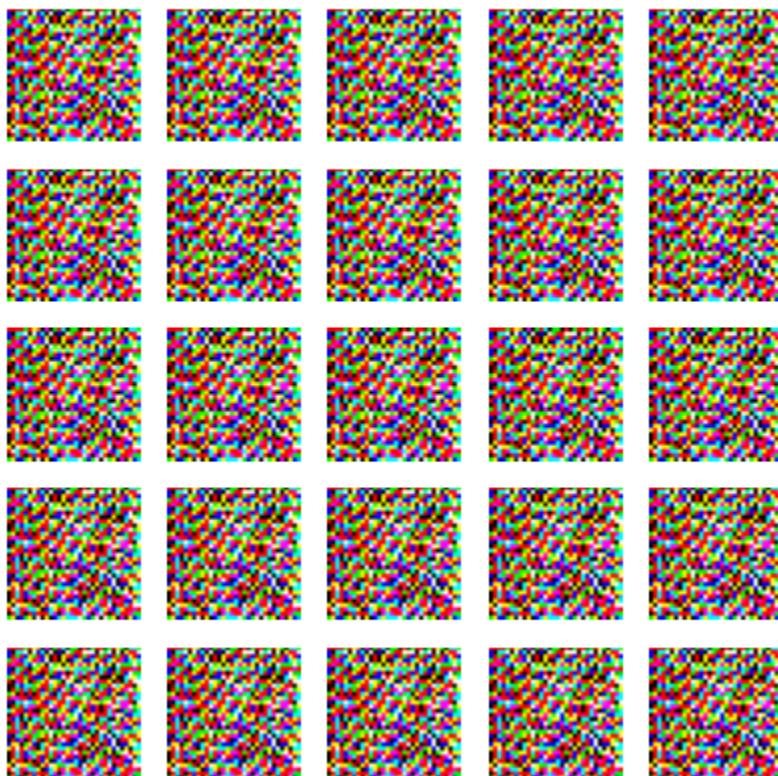
2/2	0s	194ms/step
2/2	0s	201ms/step
2/2	1s	306ms/step
2/2	0s	189ms/step
2/2	0s	198ms/step
2/2	0s	191ms/step
2/2	0s	199ms/step
2/2	0s	200ms/step
2/2	0s	214ms/step
2/2	0s	215ms/step
2/2	0s	218ms/step
2/2	0s	219ms/step
2/2	0s	220ms/step
2/2	1s	303ms/step
2/2	0s	212ms/step
2/2	0s	210ms/step
2/2	0s	189ms/step
2/2	0s	201ms/step
2/2	0s	201ms/step
2/2	0s	193ms/step
2/2	0s	195ms/step
2/2	0s	209ms/step
2/2	0s	193ms/step
2/2	0s	196ms/step
2/2	1s	323ms/step
2/2	0s	189ms/step
2/2	0s	193ms/step
2/2	0s	202ms/step
2/2	0s	227ms/step
2/2	0s	289ms/step
2/2	0s	210ms/step
2/2	0s	235ms/step
2/2	0s	199ms/step
2/2	0s	207ms/step
2/2	0s	193ms/step
2/2	1s	320ms/step
2/2	0s	197ms/step
2/2	0s	199ms/step
2/2	0s	203ms/step
2/2	0s	190ms/step
2/2	0s	203ms/step
2/2	1s	225ms/step
2/2	0s	197ms/step
2/2	0s	190ms/step
2/2	0s	208ms/step
2/2	0s	210ms/step
2/2	1s	288ms/step
2/2	0s	197ms/step
2/2	0s	195ms/step
2/2	0s	199ms/step
2/2	0s	200ms/step
2/2	1s	301ms/step
2/2	0s	197ms/step
2/2	0s	198ms/step

2/2	0s	199ms/step
2/2	0s	203ms/step
2/2	0s	197ms/step
2/2	1s	289ms/step
2/2	0s	210ms/step
2/2	0s	214ms/step
2/2	0s	219ms/step
2/2	0s	223ms/step
2/2	1s	307ms/step
2/2	0s	193ms/step
2/2	0s	216ms/step
2/2	0s	193ms/step
2/2	0s	197ms/step
2/2	0s	196ms/step
2/2	1s	293ms/step
2/2	0s	204ms/step
2/2	0s	206ms/step
2/2	0s	203ms/step
2/2	0s	194ms/step
2/2	1s	297ms/step
2/2	0s	194ms/step
2/2	0s	189ms/step
2/2	0s	196ms/step
2/2	0s	193ms/step
2/2	0s	192ms/step
2/2	1s	296ms/step
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2/2	0s	200ms/step
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2/2	1s	315ms/step
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2/2	0s	207ms/step
2/2	0s	213ms/step
2/2	0s	212ms/step
2/2	0s	207ms/step
2/2	1s	314ms/step
2/2	0s	192ms/step
2/2	0s	215ms/step
2/2	0s	220ms/step
2/2	0s	228ms/step
2/2	1s	326ms/step
2/2	0s	194ms/step
2/2	0s	203ms/step
2/2	0s	216ms/step
2/2	0s	209ms/step
2/2	0s	213ms/step
2/2	1s	298ms/step
2/2	0s	201ms/step
2/2	0s	207ms/step
2/2	0s	200ms/step
2/2	0s	201ms/step
2/2	1s	324ms/step
2/2	0s	195ms/step

