

gan

March 30, 2024

```
[ ]: !pip install opendatasets --upgrade --quiet
[ ]: import opendatasets as od
[ ]: dataset_url = 'https://www.kaggle.com/ikarus777/best-artworks-of-all-time'
[ ]: od.download(dataset_url)

0%|          | 0.00/2.29G [00:00<?, ?B/s]
Downloading best-artworks-of-all-time.zip to ./best-artworks-of-all-time
100%|      | 2.29G/2.29G [00:36<00:00, 67.9MB/s]
```

```
[ ]: data_dir = '/content/best-artworks-of-all-time/resized/'
```

```
[ ]: import os
[ ]: for cls in os.listdir(data_dir):
    print(cls, ':', len(os.listdir(data_dir + '/' + cls)))
```

resized : 8683

```
[ ]: from torchvision.datasets import ImageFolder
```

```
[ ]: dataset = ImageFolder(data_dir)
```

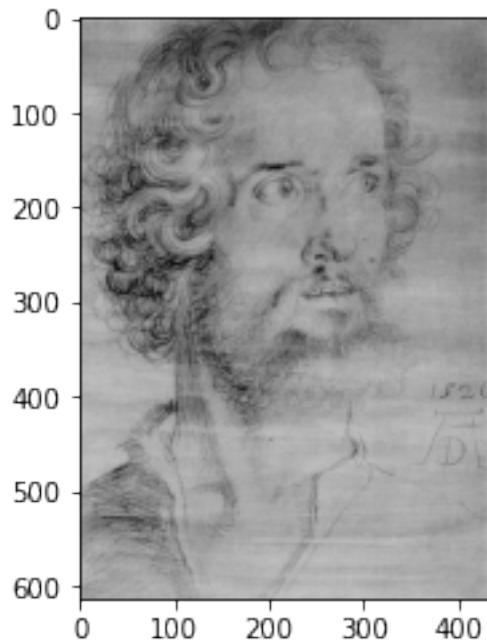
```
[ ]: len(dataset)
```

8683

```
[ ]: import matplotlib.pyplot as plt
%matplotlib inline
```

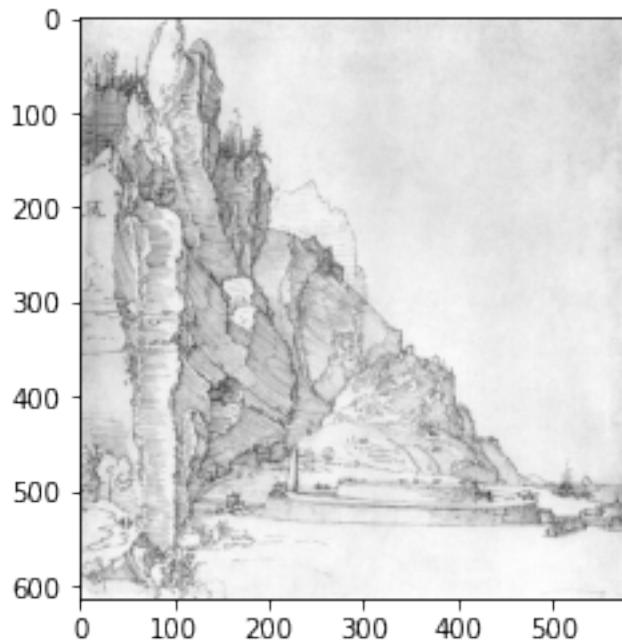
```
[ ]: img, label = dataset[0]
plt.imshow(img)
```

```
[ ]: <matplotlib.image.AxesImage at 0x7f44e079dc90>
```



```
[ ]: img, label = dataset[500]
plt.imshow(img)
```

```
[ ]: <matplotlib.image.AxesImage at 0x7f44e0049110>
```



```
[ ]: img, label = dataset[741]
plt.imshow(img)
```

```
[ ]: <matplotlib.image.AxesImage at 0x7f44defc1f50>
```



```
[ ]: import torchvision.transforms as tt
from torch.utils.data import DataLoader
```

```
[ ]: image_size = 64
batch_size = 128
stats = (0.5, 0.5, 0.5), (0.5, 0.5, 0.5)
```

```
[ ]: train_ds = ImageFolder(data_dir, transform=tt.Compose([
    tt.Resize(image_size),
    tt.CenterCrop(image_size),
    tt.ToTensor(),
    tt.Normalize(*stats)]))

train_dl = DataLoader(train_ds, batch_size, shuffle=True, num_workers=3,
                     pin_memory=True)
```

```
/usr/local/lib/python3.7/dist-packages/torch/utils/data/dataloader.py:477:
UserWarning: This DataLoader will create 3 worker processes in total. Our
```

suggested max number of worker in current system is 2, which is smaller than what this DataLoader is going to create. Please be aware that excessive worker creation might get DataLoader running slow or even freeze, lower the worker number to avoid potential slowness/freeze if necessary.

```
cpuset_checked))
```

```
[ ]: from torchvision.utils import make_grid
```

```
[ ]: def denorm(img_tensors):
    return img_tensors * stats[1][0] + stats[0][0]
```

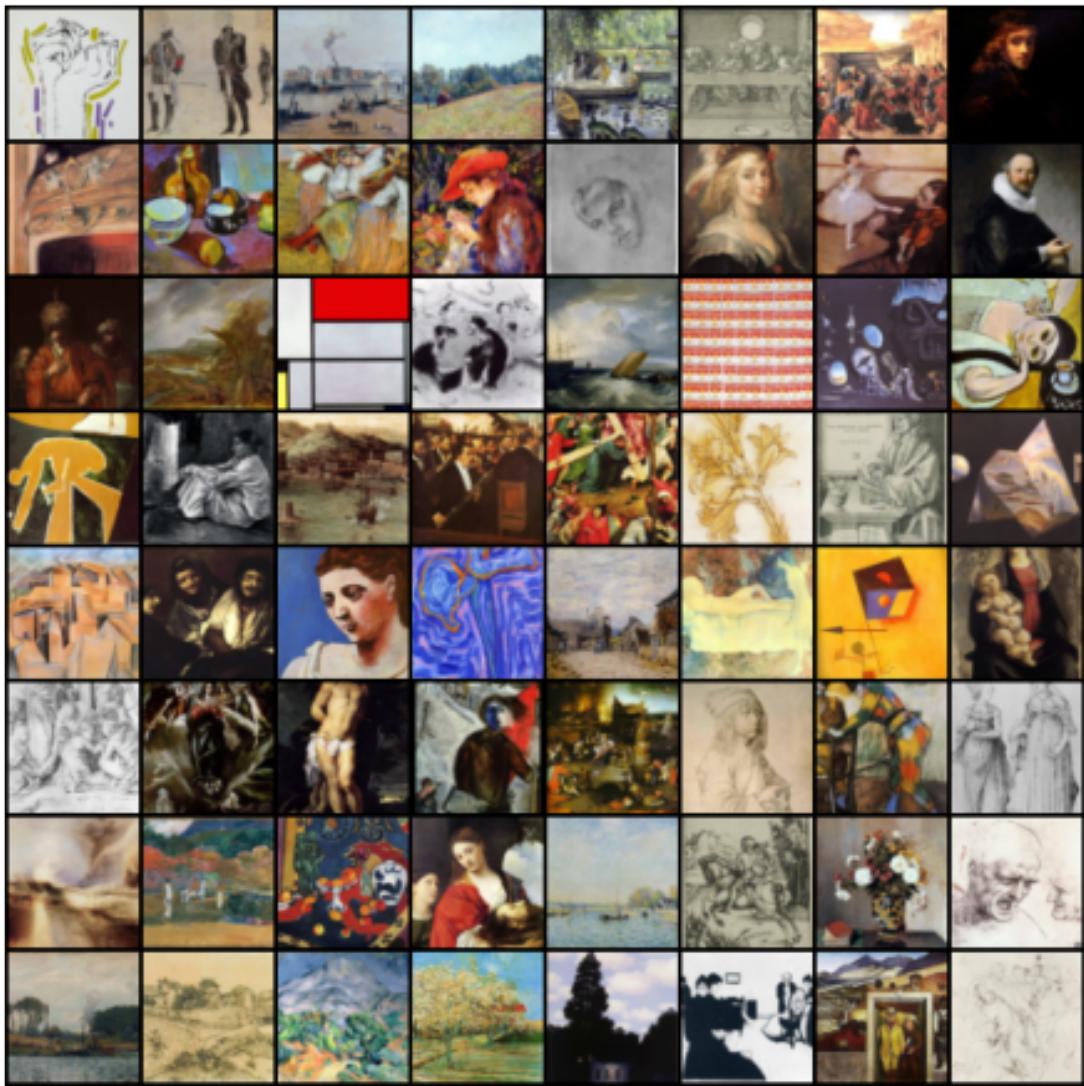
```
[ ]: def show_images(images, nmax=64):
    fig, ax = plt.subplots(figsize=(8, 8))
    ax.set_xticks([]); ax.set_yticks([])
    ax.imshow(make_grid(denorm(images.detach()[:nmax]), nrow=8).permute(1, 2, 0))

def show_batch(dl, nmax=64):
    for images, _ in dl:
        show_images(images, nmax)
        break
```

```
[ ]: show_batch(train_dl)
```

```
/usr/local/lib/python3.7/dist-packages/torch/utils/data/dataloader.py:477:
UserWarning: This DataLoader will create 3 worker processes in total. Our
suggested max number of worker in current system is 2, which is smaller than
what this DataLoader is going to create. Please be aware that excessive worker
creation might get DataLoader running slow or even freeze, lower the worker
number to avoid potential slowness/freeze if necessary.
```

```
cpuset_checked))
```



```
[ ]: def get_default_device():
    """Pick GPU if available, else CPU"""
    if torch.cuda.is_available():
        return torch.device('cuda')
    else:
        return torch.device('cpu')

def to_device(data, device):
    """Move tensor(s) to chosen device"""
    if isinstance(data, (list,tuple)):
        return [to_device(x, device) for x in data]
    return data.to(device, non_blocking=True)
```

```

class DeviceDataLoader():
    """Wrap a dataloader to move data to a device"""
    def __init__(self, dl, device):
        self.dl = dl
        self.device = device

    def __iter__(self):
        """Yield a batch of data after moving it to device"""
        for b in self.dl:
            yield to_device(b, self.device)

    def __len__(self):
        """Number of batches"""
        return len(self.dl)