2/2	0s	208ms/step
2/2	0s	204ms/step
2/2	0s	209ms/step
2/2	0s	201ms/step
2/2	1s	308ms/step
2/2	0s	194ms/step
2/2	0s	190ms/step
2/2	0s	198ms/step
2/2	0s	195ms/step
2/2	1s	326ms/step
2/2	0s	194ms/step
2/2	0s	206ms/step
2/2	0s	203ms/step
2/2	0s	201ms/step
2/2	0s	192ms/step
2/2	1s	227ms/step
2/2	0s	192ms/step
2/2	0s	196ms/step
2/2	0s	196ms/step
2/2	0s	190ms/step
2/2	1s	323ms/step
2/2	0s	200ms/step
2/2	0s	192ms/step
2/2	0s	215ms/step
2/2	0s	199ms/step
2/2	1s	333ms/step
2/2	0s	209ms/step
2/2	0s	199ms/step
2/2	0s	197ms/step
2/2	0s	203ms/step
2/2	0s	197ms/step
2/2	1s	316ms/step
2/2	0s	197ms/step
2/2	0s	191ms/step
2/2	0s	207ms/step
2/2	0s	198ms/step
2/2	0s	218ms/step
2/2	1s	231ms/step
2/2	0s	199ms/step
2/2	0s	198ms/step
2/2	0s	190ms/step
2/2	0s	198ms/step
2/2	1s	319ms/step
2/2	0s	211ms/step
2/2	0s	189ms/step
2/2	0s	196ms/step
2/2	0s	197ms/step
2/2	0s	208ms/step
2/2	1s	314ms/step
2/2	0s	193ms/step
2/2	0s	199ms/step
2/2	0s	201ms/step
2/2	0s	198ms/step
2/2	1s	292ms/step

2/2 ————— 0s 197ms/step
2/2 ————— 0s 194ms/step
2/2 ————— 0s 190ms/step
2/2 ————— 0s 188ms/step
2/2 ————— 0s 191ms/step
2/2 ————— 1s 293ms/step
2/2 ————— 0s 196ms/step
2/2 ————— 0s 196ms/step
2/2 ————— 0s 191ms/step
2/2 ————— 0s 204ms/step
2/2 ————— 0s 295ms/step
2/2 ————— 0s 193ms/step
2/2 ————— 0s 194ms/step
2/2 ————— 0s 189ms/step
1500 [D loss: 2.107771396636963] [G loss: 0.05253385379910469]
1/1 ————— 0s 166ms/step

Generated Images at Epoch 1500



2/2	0s	199ms/step
2/2	0s	198ms/step
2/2	0s	220ms/step
2/2	0s	213ms/step
2/2	0s	200ms/step
2/2	0s	189ms/step
2/2	0s	194ms/step
2/2	1s	267ms/step
2/2	0s	191ms/step
2/2	0s	185ms/step
2/2	0s	192ms/step
2/2	0s	193ms/step
2/2	0s	197ms/step
2/2	1s	295ms/step
2/2	0s	192ms/step
2/2	0s	190ms/step
2/2	0s	194ms/step
2/2	0s	195ms/step
2/2	1s	304ms/step
2/2	0s	196ms/step
2/2	0s	207ms/step
2/2	0s	193ms/step
2/2	0s	199ms/step
2/2	0s	190ms/step
2/2	1s	276ms/step
2/2	0s	207ms/step
2/2	0s	199ms/step
2/2	0s	192ms/step
2/2	0s	199ms/step
2/2	1s	297ms/step
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2/2	0s	203ms/step
2/2	0s	192ms/step
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2/2	0s	199ms/step
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2/2	0s	190ms/step
2/2	1s	312ms/step
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2/2	0s	196ms/step
2/2	0s	190ms/step
2/2	0s	190ms/step
2/2	0s	192ms/step
2/2	1s	228ms/step
2/2	0s	207ms/step

2/2	0s	207ms/step
2/2	0s	196ms/step
2/2	0s	195ms/step
2/2	1s	285ms/step
2/2	0s	192ms/step
2/2	0s	201ms/step
2/2	0s	218ms/step
2/2	0s	200ms/step
2/2	0s	210ms/step
2/2	1s	306ms/step
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2/2	0s	209ms/step
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2/2	1s	298ms/step
2/2	0s	203ms/step
2/2	0s	193ms/step
2/2	0s	195ms/step
2/2	0s	213ms/step
2/2	0s	206ms/step
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2/2	0s	203ms/step
2/2	0s	210ms/step
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2/2	0s	228ms/step
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2/2	0s	194ms/step
2/2	0s	195ms/step
2/2	0s	204ms/step
2/2	0s	206ms/step

2/2	0s	199ms/step
2/2	0s	205ms/step
2/2	0s	195ms/step
2/2	0s	198ms/step
2/2	1s	290ms/step
2/2	0s	201ms/step
2/2	0s	200ms/step
2/2	0s	211ms/step
2/2	0s	213ms/step
2/2	0s	198ms/step
2/2	1s	299ms/step
2/2	0s	201ms/step
2/2	0s	200ms/step
2/2	0s	196ms/step
2/2	0s	199ms/step
2/2	0s	308ms/step
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2/2	0s	192ms/step
2/2	0s	193ms/step
2/2	0s	189ms/step
2/2	1s	297ms/step
2/2	0s	196ms/step
2/2	0s	189ms/step
2/2	0s	189ms/step
2/2	0s	190ms/step

2/2	0s	192ms/step
2/2	0s	221ms/step
2/2	0s	199ms/step
2/2	0s	196ms/step
2/2	0s	197ms/step
2/2	0s	203ms/step
2/2	1s	312ms/step
2/2	0s	193ms/step
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2/2	0s	188ms/step
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2/2	0s	225ms/step
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2/2	0s	191ms/step
2/2	0s	198ms/step
2/2	0s	193ms/step
2/2	0s	193ms/step
2/2	1s	320ms/step
2/2	0s	199ms/step
2/2	0s	196ms/step
2/2	0s	208ms/step
2/2	0s	198ms/step
2/2	1s	278ms/step
2/2	0s	212ms/step
2/2	0s	213ms/step
2/2	0s	216ms/step

2/2	0s	195ms/step
2/2	0s	195ms/step
2/2	1s	311ms/step
2/2	0s	216ms/step
2/2	0s	207ms/step
2/2	0s	209ms/step
2/2	0s	219ms/step
2/2	1s	305ms/step
2/2	0s	193ms/step
2/2	0s	198ms/step
2/2	0s	194ms/step
2/2	0s	200ms/step
2/2	0s	196ms/step
2/2	1s	302ms/step
2/2	0s	197ms/step
2/2	0s	194ms/step
2/2	0s	193ms/step
2/2	0s	196ms/step
2/2	0s	197ms/step
2/2	0s	201ms/step
2/2	0s	197ms/step
2/2	0s	199ms/step
2/2	0s	203ms/step
2/2	0s	192ms/step
2/2	1s	302ms/step
2/2	0s	200ms/step
2/2	0s	196ms/step
2/2	0s	192ms/step
2/2	0s	193ms/step
2/2	0s	193ms/step
2/2	1s	281ms/step
2/2	0s	206ms/step
2/2	0s	214ms/step
2/2	0s	191ms/step
2/2	0s	215ms/step
2/2	0s	213ms/step
2/2	1s	294ms/step
2/2	0s	193ms/step
2/2	0s	187ms/step
2/2	0s	208ms/step
2/2	0s	207ms/step
2/2	1s	304ms/step
2/2	0s	203ms/step
2/2	0s	209ms/step
2/2	0s	208ms/step
2/2	0s	203ms/step
2/2	0s	197ms/step
2/2	1s	313ms/step
2/2	0s	216ms/step
2/2	0s	193ms/step
2/2	0s	197ms/step
2/2	0s	194ms/step
2/2	1s	290ms/step
2/2	0s	196ms/step

2/2	0s	198ms/step
2/2	0s	197ms/step
2/2	0s	196ms/step
2/2	0s	234ms/step
2/2	1s	304ms/step
2/2	0s	200ms/step
2/2	0s	195ms/step
2/2	0s	188ms/step
2/2	0s	195ms/step
2/2	1s	292ms/step
2/2	0s	198ms/step
2/2	0s	191ms/step
2/2	0s	215ms/step
2/2	0s	205ms/step
2/2	0s	202ms/step
2/2	1s	261ms/step
2/2	0s	224ms/step
2/2	0s	192ms/step
2/2	0s	197ms/step
2/2	0s	202ms/step
2/2	1s	340ms/step
2/2	0s	204ms/step
2/2	0s	209ms/step
2/2	0s	199ms/step
2/2	0s	200ms/step
2/2	0s	194ms/step
2/2	1s	317ms/step
2/2	0s	189ms/step
2/2	0s	219ms/step
2/2	0s	196ms/step
2/2	0s	203ms/step
2/2	0s	213ms/step
2/2	0s	192ms/step
2/2	0s	209ms/step
2/2	0s	194ms/step
2/2	0s	197ms/step
2/2	0s	199ms/step
2/2	1s	291ms/step
2/2	0s	205ms/step
2/2	0s	198ms/step
2/2	0s	203ms/step
2/2	0s	201ms/step
2/2	0s	197ms/step
2/2	1s	291ms/step
2/2	0s	198ms/step
2/2	0s	195ms/step
2/2	0s	197ms/step
2/2	0s	196ms/step
2/2	1s	340ms/step
2/2	0s	202ms/step
2/2	0s	199ms/step
2/2	0s	208ms/step
2/2	0s	197ms/step
2/2	0s	200ms/step

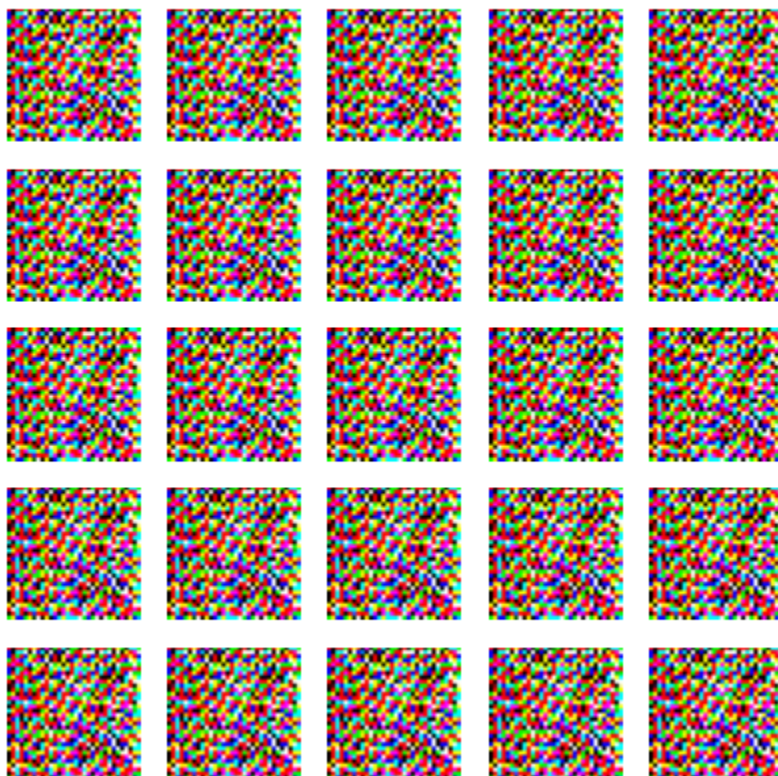
2/2	1s	311ms/step
2/2	0s	213ms/step
2/2	0s	193ms/step
2/2	0s	200ms/step
2/2	0s	199ms/step
2/2	1s	301ms/step
2/2	0s	195ms/step
2/2	0s	195ms/step
2/2	0s	190ms/step
2/2	0s	196ms/step
2/2	0s	201ms/step
2/2	1s	215ms/step
2/2	0s	198ms/step
2/2	0s	196ms/step
2/2	0s	197ms/step
2/2	0s	196ms/step
2/2	1s	289ms/step
2/2	0s	199ms/step
2/2	0s	198ms/step
2/2	0s	192ms/step
2/2	0s	193ms/step
2/2	0s	192ms/step
2/2	1s	327ms/step
2/2	0s	196ms/step
2/2	0s	197ms/step
2/2	0s	200ms/step
2/2	0s	196ms/step
2/2	1s	305ms/step
2/2	0s	192ms/step
2/2	0s	189ms/step
2/2	0s	216ms/step
2/2	0s	197ms/step
2/2	0s	196ms/step
2/2	1s	330ms/step
2/2	0s	202ms/step
2/2	0s	190ms/step
2/2	0s	195ms/step
2/2	0s	205ms/step
2/2	1s	290ms/step
2/2	0s	196ms/step
2/2	0s	189ms/step
2/2	0s	190ms/step
2/2	0s	202ms/step
2/2	0s	195ms/step
2/2	1s	319ms/step
2/2	0s	197ms/step
2/2	0s	201ms/step
2/2	0s	198ms/step
2/2	0s	190ms/step
2/2	0s	198ms/step
2/2	0s	196ms/step
2/2	0s	197ms/step
2/2	0s	214ms/step
2/2	0s	208ms/step