```

```
[ ]: import torch
```

```
[ ]: device = get_default_device()
device
```

```
[ ]: device(type='cuda')
```

```
[ ]: train_dl = DeviceDataLoader(train_dl, device)
```

```
[ ]: import torch.nn as nn
```

```

[ ]: discriminator = nn.Sequential(
    # in: 3 x 64 x 64

    nn.Conv2d(3, 64, kernel_size=4, stride=2, padding=1, bias=False),
    nn.BatchNorm2d(64),
    nn.LeakyReLU(0.2, inplace=True),
    # out: 64 x 32 x 32

    nn.Conv2d(64, 128, kernel_size=4, stride=2, padding=1, bias=False),
    nn.BatchNorm2d(128),
    nn.LeakyReLU(0.2, inplace=True),
    # out: 128 x 16 x 16

    nn.Conv2d(128, 256, kernel_size=4, stride=2, padding=1, bias=False),
    nn.BatchNorm2d(256),
    nn.LeakyReLU(0.2, inplace=True),
    # out: 256 x 8 x 8

    nn.Conv2d(256, 512, kernel_size=4, stride=2, padding=1, bias=False),
    nn.BatchNorm2d(512),
    nn.LeakyReLU(0.2, inplace=True),

```

```

# out: 512 x 4 x 4

nn.Conv2d(512, 1, kernel_size=4, stride=1, padding=0, bias=False),
# out: 1 x 1 x 1

nn.Flatten(),
nn.Sigmoid()

[ ]: discriminator = to_device(discriminator, device)

[ ]: latent_size = 128

[ ]: generator = nn.Sequential(
    # in: latent_size x 1 x 1

    nn.ConvTranspose2d(latent_size, 512, kernel_size=4, stride=1, padding=0, bias=False),
    nn.BatchNorm2d(512),
    nn.ReLU(True),
    # out: 512 x 4 x 4

    nn.ConvTranspose2d(512, 256, kernel_size=4, stride=2, padding=1, bias=False),
    nn.BatchNorm2d(256),
    nn.ReLU(True),
    # out: 256 x 8 x 8

    nn.ConvTranspose2d(256, 128, kernel_size=4, stride=2, padding=1, bias=False),
    nn.BatchNorm2d(128),
    nn.ReLU(True),
    # out: 128 x 16 x 16

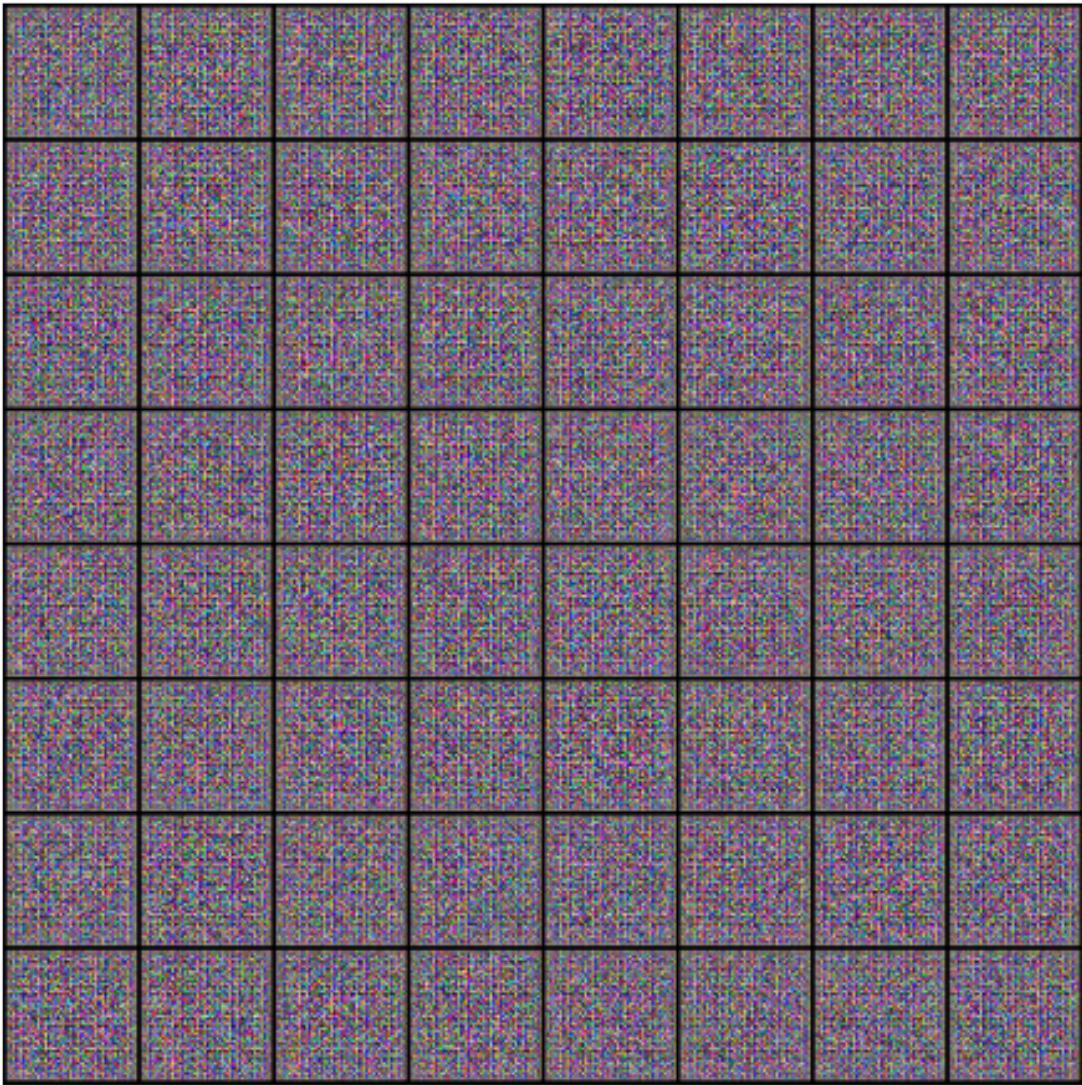
    nn.ConvTranspose2d(128, 64, kernel_size=4, stride=2, padding=1, bias=False),
    nn.BatchNorm2d(64),
    nn.ReLU(True),
    # out: 64 x 32 x 32

    nn.ConvTranspose2d(64, 3, kernel_size=4, stride=2, padding=1, bias=False),
    nn.Tanh()
    # out: 3 x 64 x 64
)

[ ]: xb = torch.randn(batch_size, latent_size, 1, 1) # random latent tensors
fake_images = generator(xb)
print(fake_images.shape)
show_images(fake_images)

```

```
torch.Size([128, 3, 64, 64])
```



```
[ ]: generator = to_device(generator, device)
```

```
[ ]: def train_discriminator(real_images, opt_d):
    # Clear discriminator gradients
    opt_d.zero_grad()

    # Pass real images through discriminator
    real_preds = discriminator(real_images)
    real_targets = torch.ones(real_images.size(0), 1, device=device)
    real_loss = F.binary_cross_entropy(real_preds, real_targets)
    real_score = torch.mean(real_preds).item()
```

```

# Generate fake images
latent = torch.randn(batch_size, latent_size, 1, 1, device=device)
fake_images = generator(latent)

# Pass fake images through discriminator
fake_targets = torch.zeros(fake_images.size(0), 1, device=device)
fake_preds = discriminator(fake_images)
fake_loss = F.binary_cross_entropy(fake_preds, fake_targets)
fake_score = torch.mean(fake_preds).item()

# Update discriminator weights
loss = real_loss + fake_loss
loss.backward()
opt_d.step()

return loss.item(), real_score, fake_score

```

```

[ ]: def train_generator(opt_g):
    # Clear generator gradients
    opt_g.zero_grad()

    # Generate fake images
    latent = torch.randn(batch_size, latent_size, 1, 1, device=device)
    fake_images = generator(latent)

    # Try to fool the discriminator
    preds = discriminator(fake_images)
    targets = torch.ones(batch_size, 1, device=device)
    loss = F.binary_cross_entropy(preds, targets)

    # Update generator weights
    loss.backward()
    opt_g.step()

    return loss.item()