2/2	0s	198ms/step
2/2	1s	280ms/step
2/2	0s	232ms/step
2/2	0s	208ms/step
2/2	0s	210ms/step
2/2	0s	213ms/step
2/2	0s	196ms/step
2/2	1s	260ms/step
2/2	0s	200ms/step
2/2	0s	200ms/step
2/2	0s	202ms/step
2/2	0s	200ms/step
2/2	1s	329ms/step
2/2	0s	187ms/step
2/2	0s	200ms/step
2/2	0s	211ms/step
2/2	0s	203ms/step
2/2	0s	199ms/step
2/2	1s	322ms/step
2/2	0s	191ms/step
2/2	0s	197ms/step
2/2	0s	190ms/step
2/2	0s	198ms/step
2/2	1s	323ms/step
2/2	0s	194ms/step
2/2	0s	199ms/step
2/2	0s	204ms/step
2/2	0s	203ms/step
2/2	0s	210ms/step
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2/2	0s	190ms/step
2/2	0s	209ms/step
2/2	0s	201ms/step
2/2	1s	333ms/step
2/2	0s	200ms/step
2/2	0s	204ms/step
2/2	0s	215ms/step
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2/2	0s	237ms/step
2/2	0s	198ms/step
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2/2	0s	197ms/step
2/2	0s	195ms/step
2/2	0s	194ms/step
2/2	1s	339ms/step
2/2	0s	188ms/step
2/2	0s	201ms/step
2/2	0s	196ms/step
2/2	0s	213ms/step
2/2	0s	288ms/step
2/2	0s	198ms/step
2/2	0s	193ms/step
2/2	0s	214ms/step

2/2	0s	205ms/step
2/2	0s	205ms/step
2/2	1s	296ms/step
2/2	0s	218ms/step
2/2	0s	195ms/step
2/2	0s	191ms/step
2/2	0s	202ms/step
2/2	0s	193ms/step
2/2	0s	197ms/step
2/2	0s	213ms/step
2/2	0s	197ms/step
2/2	0s	210ms/step
2/2	0s	193ms/step
2/2	1s	323ms/step
2/2	0s	196ms/step
2/2	0s	196ms/step
2/2	0s	206ms/step
2/2	0s	207ms/step
2/2	0s	199ms/step
2/2	1s	314ms/step
2/2	0s	201ms/step
2/2	0s	196ms/step
2/2	0s	217ms/step
2/2	0s	197ms/step
2/2	1s	304ms/step
2/2	0s	204ms/step
2/2	0s	204ms/step
2/2	0s	190ms/step
2/2	0s	196ms/step
2/2	0s	191ms/step
2/2	1s	294ms/step
2/2	0s	198ms/step
2/2	0s	195ms/step
2/2	0s	194ms/step
2/2	0s	221ms/step
2/2	1s	314ms/step
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2/2	0s	197ms/step
2/2	0s	200ms/step
2/2	0s	199ms/step
2/2	0s	200ms/step
2/2	0s	203ms/step
2/2	0s	195ms/step
2/2	0s	205ms/step
2/2	0s	191ms/step
2/2	0s	200ms/step
2/2	0s	223ms/step
2/2	1s	313ms/step
2/2	0s	207ms/step

2/2 ————— 0s 214ms/step
2/2 ————— 0s 197ms/step
2/2 ————— 0s 201ms/step
2/2 ————— 0s 223ms/step
2/2 ————— 0s 208ms/step
2/2 ————— 0s 196ms/step
2/2 ————— 0s 190ms/step
2/2 ————— 0s 197ms/step
2/2 ————— 0s 190ms/step
2/2 ————— 1s 312ms/step
2/2 ————— 0s 211ms/step
2/2 ————— 0s 212ms/step
2/2 ————— 0s 202ms/step
2/2 ————— 0s 201ms/step
2000 [D loss: 2.1957006454467773] [G loss: 0.04319695755839348]
1/1 ————— 0s 183ms/step

Generated Images at Epoch 2000



2/2	1s	304ms/step
2/2	0s	197ms/step
2/2	0s	223ms/step
2/2	0s	195ms/step
2/2	0s	206ms/step
2/2	0s	203ms/step
2/2	1s	308ms/step
2/2	0s	218ms/step
2/2	0s	208ms/step
2/2	0s	210ms/step
2/2	0s	214ms/step
2/2	1s	279ms/step
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2/2	0s	197ms/step
2/2	0s	192ms/step
2/2	0s	193ms/step
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2/2	1s	281ms/step
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2/2	0s	204ms/step
2/2	0s	204ms/step

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2/2	0s	193ms/step
2/2	0s	197ms/step
2/2	0s	198ms/step
2/2	0s	201ms/step
2/2	0s	201ms/step
2/2	0s	225ms/step
2/2	0s	198ms/step
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2/2	0s	196ms/step
2/2	0s	192ms/step
2/2	0s	200ms/step
2/2	0s	191ms/step
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2/2	0s	211ms/step
2/2	0s	216ms/step
2/2	0s	282ms/step
2/2	0s	217ms/step
2/2	0s	203ms/step
2/2	0s	210ms/step
2/2	0s	213ms/step
2/2	0s	196ms/step
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2/2	0s	213ms/step
2/2	0s	216ms/step
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2/2	0s	197ms/step
2/2	0s	191ms/step
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2/2	0s	309ms/step
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2/2	0s	204ms/step
2/2	0s	191ms/step
2/2	0s	192ms/step
2/2	0s	193ms/step
2/2	1s	301ms/step
2/2	0s	198ms/step
2/2	0s	198ms/step

2/2	0s	200ms/step
2/2	0s	195ms/step
2/2	0s	190ms/step
2/2	1s	296ms/step
2/2	0s	195ms/step
2/2	0s	195ms/step
2/2	0s	195ms/step
2/2	0s	193ms/step
2/2	1s	340ms/step
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2/2	0s	205ms/step
2/2	0s	196ms/step
2/2	0s	198ms/step
2/2	0s	201ms/step

2/2	1s	324ms/step
2/2	0s	203ms/step
2/2	0s	206ms/step
2/2	0s	197ms/step
2/2	0s	209ms/step
2/2	1s	289ms/step
2/2	0s	194ms/step
2/2	0s	201ms/step
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2/2	0s	210ms/step
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2/2	0s	195ms/step
2/2	0s	197ms/step
2/2	0s	193ms/step
2/2	0s	211ms/step
2/2	0s	217ms/step
2/2	0s	188ms/step
2/2	0s	196ms/step
2/2	0s	189ms/step

2/2	0s	202ms/step
2/2	0s	194ms/step
2/2	1s	313ms/step
2/2	0s	214ms/step
2/2	0s	208ms/step
2/2	0s	199ms/step
2/2	0s	211ms/step
2/2	0s	223ms/step
2/2	1s	294ms/step
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2/2	0s	195ms/step
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2/2	0s	191ms/step
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2/2	0s	211ms/step
2/2	0s	215ms/step
2/2	0s	195ms/step
2/2	1s	312ms/step
2/2	0s	196ms/step

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2/2	0s	203ms/step
2/2	0s	203ms/step
2/2	0s	207ms/step
2/2	1s	317ms/step
2/2	0s	217ms/step
2/2	0s	198ms/step
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2/2	0s	193ms/step
2/2	0s	201ms/step
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2/2	0s	214ms/step
2/2	0s	202ms/step
2/2	0s	208ms/step
2/2	1s	323ms/step
2/2	0s	222ms/step
2/2	0s	226ms/step
2/2	0s	193ms/step
2/2	0s	200ms/step
2/2	0s	197ms/step
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2/2	1s	334ms/step
2/2	0s	194ms/step
2/2	0s	209ms/step
2/2	0s	215ms/step
2/2	0s	185ms/step
2/2	1s	300ms/step
2/2	0s	198ms/step
2/2	0s	196ms/step
2/2	0s	211ms/step
2/2	0s	197ms/step

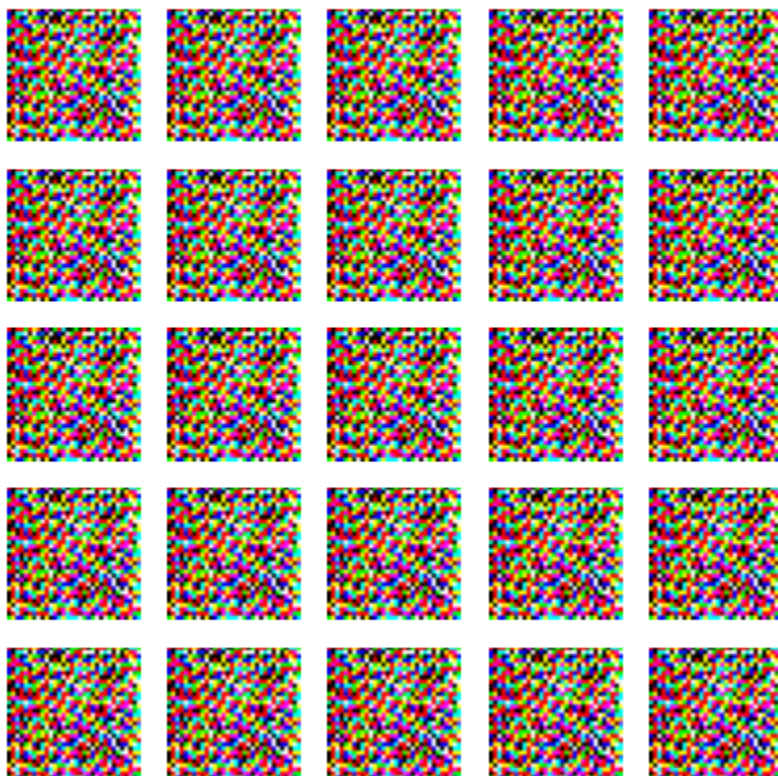
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2/2	1s	295ms/step
2/2	0s	194ms/step
2/2	0s	217ms/step
2/2	0s	216ms/step
2/2	0s	203ms/step
2/2	0s	266ms/step
2/2	0s	194ms/step
2/2	0s	195ms/step
2/2	0s	201ms/step
2/2	0s	196ms/step
2/2	0s	200ms/step
2/2	1s	343ms/step
2/2	0s	193ms/step
2/2	0s	199ms/step
2/2	0s	202ms/step
2/2	0s	223ms/step
2/2	1s	297ms/step
2/2	0s	217ms/step
2/2	0s	207ms/step
2/2	0s	209ms/step
2/2	0s	191ms/step
2/2	0s	198ms/step
2/2	1s	299ms/step
2/2	0s	190ms/step
2/2	0s	202ms/step
2/2	0s	201ms/step
2/2	0s	197ms/step
2/2	0s	201ms/step
2/2	1s	250ms/step
2/2	0s	190ms/step
2/2	0s	194ms/step
2/2	0s	191ms/step
2/2	0s	188ms/step
2/2	1s	311ms/step
2/2	0s	192ms/step
2/2	0s	201ms/step
2/2	0s	196ms/step
2/2	0s	208ms/step
2/2	0s	216ms/step
2/2	0s	217ms/step
2/2	0s	218ms/step
2/2	0s	197ms/step
2/2	0s	205ms/step
2/2	0s	212ms/step
2/2	1s	303ms/step
2/2	0s	209ms/step
2/2	0s	193ms/step
2/2	0s	212ms/step
2/2	0s	208ms/step
2/2	0s	204ms/step
2/2	1s	295ms/step
2/2	0s	199ms/step
2/2	0s	207ms/step