```

```
[ ]: from torchvision.utils import save_image
```

```
[ ]: sample_dir = 'generated'
os.makedirs(sample_dir, exist_ok=True)
```

```

[ ]: def save_samples(index, latent_tensors, show=True):
    fake_images = generator(latent_tensors)
    fake_fname = 'generated-images-{0:0=4d}.png'.format(index)
    save_image(denorm(fake_images), os.path.join(sample_dir, fake_fname), □
               nrow=8)
    print('Saving', fake_fname)

```

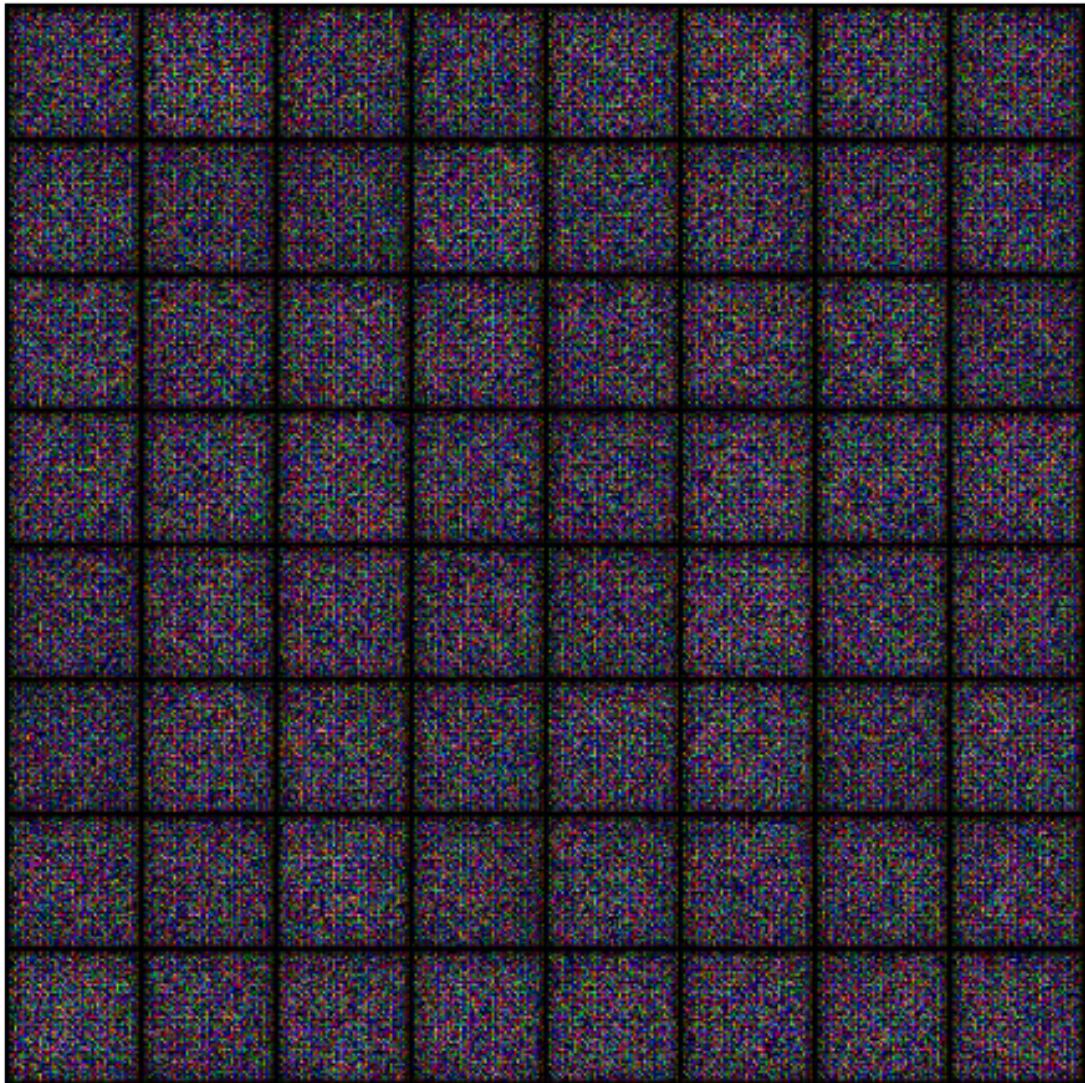
```
if show:  
    fig, ax = plt.subplots(figsize=(8, 8))  
    ax.set_xticks([]); ax.set_yticks([])  
    ax.imshow(make_grid(fake_images.cpu().detach(), nrow=8).permute(1, 2, 0))
```

```
[ ]: fixed_latent = torch.randn(64, latent_size, 1, 1, device=device)
```

```
[ ]: save_samples(0, fixed_latent)
```

Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..255] for integers).