2/2	0s	202ms/step
2/2	0s	203ms/step
2/2	0s	231ms/step
2/2	0s	201ms/step
2/2	0s	198ms/step
2/2	0s	192ms/step
2/2	0s	201ms/step
2/2	0s	207ms/step
2/2	1s	272ms/step
2/2	0s	195ms/step
2/2	0s	198ms/step
2/2	0s	200ms/step
2/2	0s	199ms/step
2/2	0s	202ms/step
2/2	1s	343ms/step
2/2	0s	213ms/step
2/2	0s	199ms/step
2/2	0s	204ms/step
2/2	0s	206ms/step
2/2	1s	284ms/step
2/2	0s	200ms/step
2/2	0s	204ms/step
2/2	0s	198ms/step
2/2	0s	200ms/step
2/2	0s	200ms/step
2/2	1s	284ms/step
2/2	0s	210ms/step
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2/2	0s	193ms/step
2/2	0s	202ms/step
2/2	1s	311ms/step
2/2	0s	201ms/step
2/2	0s	206ms/step
2/2	0s	212ms/step
2/2	0s	203ms/step
2/2	0s	213ms/step
2/2	1s	308ms/step
2/2	0s	218ms/step
2/2	0s	211ms/step
2/2	0s	209ms/step
2/2	0s	222ms/step
2/2	1s	297ms/step
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2/2	0s	197ms/step
2/2	0s	193ms/step
2/2	0s	196ms/step
2/2	0s	200ms/step
2/2	1s	321ms/step
2/2	0s	201ms/step
2/2	0s	206ms/step
2/2	0s	194ms/step
2/2	0s	193ms/step
2/2	0s	193ms/step
2/2	1s	326ms/step

2/2	0s	220ms/step
2/2	0s	218ms/step
2/2	0s	195ms/step
2/2	0s	213ms/step
2/2	0s	211ms/step
2/2	1s	313ms/step
2/2	0s	205ms/step
2/2	0s	203ms/step
2/2	0s	194ms/step
2/2	0s	195ms/step
2/2	1s	293ms/step
2/2	0s	196ms/step
2/2	0s	193ms/step
2/2	0s	196ms/step
2/2	0s	201ms/step
2/2	0s	216ms/step
2/2	1s	307ms/step
2/2	0s	193ms/step
2/2	0s	198ms/step
2/2	0s	192ms/step
2/2	0s	196ms/step
2/2	0s	193ms/step
2/2	1s	297ms/step
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2/2	0s	195ms/step
2/2	0s	196ms/step
2/2	0s	197ms/step
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2/2	0s	190ms/step
2/2	0s	196ms/step
2/2	0s	196ms/step
2/2	0s	198ms/step
2/2	1s	318ms/step
2/2	0s	193ms/step
2/2	0s	203ms/step
2/2	0s	204ms/step
2/2	0s	195ms/step
2/2	0s	200ms/step
2/2	0s	197ms/step
2/2	0s	195ms/step
2/2	0s	195ms/step
2/2	0s	198ms/step
2/2	0s	189ms/step
2/2	1s	273ms/step
2/2	0s	195ms/step
2/2	0s	195ms/step
2/2	0s	191ms/step
2/2	0s	201ms/step
2/2	0s	199ms/step
2/2	1s	306ms/step
2/2	0s	199ms/step
2/2	0s	192ms/step
2/2	0s	196ms/step

2/2 ————— 0s 189ms/step
2/2 ————— 0s 193ms/step
2/2 ————— 0s 224ms/step
2/2 ————— 0s 193ms/step
2/2 ————— 0s 254ms/step
2/2 ————— 0s 195ms/step
2/2 ————— 0s 207ms/step
2/2 ————— 1s 297ms/step
2/2 ————— 0s 193ms/step
2/2 ————— 0s 204ms/step
2/2 ————— 0s 193ms/step
2/2 ————— 0s 196ms/step
2/2 ————— 0s 189ms/step
2/2 ————— 1s 298ms/step
2500 [D loss: 2.256368637084961] [G loss: 0.03736592084169388]
1/1 ————— 0s 181ms/step

Generated Images at Epoch 2500



2/2	0s	197ms/step
2/2	0s	199ms/step
2/2	0s	194ms/step
2/2	0s	200ms/step
2/2	1s	313ms/step
2/2	0s	199ms/step
2/2	0s	199ms/step
2/2	0s	193ms/step
2/2	0s	196ms/step
2/2	0s	202ms/step
2/2	1s	250ms/step
2/2	0s	195ms/step
2/2	0s	202ms/step
2/2	0s	195ms/step
2/2	0s	200ms/step
2/2	1s	322ms/step
2/2	0s	205ms/step
2/2	0s	193ms/step
2/2	0s	200ms/step
2/2	0s	201ms/step
2/2	0s	202ms/step
2/2	1s	295ms/step
2/2	0s	193ms/step
2/2	0s	198ms/step
2/2	0s	190ms/step
2/2	0s	194ms/step
2/2	1s	285ms/step
2/2	0s	192ms/step
2/2	0s	207ms/step
2/2	0s	196ms/step
2/2	0s	194ms/step
2/2	0s	194ms/step
2/2	1s	285ms/step
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2/2	0s	217ms/step
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2/2	0s	204ms/step
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2/2	0s	208ms/step
2/2	0s	222ms/step
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2/2	0s	203ms/step
2/2	0s	208ms/step
2/2	0s	219ms/step
2/2	0s	194ms/step
2/2	1s	275ms/step
2/2	0s	201ms/step
2/2	0s	226ms/step
2/2	0s	216ms/step
2/2	0s	199ms/step