Saving generated-images-0000.png



```
[ ]: from tqdm.notebook import tqdm
      import torch.nn.functional as F

[ ]: def fit(epochs, lr, start_idx=1):
      torch.cuda.empty_cache()

      # Losses & scores
      losses_g = []
      losses_d = []
      real_scores = []
      fake_scores = []

      # Create optimizers
      opt_d = torch.optim.Adam(discriminator.parameters(), lr=lr, betas=(0.5, 0.
      ↪999))
      opt_g = torch.optim.Adam(generator.parameters(), lr=lr, betas=(0.5, 0.999))

      for epoch in range(epochs):
          for real_images, _ in tqdm(train_dl):
              # Train discriminator
              loss_d, real_score, fake_score = train_discriminator(real_images, ↪
              ↪opt_d)
              # Train generator
              loss_g = train_generator(opt_g)

              # Record losses & scores
              losses_g.append(loss_g)
              losses_d.append(loss_d)
              real_scores.append(real_score)
              fake_scores.append(fake_score)

              # Log losses & scores (last batch)
              print("Epoch [{}/{}], loss_g: {:.4f}, loss_d: {:.4f}, real_score: {:.4f}, fake_score: {:.4f}".format(
                  epoch+1, epochs, loss_g, loss_d, real_score, fake_score))

              # Save generated images
              save_samples(epoch+start_idx, fixed_latent, show=False)

      return losses_g, losses_d, real_scores, fake_scores
```

```
[ ]: lr = 0.0002
      epochs = 300
```

```
[ ]: history = fit(epochs, lr)
```

```
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

/usr/local/lib/python3.7/dist-packages/torch/utils/data/dataloader.py:477:
UserWarning: This DataLoader will create 3 worker processes in total. Our
suggested max number of worker in current system is 2, which is smaller than
what this DataLoader is going to create. Please be aware that excessive worker
creation might get DataLoader running slow or even freeze, lower the worker
number to avoid potential slowness/freeze if necessary.

cpuset_checked)

Epoch [1/300], loss_g: 8.7825, loss_d: 0.7904, real_score: 0.9316, fake_score:
0.4317
Saving generated-images-0001.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [2/300], loss_g: 3.4211, loss_d: 0.2709, real_score: 0.8479, fake_score:
0.0866
Saving generated-images-0002.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [3/300], loss_g: 2.4730, loss_d: 0.6031, real_score: 0.6400, fake_score:
0.0274
Saving generated-images-0003.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [4/300], loss_g: 4.1365, loss_d: 0.7612, real_score: 0.7983, fake_score:
0.3907
Saving generated-images-0004.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [5/300], loss_g: 1.9669, loss_d: 0.5368, real_score: 0.6597, fake_score:
0.0576
Saving generated-images-0005.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [6/300], loss_g: 6.2622, loss_d: 4.5370, real_score: 0.1312, fake_score:
0.0001
Saving generated-images-0006.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [7/300], loss_g: 3.6734, loss_d: 0.3283, real_score: 0.7871, fake_score:
```

```
0.0588
Saving generated-images-0007.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [8/300], loss_g: 4.8775, loss_d: 0.5916, real_score: 0.8569, fake_score:
0.3191
Saving generated-images-0008.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [9/300], loss_g: 1.8112, loss_d: 1.2102, real_score: 0.3889, fake_score:
0.0523
Saving generated-images-0009.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [10/300], loss_g: 4.2508, loss_d: 0.6058, real_score: 0.9490, fake_score:
0.3995
Saving generated-images-0010.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [11/300], loss_g: 2.2385, loss_d: 0.7466, real_score: 0.5682, fake_score:
0.0801
Saving generated-images-0011.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [12/300], loss_g: 5.3668, loss_d: 0.7184, real_score: 0.8951, fake_score:
0.4029
Saving generated-images-0012.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [13/300], loss_g: 3.1704, loss_d: 0.5827, real_score: 0.6483, fake_score:
0.0845
Saving generated-images-0013.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [14/300], loss_g: 4.8398, loss_d: 0.5649, real_score: 0.8519, fake_score:
0.3021
Saving generated-images-0014.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [15/300], loss_g: 3.8496, loss_d: 0.3954, real_score: 0.8188, fake_score:
```

```
0.1596
Saving generated-images-0015.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [16/300], loss_g: 4.6968, loss_d: 0.4931, real_score: 0.9656, fake_score:
0.3218
Saving generated-images-0016.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [17/300], loss_g: 4.5216, loss_d: 0.4278, real_score: 0.7263, fake_score:
0.0592
Saving generated-images-0017.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [18/300], loss_g: 4.1165, loss_d: 0.3501, real_score: 0.9260, fake_score:
0.2215
Saving generated-images-0018.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [19/300], loss_g: 2.4454, loss_d: 0.5522, real_score: 0.8189, fake_score:
0.2559
Saving generated-images-0019.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [20/300], loss_g: 1.4974, loss_d: 0.9464, real_score: 0.5162, fake_score:
0.1389
Saving generated-images-0020.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [21/300], loss_g: 4.3900, loss_d: 0.5826, real_score: 0.8517, fake_score:
0.3080
Saving generated-images-0021.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [22/300], loss_g: 4.4637, loss_d: 0.2885, real_score: 0.8031, fake_score:
0.0484
Saving generated-images-0022.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [23/300], loss_g: 2.8200, loss_d: 0.5408, real_score: 0.7784, fake_score:
```

```
0.2174
Saving generated-images-0023.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [24/300], loss_g: 3.8707, loss_d: 0.6011, real_score: 0.9521, fake_score:
0.3824
Saving generated-images-0024.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [25/300], loss_g: 2.9607, loss_d: 0.3659, real_score: 0.8033, fake_score:
0.1117
Saving generated-images-0025.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [26/300], loss_g: 4.2555, loss_d: 0.4314, real_score: 0.8579, fake_score:
0.2196
Saving generated-images-0026.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [27/300], loss_g: 3.8283, loss_d: 0.4395, real_score: 0.8423, fake_score:
0.2131
Saving generated-images-0027.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [28/300], loss_g: 3.6477, loss_d: 0.4951, real_score: 0.8329, fake_score:
0.2434
Saving generated-images-0028.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [29/300], loss_g: 3.9049, loss_d: 0.4029, real_score: 0.7200, fake_score:
0.0349
Saving generated-images-0029.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [30/300], loss_g: 3.9712, loss_d: 0.4071, real_score: 0.8990, fake_score:
0.2357
Saving generated-images-0030.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [31/300], loss_g: 4.0019, loss_d: 0.2767, real_score: 0.8056, fake_score:
```

```
0.0479
Saving generated-images-0031.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [32/300], loss_g: 4.2405, loss_d: 0.1914, real_score: 0.9066, fake_score:
0.0811
Saving generated-images-0032.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [33/300], loss_g: 2.2469, loss_d: 0.3447, real_score: 0.7782, fake_score:
0.0644
Saving generated-images-0033.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [34/300], loss_g: 5.7505, loss_d: 0.6312, real_score: 0.5814, fake_score:
0.0053
Saving generated-images-0034.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [35/300], loss_g: 2.6058, loss_d: 0.6214, real_score: 0.6990, fake_score:
0.1661
Saving generated-images-0035.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [36/300], loss_g: 4.4408, loss_d: 0.4194, real_score: 0.8735, fake_score:
0.2180
Saving generated-images-0036.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [37/300], loss_g: 4.1383, loss_d: 0.1700, real_score: 0.8982, fake_score:
0.0540
Saving generated-images-0037.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [38/300], loss_g: 5.7630, loss_d: 0.5549, real_score: 0.9513, fake_score:
0.3677
Saving generated-images-0038.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [39/300], loss_g: 3.8254, loss_d: 0.2694, real_score: 0.9261, fake_score:
```

```
0.1615
Saving generated-images-0039.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [40/300], loss_g: 5.3135, loss_d: 0.3890, real_score: 0.8959, fake_score:
0.2198
Saving generated-images-0040.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [41/300], loss_g: 2.6716, loss_d: 1.4865, real_score: 0.3089, fake_score:
0.0043
Saving generated-images-0041.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [42/300], loss_g: 5.0262, loss_d: 0.5437, real_score: 0.8860, fake_score:
0.3069
Saving generated-images-0042.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [43/300], loss_g: 2.4709, loss_d: 0.1863, real_score: 0.9152, fake_score:
0.0737
Saving generated-images-0043.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [44/300], loss_g: 3.4992, loss_d: 0.3383, real_score: 0.8073, fake_score:
0.0949
Saving generated-images-0044.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [45/300], loss_g: 5.0852, loss_d: 0.6782, real_score: 0.9027, fake_score:
0.3749
Saving generated-images-0045.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [46/300], loss_g: 1.6398, loss_d: 0.6070, real_score: 0.6862, fake_score:
0.1533
Saving generated-images-0046.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [47/300], loss_g: 4.3788, loss_d: 0.4289, real_score: 0.9645, fake_score:
```

```
0.2966
Saving generated-images-0047.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [48/300], loss_g: 5.5451, loss_d: 0.6056, real_score: 0.9448, fake_score:
0.3804
Saving generated-images-0048.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [49/300], loss_g: 5.0641, loss_d: 0.4987, real_score: 0.6583, fake_score:
0.0172
Saving generated-images-0049.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [50/300], loss_g: 5.7209, loss_d: 0.4743, real_score: 0.9574, fake_score:
0.3216
Saving generated-images-0050.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [51/300], loss_g: 1.4794, loss_d: 0.4900, real_score: 0.6745, fake_score:
0.0290
Saving generated-images-0051.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [52/300], loss_g: 2.3949, loss_d: 0.4203, real_score: 0.7029, fake_score:
0.0072
Saving generated-images-0052.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [53/300], loss_g: 5.5298, loss_d: 0.4999, real_score: 0.9468, fake_score:
0.3267
Saving generated-images-0053.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [54/300], loss_g: 2.9194, loss_d: 0.1358, real_score: 0.9849, fake_score:
0.1084
Saving generated-images-0054.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [55/300], loss_g: 4.2582, loss_d: 0.5005, real_score: 0.9033, fake_score:
```

```
0.2527
Saving generated-images-0055.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [56/300], loss_g: 4.7154, loss_d: 0.5153, real_score: 0.8818, fake_score:
0.2850
Saving generated-images-0056.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [57/300], loss_g: 4.1787, loss_d: 0.3175, real_score: 0.9125, fake_score:
0.1819
Saving generated-images-0057.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [58/300], loss_g: 4.1998, loss_d: 0.3356, real_score: 0.9189, fake_score:
0.1980
Saving generated-images-0058.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [59/300], loss_g: 4.2480, loss_d: 0.3673, real_score: 0.9574, fake_score:
0.2384
Saving generated-images-0059.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [60/300], loss_g: 4.9769, loss_d: 0.3984, real_score: 0.9756, fake_score:
0.2882
Saving generated-images-0060.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [61/300], loss_g: 2.2895, loss_d: 0.4679, real_score: 0.6796, fake_score:
0.0332
Saving generated-images-0061.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [62/300], loss_g: 0.9979, loss_d: 0.6940, real_score: 0.5905, fake_score:
0.0883
Saving generated-images-0062.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [63/300], loss_g: 3.3774, loss_d: 0.2617, real_score: 0.9306, fake_score:
```

```
0.1603
Saving generated-images-0063.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [64/300], loss_g: 1.7347, loss_d: 0.9891, real_score: 0.4476, fake_score:
0.0051
Saving generated-images-0064.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [65/300], loss_g: 3.0468, loss_d: 0.3239, real_score: 0.8600, fake_score:
0.1357
Saving generated-images-0065.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [66/300], loss_g: 2.4249, loss_d: 0.5033, real_score: 0.6656, fake_score:
0.0250
Saving generated-images-0066.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [67/300], loss_g: 4.7645, loss_d: 0.1437, real_score: 0.9262, fake_score:
0.0609
Saving generated-images-0067.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [68/300], loss_g: 1.6307, loss_d: 0.7362, real_score: 0.5438, fake_score:
0.0174
Saving generated-images-0068.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [69/300], loss_g: 4.2789, loss_d: 0.4216, real_score: 0.9725, fake_score:
0.2907
Saving generated-images-0069.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [70/300], loss_g: 3.6868, loss_d: 0.3246, real_score: 0.7804, fake_score:
0.0306
Saving generated-images-0070.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [71/300], loss_g: 4.0483, loss_d: 0.2171, real_score: 0.9303, fake_score:
```

```
0.1237
Saving generated-images-0071.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [72/300], loss_g: 4.7063, loss_d: 0.2667, real_score: 0.9327, fake_score:
0.1632
Saving generated-images-0072.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [73/300], loss_g: 5.7934, loss_d: 0.2228, real_score: 0.8606, fake_score:
0.0557
Saving generated-images-0073.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [74/300], loss_g: 2.8351, loss_d: 0.2639, real_score: 0.8545, fake_score:
0.0848
Saving generated-images-0074.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [75/300], loss_g: 4.2625, loss_d: 0.2045, real_score: 0.9660, fake_score:
0.1430
Saving generated-images-0075.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [76/300], loss_g: 4.1049, loss_d: 0.0791, real_score: 0.9862, fake_score:
0.0608
Saving generated-images-0076.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [77/300], loss_g: 4.3872, loss_d: 0.1608, real_score: 0.9736, fake_score:
0.1132
Saving generated-images-0077.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [78/300], loss_g: 2.8602, loss_d: 2.2786, real_score: 0.1713, fake_score:
0.0005
Saving generated-images-0078.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [79/300], loss_g: 3.4065, loss_d: 0.2282, real_score: 0.8395, fake_score:
```

```
0.0412
Saving generated-images-0079.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [80/300], loss_g: 12.2827, loss_d: 6.1950, real_score: 0.9997, fake_score:
0.9903
Saving generated-images-0080.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [81/300], loss_g: 3.5381, loss_d: 0.2944, real_score: 0.8984, fake_score:
0.1531
Saving generated-images-0081.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [82/300], loss_g: 3.5676, loss_d: 0.3172, real_score: 0.9747, fake_score:
0.2314
Saving generated-images-0082.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [83/300], loss_g: 5.3885, loss_d: 0.1819, real_score: 0.9462, fake_score:
0.1091
Saving generated-images-0083.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [84/300], loss_g: 5.2485, loss_d: 0.1125, real_score: 0.9635, fake_score:
0.0678
Saving generated-images-0084.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [85/300], loss_g: 0.1927, loss_d: 1.1495, real_score: 0.4265, fake_score:
0.0012
Saving generated-images-0085.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [86/300], loss_g: 0.7533, loss_d: 0.7512, real_score: 0.5383, fake_score:
0.0274
Saving generated-images-0086.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [87/300], loss_g: 4.7669, loss_d: 0.1868, real_score: 0.8679, fake_score:
```

```
0.0266
Saving generated-images-0087.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [88/300], loss_g: 6.3084, loss_d: 0.4293, real_score: 0.9954, fake_score:
0.2967
Saving generated-images-0088.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [89/300], loss_g: 3.3627, loss_d: 0.2998, real_score: 0.8733, fake_score:
0.1337
Saving generated-images-0089.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [90/300], loss_g: 2.3877, loss_d: 0.4788, real_score: 0.7234, fake_score:
0.0746
Saving generated-images-0090.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [91/300], loss_g: 4.8529, loss_d: 0.1049, real_score: 0.9714, fake_score:
0.0683
Saving generated-images-0091.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [92/300], loss_g: 3.0419, loss_d: 0.2824, real_score: 0.8082, fake_score:
0.0397
Saving generated-images-0092.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [93/300], loss_g: 4.6579, loss_d: 0.3889, real_score: 0.7141, fake_score:
0.0060
Saving generated-images-0093.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [94/300], loss_g: 0.1629, loss_d: 1.6674, real_score: 0.2856, fake_score:
0.0031
Saving generated-images-0094.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [95/300], loss_g: 2.5806, loss_d: 0.2642, real_score: 0.8454, fake_score:
```

```
0.0747
Saving generated-images-0095.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [96/300], loss_g: 5.2361, loss_d: 0.6874, real_score: 0.9878, fake_score:
0.4428
Saving generated-images-0096.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [97/300], loss_g: 2.5062, loss_d: 0.1942, real_score: 0.9575, fake_score:
0.1127
Saving generated-images-0097.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [98/300], loss_g: 2.7958, loss_d: 0.2999, real_score: 0.8439, fake_score:
0.1076
Saving generated-images-0098.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [99/300], loss_g: 4.0139, loss_d: 0.2434, real_score: 0.8933, fake_score:
0.1057
Saving generated-images-0099.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [100/300], loss_g: 6.0835, loss_d: 0.0532, real_score: 0.9778, fake_score:
0.0293
Saving generated-images-0100.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [101/300], loss_g: 1.1195, loss_d: 0.6515, real_score: 0.5945, fake_score:
0.0476
Saving generated-images-0101.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [102/300], loss_g: 3.3467, loss_d: 0.2861, real_score: 0.8270, fake_score:
0.0682
Saving generated-images-0102.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [103/300], loss_g: 3.0028, loss_d: 0.1627, real_score: 0.9452, fake_score:
```

```
0.0931
Saving generated-images-0103.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [104/300], loss_g: 5.0035, loss_d: 0.0901, real_score: 0.9285, fake_score:
0.0127
Saving generated-images-0104.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [105/300], loss_g: 3.8201, loss_d: 0.5563, real_score: 0.9304, fake_score:
0.2695
Saving generated-images-0105.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [106/300], loss_g: 3.7490, loss_d: 0.2100, real_score: 0.9343, fake_score:
0.1217
Saving generated-images-0106.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [107/300], loss_g: 3.5912, loss_d: 0.2403, real_score: 0.8098, fake_score:
0.0121
Saving generated-images-0107.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [108/300], loss_g: 2.0973, loss_d: 0.2508, real_score: 0.9520, fake_score:
0.1632
Saving generated-images-0108.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [109/300], loss_g: 5.2330, loss_d: 0.3046, real_score: 0.9793, fake_score:
0.2182
Saving generated-images-0109.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [110/300], loss_g: 4.5068, loss_d: 0.1009, real_score: 0.9929, fake_score:
0.0857
Saving generated-images-0110.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [111/300], loss_g: 5.6088, loss_d: 0.1488, real_score: 0.9815, fake_score:
```

```
0.1065
Saving generated-images-0111.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [112/300], loss_g: 4.6304, loss_d: 0.1537, real_score: 0.8844, fake_score:
0.0185
Saving generated-images-0112.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [113/300], loss_g: 2.9420, loss_d: 0.2710, real_score: 0.8395, fake_score:
0.0615
Saving generated-images-0113.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [114/300], loss_g: 3.9529, loss_d: 0.6294, real_score: 0.9663, fake_score:
0.3671
Saving generated-images-0114.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [115/300], loss_g: 5.1461, loss_d: 0.2135, real_score: 0.9740, fake_score:
0.1530
Saving generated-images-0115.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [116/300], loss_g: 4.2442, loss_d: 0.1352, real_score: 0.9950, fake_score:
0.1147
Saving generated-images-0116.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [117/300], loss_g: 3.7058, loss_d: 0.3014, real_score: 0.9410, fake_score:
0.2001
Saving generated-images-0117.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [118/300], loss_g: 4.6217, loss_d: 0.2099, real_score: 0.9873, fake_score:
0.1616
Saving generated-images-0118.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [119/300], loss_g: 6.3873, loss_d: 0.0665, real_score: 0.9507, fake_score:
```

```
0.0140
Saving generated-images-0119.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [120/300], loss_g: 4.7139, loss_d: 0.1708, real_score: 0.9262, fake_score:
0.0826
Saving generated-images-0120.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [121/300], loss_g: 5.6837, loss_d: 0.3394, real_score: 0.9804, fake_score:
0.2411
Saving generated-images-0121.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [122/300], loss_g: 4.6684, loss_d: 0.7015, real_score: 0.9863, fake_score:
0.4171
Saving generated-images-0122.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [123/300], loss_g: 4.5568, loss_d: 0.0923, real_score: 0.9589, fake_score:
0.0465
Saving generated-images-0123.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [124/300], loss_g: 4.8403, loss_d: 0.1061, real_score: 0.9270, fake_score:
0.0244
Saving generated-images-0124.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [125/300], loss_g: 4.4883, loss_d: 0.1041, real_score: 0.9511, fake_score:
0.0498
Saving generated-images-0125.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [126/300], loss_g: 1.6391, loss_d: 0.6618, real_score: 0.5835, fake_score:
0.0024
Saving generated-images-0126.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [127/300], loss_g: 1.5913, loss_d: 0.9515, real_score: 0.4690, fake_score:
```

```
0.0044
Saving generated-images-0127.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [128/300], loss_g: 5.2896, loss_d: 0.2114, real_score: 0.8246, fake_score:
0.0031
Saving generated-images-0128.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [129/300], loss_g: 3.7928, loss_d: 0.1055, real_score: 0.9414, fake_score:
0.0393
Saving generated-images-0129.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [130/300], loss_g: 5.1428, loss_d: 0.5305, real_score: 0.9968, fake_score:
0.3562
Saving generated-images-0130.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [131/300], loss_g: 2.9132, loss_d: 0.1677, real_score: 0.8796, fake_score:
0.0305
Saving generated-images-0131.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [132/300], loss_g: 4.8129, loss_d: 0.0805, real_score: 0.9855, fake_score:
0.0580
Saving generated-images-0132.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [133/300], loss_g: 2.5735, loss_d: 0.3141, real_score: 0.7779, fake_score:
0.0325
Saving generated-images-0133.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [134/300], loss_g: 4.9417, loss_d: 0.4546, real_score: 0.9767, fake_score:
0.2941
Saving generated-images-0134.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [135/300], loss_g: 2.6019, loss_d: 0.1374, real_score: 0.9198, fake_score:
```

```
0.0482
Saving generated-images-0135.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [136/300], loss_g: 6.0439, loss_d: 0.0568, real_score: 0.9665, fake_score:
0.0213
Saving generated-images-0136.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [137/300], loss_g: 1.6290, loss_d: 0.9262, real_score: 0.7137, fake_score:
0.2666
Saving generated-images-0137.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [138/300], loss_g: 4.0781, loss_d: 0.1264, real_score: 0.9964, fake_score:
0.0926
Saving generated-images-0138.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [139/300], loss_g: 4.8626, loss_d: 0.1625, real_score: 0.9739, fake_score:
0.1183
Saving generated-images-0139.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [140/300], loss_g: 3.9662, loss_d: 0.1080, real_score: 0.9428, fake_score:
0.0434
Saving generated-images-0140.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [141/300], loss_g: 5.6297, loss_d: 0.0264, real_score: 0.9944, fake_score:
0.0198
Saving generated-images-0141.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [142/300], loss_g: 4.4593, loss_d: 0.0446, real_score: 0.9868, fake_score:
0.0301
Saving generated-images-0142.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [143/300], loss_g: 6.8725, loss_d: 0.0165, real_score: 0.9929, fake_score:
```

```
0.0093
Saving generated-images-0143.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [144/300], loss_g: 4.3462, loss_d: 0.1220, real_score: 0.9042, fake_score:
0.0159
Saving generated-images-0144.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [145/300], loss_g: 4.8927, loss_d: 0.7592, real_score: 0.6584, fake_score:
0.0544
Saving generated-images-0145.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [146/300], loss_g: 3.4796, loss_d: 0.3523, real_score: 0.9483, fake_score:
0.2290
Saving generated-images-0146.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [147/300], loss_g: 3.2383, loss_d: 0.1632, real_score: 0.9528, fake_score:
0.1012
Saving generated-images-0147.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [148/300], loss_g: 3.6731, loss_d: 0.1184, real_score: 0.9108, fake_score:
0.0172
Saving generated-images-0148.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [149/300], loss_g: 3.9094, loss_d: 0.1232, real_score: 0.9107, fake_score:
0.0220
Saving generated-images-0149.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [150/300], loss_g: 0.5053, loss_d: 0.7303, real_score: 0.5311, fake_score:
0.0048
Saving generated-images-0150.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [151/300], loss_g: 3.5871, loss_d: 0.1938, real_score: 0.8435, fake_score:
```

```
0.0106
Saving generated-images-0151.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [152/300], loss_g: 3.4249, loss_d: 0.1062, real_score: 0.9200, fake_score:
0.0196
Saving generated-images-0152.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [153/300], loss_g: 6.1652, loss_d: 0.0283, real_score: 0.9929, fake_score:
0.0200
Saving generated-images-0153.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [154/300], loss_g: 3.7419, loss_d: 0.2542, real_score: 0.8314, fake_score:
0.0335
Saving generated-images-0154.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [155/300], loss_g: 3.7034, loss_d: 0.1651, real_score: 0.8949, fake_score:
0.0412
Saving generated-images-0155.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [156/300], loss_g: 5.0797, loss_d: 0.1280, real_score: 0.9976, fake_score:
0.1106
Saving generated-images-0156.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [157/300], loss_g: 3.6427, loss_d: 0.1534, real_score: 0.9582, fake_score:
0.0855
Saving generated-images-0157.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [158/300], loss_g: 4.4029, loss_d: 0.0721, real_score: 0.9673, fake_score:
0.0358
Saving generated-images-0158.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [159/300], loss_g: 4.4343, loss_d: 0.0516, real_score: 0.9932, fake_score:
```

```
0.0415
Saving generated-images-0159.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [160/300], loss_g: 3.8934, loss_d: 0.1159, real_score: 0.9091, fake_score:
0.0154
Saving generated-images-0160.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [161/300], loss_g: 4.3177, loss_d: 0.1567, real_score: 0.8680, fake_score:
0.0089
Saving generated-images-0161.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [162/300], loss_g: 2.4234, loss_d: 0.6945, real_score: 0.6711, fake_score:
0.0948
Saving generated-images-0162.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [163/300], loss_g: 3.8114, loss_d: 0.1819, real_score: 0.9207, fake_score:
0.0765
Saving generated-images-0163.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [164/300], loss_g: 3.9116, loss_d: 0.2024, real_score: 0.9481, fake_score:
0.1094
Saving generated-images-0164.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [165/300], loss_g: 3.5536, loss_d: 0.1393, real_score: 0.9351, fake_score:
0.0639
Saving generated-images-0165.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [166/300], loss_g: 4.1554, loss_d: 0.1036, real_score: 0.9396, fake_score:
0.0378
Saving generated-images-0166.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [167/300], loss_g: 3.7526, loss_d: 0.1807, real_score: 0.8534, fake_score:
```

```
0.0073
Saving generated-images-0167.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [168/300], loss_g: 5.3457, loss_d: 0.1106, real_score: 0.9654, fake_score:
0.0686
Saving generated-images-0168.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [169/300], loss_g: 4.6323, loss_d: 0.2188, real_score: 0.8227, fake_score:
0.0056
Saving generated-images-0169.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [170/300], loss_g: 2.4949, loss_d: 0.2619, real_score: 0.8006, fake_score:
0.0167
Saving generated-images-0170.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [171/300], loss_g: 5.4089, loss_d: 0.0338, real_score: 0.9819, fake_score:
0.0149
Saving generated-images-0171.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [172/300], loss_g: 2.9670, loss_d: 0.1037, real_score: 0.9552, fake_score:
0.0524
Saving generated-images-0172.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [173/300], loss_g: 3.8423, loss_d: 0.0720, real_score: 0.9516, fake_score:
0.0205
Saving generated-images-0173.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [174/300], loss_g: 5.6715, loss_d: 0.4074, real_score: 0.9931, fake_score:
0.2542
Saving generated-images-0174.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [175/300], loss_g: 4.0258, loss_d: 0.1257, real_score: 0.9541, fake_score:
```

```
0.0666
Saving generated-images-0175.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [176/300], loss_g: 4.2833, loss_d: 0.0813, real_score: 0.9489, fake_score:
0.0263
Saving generated-images-0176.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [177/300], loss_g: 5.0921, loss_d: 0.2082, real_score: 0.9441, fake_score:
0.1249
Saving generated-images-0177.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [178/300], loss_g: 5.0536, loss_d: 0.0178, real_score: 0.9959, fake_score:
0.0135
Saving generated-images-0178.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [179/300], loss_g: 3.6860, loss_d: 0.1495, real_score: 0.9254, fake_score:
0.0602
Saving generated-images-0179.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [180/300], loss_g: 4.8180, loss_d: 0.3395, real_score: 0.9819, fake_score:
0.2486
Saving generated-images-0180.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [181/300], loss_g: 4.3720, loss_d: 0.0911, real_score: 0.9432, fake_score:
0.0292
Saving generated-images-0181.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [182/300], loss_g: 4.9328, loss_d: 0.0607, real_score: 0.9647, fake_score:
0.0231
Saving generated-images-0182.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [183/300], loss_g: 11.2727, loss_d: 2.4180, real_score: 0.9545,
```

```
fake_score: 0.7597
Saving generated-images-0183.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [184/300], loss_g: 3.5209, loss_d: 0.1176, real_score: 0.9407, fake_score:
0.0478
Saving generated-images-0184.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [185/300], loss_g: 1.9108, loss_d: 0.6693, real_score: 0.6100, fake_score:
0.0029
Saving generated-images-0185.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [186/300], loss_g: 4.1166, loss_d: 0.1796, real_score: 0.8604, fake_score:
0.0140
Saving generated-images-0186.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [187/300], loss_g: 3.1966, loss_d: 0.1867, real_score: 0.8685, fake_score:
0.0322
Saving generated-images-0187.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [188/300], loss_g: 4.2367, loss_d: 0.0761, real_score: 0.9739, fake_score:
0.0464
Saving generated-images-0188.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [189/300], loss_g: 5.7819, loss_d: 0.0186, real_score: 0.9982, fake_score:
0.0162
Saving generated-images-0189.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [190/300], loss_g: 4.2227, loss_d: 0.0631, real_score: 0.9517, fake_score:
0.0119
Saving generated-images-0190.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [191/300], loss_g: 4.8284, loss_d: 0.0618, real_score: 0.9685, fake_score:
```

```
0.0280
Saving generated-images-0191.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [192/300], loss_g: 6.5711, loss_d: 0.0157, real_score: 0.9913, fake_score:
0.0068
Saving generated-images-0192.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [193/300], loss_g: 3.7888, loss_d: 0.8161, real_score: 0.8501, fake_score:
0.3632
Saving generated-images-0193.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [194/300], loss_g: 5.4171, loss_d: 0.0509, real_score: 0.9641, fake_score:
0.0125
Saving generated-images-0194.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [195/300], loss_g: 4.8531, loss_d: 0.0871, real_score: 0.9790, fake_score:
0.0610
Saving generated-images-0195.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [196/300], loss_g: 2.1129, loss_d: 0.3115, real_score: 0.7936, fake_score:
0.0438
Saving generated-images-0196.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [197/300], loss_g: 3.5290, loss_d: 0.1194, real_score: 0.9253, fake_score:
0.0375
Saving generated-images-0197.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [198/300], loss_g: 4.3211, loss_d: 0.0860, real_score: 0.9648, fake_score:
0.0459
Saving generated-images-0198.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [199/300], loss_g: 3.9034, loss_d: 0.0483, real_score: 0.9997, fake_score:
```

```
0.0444
Saving generated-images-0199.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [200/300], loss_g: 4.7162, loss_d: 0.0726, real_score: 0.9425, fake_score:
0.0119
Saving generated-images-0200.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [201/300], loss_g: 5.1380, loss_d: 0.0370, real_score: 0.9981, fake_score:
0.0333
Saving generated-images-0201.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [202/300], loss_g: 0.8901, loss_d: 1.4104, real_score: 0.4140, fake_score:
0.1874
Saving generated-images-0202.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [203/300], loss_g: 5.0127, loss_d: 0.1520, real_score: 0.9283, fake_score:
0.0596
Saving generated-images-0203.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [204/300], loss_g: 5.3391, loss_d: 0.5001, real_score: 0.9900, fake_score:
0.3162
Saving generated-images-0204.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [205/300], loss_g: 3.8825, loss_d: 0.1288, real_score: 0.9160, fake_score:
0.0332
Saving generated-images-0205.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [206/300], loss_g: 5.5850, loss_d: 0.0797, real_score: 0.9964, fake_score:
0.0697
Saving generated-images-0206.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [207/300], loss_g: 3.4817, loss_d: 0.1186, real_score: 0.9197, fake_score:
```

```
0.0290
Saving generated-images-0207.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [208/300], loss_g: 4.2559, loss_d: 0.0779, real_score: 0.9393, fake_score:
0.0125
Saving generated-images-0208.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [209/300], loss_g: 2.9436, loss_d: 0.1332, real_score: 0.8997, fake_score:
0.0145
Saving generated-images-0209.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [210/300], loss_g: 4.5236, loss_d: 0.0423, real_score: 0.9991, fake_score:
0.0390
Saving generated-images-0210.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [211/300], loss_g: 1.9341, loss_d: 0.6581, real_score: 0.5638, fake_score:
0.0001
Saving generated-images-0211.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [212/300], loss_g: 6.0963, loss_d: 0.0321, real_score: 0.9872, fake_score:
0.0187
Saving generated-images-0212.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [213/300], loss_g: 4.5681, loss_d: 0.0267, real_score: 0.9850, fake_score:
0.0113
Saving generated-images-0213.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [214/300], loss_g: 4.3882, loss_d: 0.0354, real_score: 0.9901, fake_score:
0.0241
Saving generated-images-0214.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [215/300], loss_g: 0.0081, loss_d: 5.5335, real_score: 0.0224, fake_score:
```

```
0.0002
Saving generated-images-0215.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [216/300], loss_g: 5.1269, loss_d: 0.1149, real_score: 0.9707, fake_score:
0.0748
Saving generated-images-0216.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [217/300], loss_g: 4.4422, loss_d: 0.1311, real_score: 0.9677, fake_score:
0.0830
Saving generated-images-0217.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [218/300], loss_g: 5.5590, loss_d: 0.0516, real_score: 0.9621, fake_score:
0.0120
Saving generated-images-0218.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [219/300], loss_g: 4.2898, loss_d: 0.0733, real_score: 0.9577, fake_score:
0.0279
Saving generated-images-0219.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [220/300], loss_g: 5.0215, loss_d: 0.0431, real_score: 0.9798, fake_score:
0.0215
Saving generated-images-0220.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [221/300], loss_g: 4.1745, loss_d: 0.0499, real_score: 0.9944, fake_score:
0.0410
Saving generated-images-0221.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [222/300], loss_g: 4.3761, loss_d: 0.0682, real_score: 0.9611, fake_score:
0.0160
Saving generated-images-0222.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [223/300], loss_g: 1.7579, loss_d: 0.3784, real_score: 0.7181, fake_score:
```

```
0.0040
Saving generated-images-0223.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [224/300], loss_g: 4.9301, loss_d: 0.0787, real_score: 0.9502, fake_score:
0.0250
Saving generated-images-0224.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [225/300], loss_g: 5.4764, loss_d: 0.0212, real_score: 0.9882, fake_score:
0.0091
Saving generated-images-0225.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [226/300], loss_g: 5.4576, loss_d: 0.0266, real_score: 0.9983, fake_score:
0.0242
Saving generated-images-0226.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [227/300], loss_g: 5.0704, loss_d: 0.0377, real_score: 0.9974, fake_score:
0.0331
Saving generated-images-0227.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [228/300], loss_g: 5.2199, loss_d: 0.0340, real_score: 0.9815, fake_score:
0.0148
Saving generated-images-0228.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [229/300], loss_g: 1.5375, loss_d: 1.4927, real_score: 0.5272, fake_score:
0.2639
Saving generated-images-0229.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [230/300], loss_g: 4.3695, loss_d: 0.2630, real_score: 0.9473, fake_score:
0.1436
Saving generated-images-0230.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [231/300], loss_g: 5.0056, loss_d: 0.0787, real_score: 0.9449, fake_score:
```

```
0.0187
Saving generated-images-0231.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [232/300], loss_g: 3.5748, loss_d: 0.1299, real_score: 0.9043, fake_score:
0.0210
Saving generated-images-0232.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [233/300], loss_g: 3.8392, loss_d: 0.1307, real_score: 0.9088, fake_score:
0.0292
Saving generated-images-0233.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [234/300], loss_g: 3.8039, loss_d: 0.1005, real_score: 0.9184, fake_score:
0.0113
Saving generated-images-0234.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [235/300], loss_g: 5.3265, loss_d: 0.0332, real_score: 0.9958, fake_score:
0.0280
Saving generated-images-0235.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [236/300], loss_g: 5.0464, loss_d: 0.0188, real_score: 0.9978, fake_score:
0.0163
Saving generated-images-0236.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [237/300], loss_g: 4.6737, loss_d: 0.1231, real_score: 0.9971, fake_score:
0.1017
Saving generated-images-0237.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [238/300], loss_g: 6.5940, loss_d: 0.0210, real_score: 0.9962, fake_score:
0.0167
Saving generated-images-0238.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [239/300], loss_g: 4.6915, loss_d: 0.0968, real_score: 0.9228, fake_score:
```

```
0.0123
Saving generated-images-0239.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [240/300], loss_g: 4.9338, loss_d: 0.0443, real_score: 0.9913, fake_score:
0.0334
Saving generated-images-0240.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [241/300], loss_g: 5.6800, loss_d: 0.0362, real_score: 0.9747, fake_score:
0.0094
Saving generated-images-0241.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [242/300], loss_g: 3.2181, loss_d: 0.1458, real_score: 0.8778, fake_score:
0.0059
Saving generated-images-0242.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [243/300], loss_g: 5.4061, loss_d: 0.0240, real_score: 0.9854, fake_score:
0.0091
Saving generated-images-0243.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [244/300], loss_g: 1.6585, loss_d: 0.1394, real_score: 0.8921, fake_score:
0.0145
Saving generated-images-0244.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [245/300], loss_g: 4.5700, loss_d: 0.4494, real_score: 0.9308, fake_score:
0.2362
Saving generated-images-0245.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [246/300], loss_g: 4.1360, loss_d: 0.1926, real_score: 0.8859, fake_score:
0.0465
Saving generated-images-0246.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [247/300], loss_g: 4.1666, loss_d: 0.1712, real_score: 0.9930, fake_score:
```

```
0.1362
Saving generated-images-0247.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [248/300], loss_g: 4.5465, loss_d: 0.0534, real_score: 0.9987, fake_score:
0.0485
Saving generated-images-0248.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [249/300], loss_g: 4.0883, loss_d: 0.0471, real_score: 0.9726, fake_score:
0.0184
Saving generated-images-0249.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [250/300], loss_g: 4.9801, loss_d: 0.0636, real_score: 0.9913, fake_score:
0.0509
Saving generated-images-0250.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [251/300], loss_g: 5.0231, loss_d: 0.0256, real_score: 0.9850, fake_score:
0.0102
Saving generated-images-0251.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [252/300], loss_g: 5.9148, loss_d: 0.0344, real_score: 0.9966, fake_score:
0.0299
Saving generated-images-0252.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [253/300], loss_g: 6.0495, loss_d: 0.0287, real_score: 0.9982, fake_score:
0.0253
Saving generated-images-0253.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [254/300], loss_g: 6.1087, loss_d: 0.0190, real_score: 0.9944, fake_score:
0.0128
Saving generated-images-0254.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [255/300], loss_g: 4.5458, loss_d: 0.7097, real_score: 0.7240, fake_score:
```

```
0.1307
Saving generated-images-0255.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [256/300], loss_g: 4.6418, loss_d: 0.0548, real_score: 0.9987, fake_score:
0.0501
Saving generated-images-0256.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [257/300], loss_g: 4.7077, loss_d: 0.1139, real_score: 0.9794, fake_score:
0.0790
Saving generated-images-0257.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [258/300], loss_g: 3.7106, loss_d: 0.1628, real_score: 0.8749, fake_score:
0.0186
Saving generated-images-0258.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [259/300], loss_g: 4.7031, loss_d: 0.1078, real_score: 0.9493, fake_score:
0.0511
Saving generated-images-0259.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [260/300], loss_g: 5.1854, loss_d: 0.0511, real_score: 0.9860, fake_score:
0.0350
Saving generated-images-0260.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [261/300], loss_g: 5.0294, loss_d: 0.0901, real_score: 0.9225, fake_score:
0.0056
Saving generated-images-0261.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [262/300], loss_g: 5.2195, loss_d: 0.0402, real_score: 0.9757, fake_score:
0.0148
Saving generated-images-0262.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [263/300], loss_g: 5.8242, loss_d: 0.0220, real_score: 0.9937, fake_score:
```

```
0.0155
Saving generated-images-0263.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [264/300], loss_g: 5.8478, loss_d: 0.0155, real_score: 0.9954, fake_score:
0.0107
Saving generated-images-0264.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [265/300], loss_g: 6.2049, loss_d: 0.0252, real_score: 0.9935, fake_score:
0.0181
Saving generated-images-0265.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [266/300], loss_g: 6.4924, loss_d: 0.0070, real_score: 0.9980, fake_score:
0.0050
Saving generated-images-0266.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [267/300], loss_g: 5.3005, loss_d: 0.0306, real_score: 0.9767, fake_score:
0.0067
Saving generated-images-0267.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [268/300], loss_g: 5.0637, loss_d: 0.0500, real_score: 0.9601, fake_score:
0.0086
Saving generated-images-0268.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [269/300], loss_g: 1.8473, loss_d: 1.3970, real_score: 0.7416, fake_score:
0.4926
Saving generated-images-0269.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [270/300], loss_g: 1.8715, loss_d: 0.8935, real_score: 0.7066, fake_score:
0.2880
Saving generated-images-0270.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [271/300], loss_g: 3.3875, loss_d: 0.6356, real_score: 0.7449, fake_score:
```

```
0.1879
Saving generated-images-0271.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [272/300], loss_g: 3.0668, loss_d: 0.2518, real_score: 0.8170, fake_score:
0.0139
Saving generated-images-0272.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [273/300], loss_g: 3.3491, loss_d: 0.2435, real_score: 0.8183, fake_score:
0.0178
Saving generated-images-0273.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [274/300], loss_g: 5.1830, loss_d: 0.0502, real_score: 0.9888, fake_score:
0.0362
Saving generated-images-0274.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [275/300], loss_g: 4.2275, loss_d: 0.1127, real_score: 0.9261, fake_score:
0.0315
Saving generated-images-0275.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [276/300], loss_g: 4.6205, loss_d: 0.1647, real_score: 0.9882, fake_score:
0.1217
Saving generated-images-0276.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [277/300], loss_g: 5.8363, loss_d: 0.0401, real_score: 0.9743, fake_score:
0.0131
Saving generated-images-0277.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [278/300], loss_g: 5.3602, loss_d: 0.0363, real_score: 0.9797, fake_score:
0.0148
Saving generated-images-0278.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [279/300], loss_g: 5.6979, loss_d: 0.0366, real_score: 0.9847, fake_score:
```

```
0.0205
Saving generated-images-0279.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [280/300], loss_g: 5.1027, loss_d: 0.0477, real_score: 0.9869, fake_score:
0.0328
Saving generated-images-0280.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [281/300], loss_g: 4.8241, loss_d: 0.0735, real_score: 0.9511, fake_score:
0.0218
Saving generated-images-0281.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [282/300], loss_g: 6.2703, loss_d: 0.0151, real_score: 0.9963, fake_score:
0.0112
Saving generated-images-0282.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [283/300], loss_g: 5.6851, loss_d: 0.0321, real_score: 0.9976, fake_score:
0.0283
Saving generated-images-0283.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [284/300], loss_g: 5.2389, loss_d: 0.0266, real_score: 0.9950, fake_score:
0.0209
Saving generated-images-0284.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [285/300], loss_g: 5.0501, loss_d: 0.0286, real_score: 0.9991, fake_score:
0.0260
Saving generated-images-0285.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [286/300], loss_g: 5.0556, loss_d: 0.0136, real_score: 0.9967, fake_score:
0.0101
Saving generated-images-0286.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [287/300], loss_g: 4.4772, loss_d: 0.0538, real_score: 0.9932, fake_score:
```

```
0.0437
Saving generated-images-0287.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [288/300], loss_g: 5.6453, loss_d: 0.0171, real_score: 0.9972, fake_score:
0.0140
Saving generated-images-0288.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [289/300], loss_g: 7.1126, loss_d: 0.0053, real_score: 0.9974, fake_score:
0.0027
Saving generated-images-0289.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [290/300], loss_g: 7.9470, loss_d: 0.0087, real_score: 0.9956, fake_score:
0.0041
Saving generated-images-0290.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [291/300], loss_g: 6.0630, loss_d: 0.0372, real_score: 0.9700, fake_score:
0.0061
Saving generated-images-0291.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [292/300], loss_g: 10.1886, loss_d: 0.8131, real_score: 0.9992,
fake_score: 0.2678
Saving generated-images-0292.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [293/300], loss_g: 6.1051, loss_d: 0.3715, real_score: 0.9313, fake_score:
0.1751
Saving generated-images-0293.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [294/300], loss_g: 6.3494, loss_d: 0.0585, real_score: 0.9754, fake_score:
0.0303
Saving generated-images-0294.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [295/300], loss_g: 3.9548, loss_d: 0.2532, real_score: 0.8196, fake_score:
```

```
0.0029
Saving generated-images-0295.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [296/300], loss_g: 5.0374, loss_d: 0.1134, real_score: 0.9098, fake_score:
0.0062
Saving generated-images-0296.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [297/300], loss_g: 5.1969, loss_d: 0.0532, real_score: 0.9711, fake_score:
0.0208
Saving generated-images-0297.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [298/300], loss_g: 5.7372, loss_d: 0.0104, real_score: 0.9989, fake_score:
0.0092
Saving generated-images-0298.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [299/300], loss_g: 5.6232, loss_d: 0.0216, real_score: 0.9869, fake_score:
0.0082
Saving generated-images-0299.png
HBox(children=(FloatProgress(value=0.0, max=68.0), HTML(value='')))

Epoch [300/300], loss_g: 6.3501, loss_d: 0.0124, real_score: 0.9972, fake_score:
0.0094
Saving generated-images-0300.png
```