2/2	1s	276ms/step
2/2	0s	211ms/step
2/2	0s	196ms/step
2/2	0s	209ms/step
2/2	0s	203ms/step
2/2	0s	195ms/step
2/2	1s	292ms/step
2/2	0s	205ms/step
2/2	0s	193ms/step
2/2	0s	202ms/step
2/2	0s	194ms/step
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2/2	0s	210ms/step
2/2	0s	200ms/step
2/2	0s	194ms/step
2/2	0s	198ms/step
2/2	1s	268ms/step
2/2	0s	200ms/step
2/2	0s	189ms/step
2/2	0s	188ms/step
2/2	0s	195ms/step
2/2	0s	196ms/step
2/2	1s	259ms/step
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2/2	0s	196ms/step
2/2	0s	193ms/step
2/2	1s	316ms/step
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2/2	0s	195ms/step
2/2	0s	213ms/step
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2/2	0s	191ms/step
2/2	0s	203ms/step
2/2	0s	196ms/step
2/2	0s	197ms/step
2/2	1s	308ms/step
2/2	0s	195ms/step
2/2	1s	270ms/step
2/2	0s	202ms/step

2/2	0s	196ms/step
2/2	1s	310ms/step
2/2	0s	216ms/step
2/2	0s	208ms/step
2/2	0s	210ms/step
2/2	0s	190ms/step
2/2	0s	200ms/step
2/2	1s	314ms/step
2/2	0s	210ms/step
2/2	0s	188ms/step
2/2	0s	189ms/step
2/2	0s	191ms/step
2/2	0s	193ms/step
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2/2	0s	203ms/step
2/2	0s	195ms/step
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2/2	0s	200ms/step
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2/2	0s	193ms/step
2/2	0s	210ms/step
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2/2	0s	194ms/step
2/2	0s	194ms/step
2/2	1s	296ms/step
2/2	0s	216ms/step
2/2	0s	193ms/step
2/2	0s	193ms/step
2/2	0s	195ms/step
2/2	0s	221ms/step
2/2	1s	304ms/step
2/2	0s	198ms/step

2/2	0s	203ms/step
2/2	0s	217ms/step
2/2	0s	195ms/step
2/2	0s	255ms/step
2/2	0s	198ms/step
2/2	0s	195ms/step
2/2	0s	196ms/step
2/2	0s	189ms/step
2/2	0s	196ms/step
2/2	1s	333ms/step
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2/2	0s	202ms/step
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2/2	0s	205ms/step
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2/2	0s	204ms/step
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2/2	0s	205ms/step
2/2	0s	195ms/step
2/2	0s	198ms/step
2/2	0s	204ms/step

2/2	1s	299ms/step
2/2	0s	196ms/step
2/2	0s	215ms/step
2/2	0s	198ms/step
2/2	0s	208ms/step
2/2	1s	274ms/step
2/2	0s	216ms/step
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2/2	0s	200ms/step
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2/2	0s	192ms/step
2/2	0s	195ms/step

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2/2	1s	309ms/step
2/2	0s	200ms/step
2/2	0s	195ms/step
2/2	0s	198ms/step
2/2	0s	200ms/step
2/2	0s	201ms/step
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2/2	0s	202ms/step
2/2	1s	295ms/step
2/2	0s	225ms/step
2/2	0s	208ms/step

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2/2	0s	194ms/step
2/2	1s	313ms/step
2/2	0s	198ms/step
2/2	0s	194ms/step
2/2	0s	197ms/step
2/2	0s	206ms/step
2/2	0s	207ms/step
2/2	0s	199ms/step
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2/2	0s	201ms/step
2/2	0s	211ms/step
2/2	0s	218ms/step
2/2	1s	303ms/step

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2/2	0s	197ms/step
2/2	0s	200ms/step
2/2	0s	231ms/step
2/2	1s	316ms/step
2/2	0s	202ms/step
2/2	0s	214ms/step
2/2	0s	217ms/step
2/2	0s	202ms/step
2/2	0s	197ms/step
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2/2	0s	208ms/step
2/2	1s	218ms/step
2/2	0s	205ms/step
2/2	0s	207ms/step
2/2	0s	213ms/step
2/2	0s	207ms/step

2/2	1s	342ms/step
2/2	0s	212ms/step
2/2	0s	218ms/step
2/2	0s	227ms/step
2/2	0s	196ms/step
2/2	0s	208ms/step
2/2	1s	299ms/step
2/2	0s	200ms/step
2/2	0s	199ms/step
2/2	0s	198ms/step
2/2	0s	214ms/step
2/2	1s	317ms/step
2/2	0s	197ms/step
2/2	0s	197ms/step
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2/2	0s	205ms/step
2/2	0s	200ms/step
2/2	0s	201ms/step
2/2	0s	216ms/step
2/2	1s	261ms/step
2/2	0s	204ms/step
2/2	0s	197ms/step
2/2	0s	213ms/step
2/2	0s	227ms/step
2/2	1s	313ms/step
2/2	0s	212ms/step
2/2	0s	231ms/step
2/2	0s	225ms/step
2/2	0s	222ms/step
2/2	1s	279ms/step
2/2	0s	209ms/step
2/2	0s	204ms/step
2/2	0s	211ms/step
2/2	0s	209ms/step
2/2	0s	200ms/step
2/2	1s	285ms/step
2/2	0s	204ms/step
2/2	0s	194ms/step
2/2	0s	205ms/step
2/2	0s	200ms/step
2/2	0s	201ms/step
2/2	1s	220ms/step
2/2	0s	205ms/step
2/2	0s	200ms/step
2/2	0s	206ms/step

2/2	_____	0s	201ms/step
2/2	_____	1s	325ms/step
2/2	_____	0s	195ms/step
2/2	_____	0s	194ms/step
2/2	_____	0s	195ms/step
2/2	_____	0s	196ms/step
2/2	_____	0s	193ms/step
2/2	_____	1s	286ms/step
2/2	_____	0s	201ms/step
2/2	_____	0s	206ms/step
2/2	_____	0s	207ms/step
2/2	_____	0s	212ms/step
2/2	_____	1s	293ms/step

Exp-12: Implement a Deep Convolutional GAN to Generate Complex Color Images.

Aim:

To design a Deep Convolutional GAN (DCGAN) that generate realistic color images using convolutional layers.

Description:

A GAN consists of a Generator that creates fake images and a Discriminator that distinguishes real from fake.

The DCGAN replaces dense layers with convolutional ones for better image detail and stability.

Procedure:

- 1) Prepare and normalize a colour image dataset
- 2) Build generator using transposed convolutions to upsample noise vectors.
- 3) Build Discriminator using CNN layers to classify images.
- 4) Train both adversarially: Generator tries to fool the Discriminator.
- 5) Generate sample images during training

Noise (100)

Generator

Dense \rightarrow Reshape \rightarrow Conv 2D Transpose $\times 3$
Output $(32 \times 32 \times 3)$

fake Image $(32 \times 32 \times 3)$

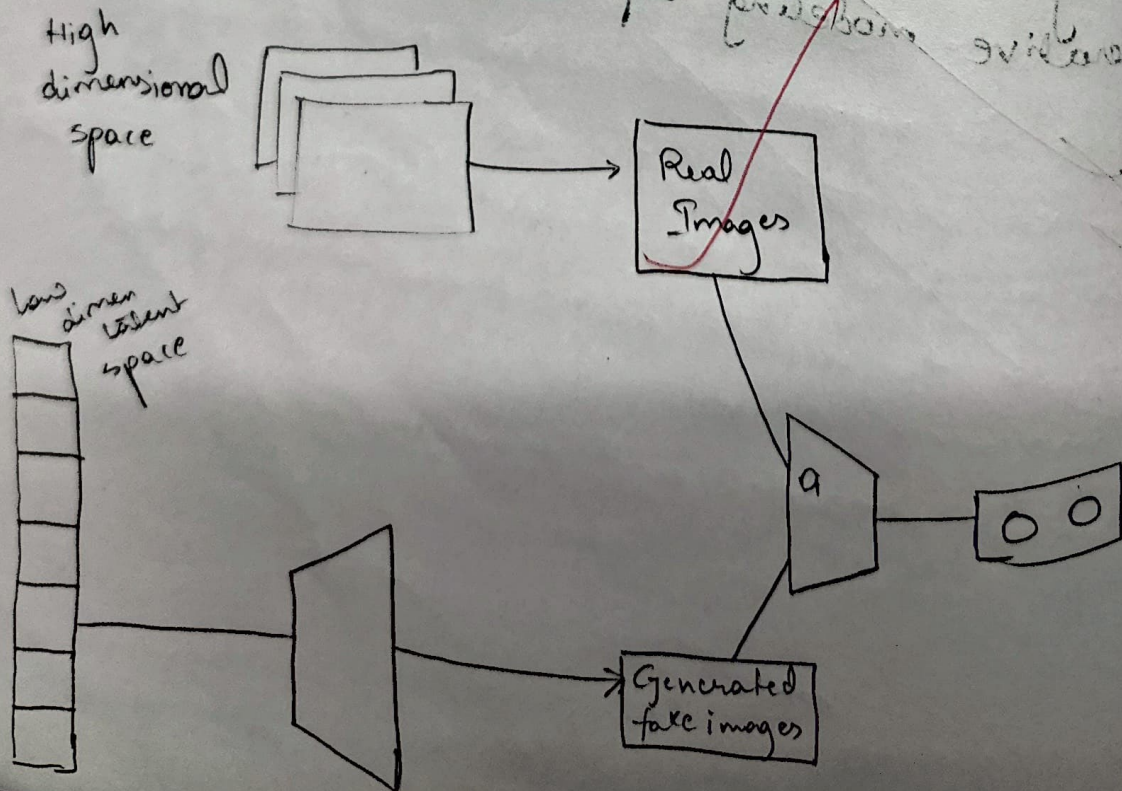
Discriminator:

Conv 2D $\times 3 \rightarrow$ Flatten \rightarrow Dense \rightarrow Signal

Output: Real / Fake

Adversarial Training

between Generator and Discriminator



Pseudocode:

Load CIFAR-10 dataset

Build Generator (noise \rightarrow conv layers \rightarrow image)

Build Discriminator (image \rightarrow conv layers \rightarrow output)

Adversarial training loop:

Train Discriminator on real and fake images

Train Generator to fool Discriminator.

Generate and display sample images.

Observation:

Generated color images improves with epochs,
showing realistic patterns and textures.

~~Result:~~ Result: The DCGAN successfully produced convincing
color images, proving its capability for
deep ~~learning~~ generative image
modeling.

Output :

Epoch [1/10] / Loss : 0.2675 / 4 Loss : 1.3297

Epoch [2/10] / Loss : 0.2787 / 4 Loss : 1.8825

Epoch [3/10] / Loss : 0.2546 / 4 Loss : 2.0490

Epoch [6/10] / Loss : 0.3482 / 4 Loss : 1.1048

Epoch [7/10] / Loss : 0.3175 / 4 Loss : 1.3139

Epoch [8/10] / Loss : 0.3072 / 4 Loss : 1.2922

Epoch [10/10] / 0 Loss : 0.8295 / 4 Loss : 1.0922