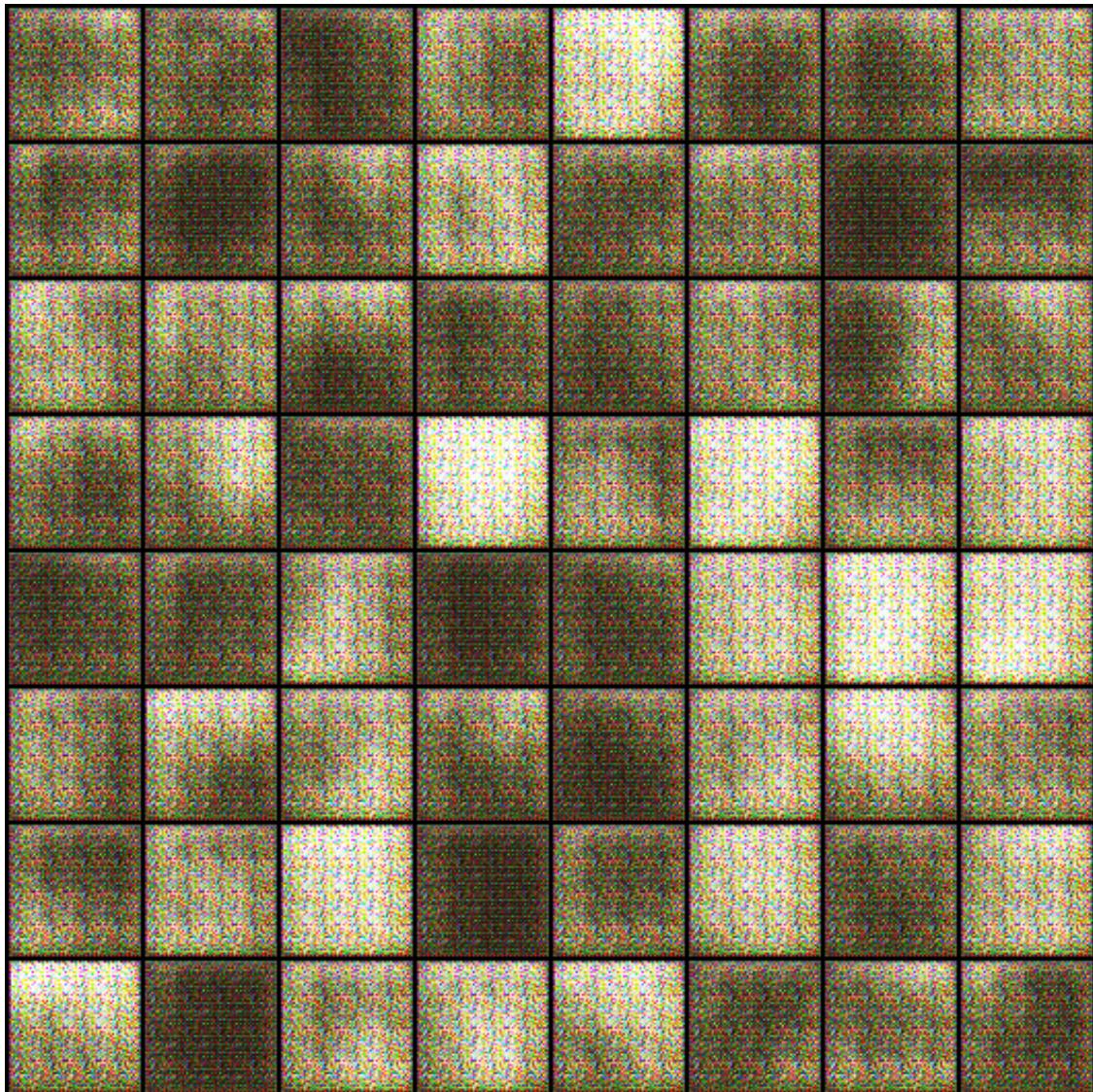
```
[ ]: losses_g, losses_d, real_scores, fake_scores = history
```

```
[ ]: # Save the model checkpoints
torch.save(generator.state_dict(), 'G.pth')
torch.save(discriminator.state_dict(), 'D.pth')
```

```
[ ]: from IPython.display import Image
```

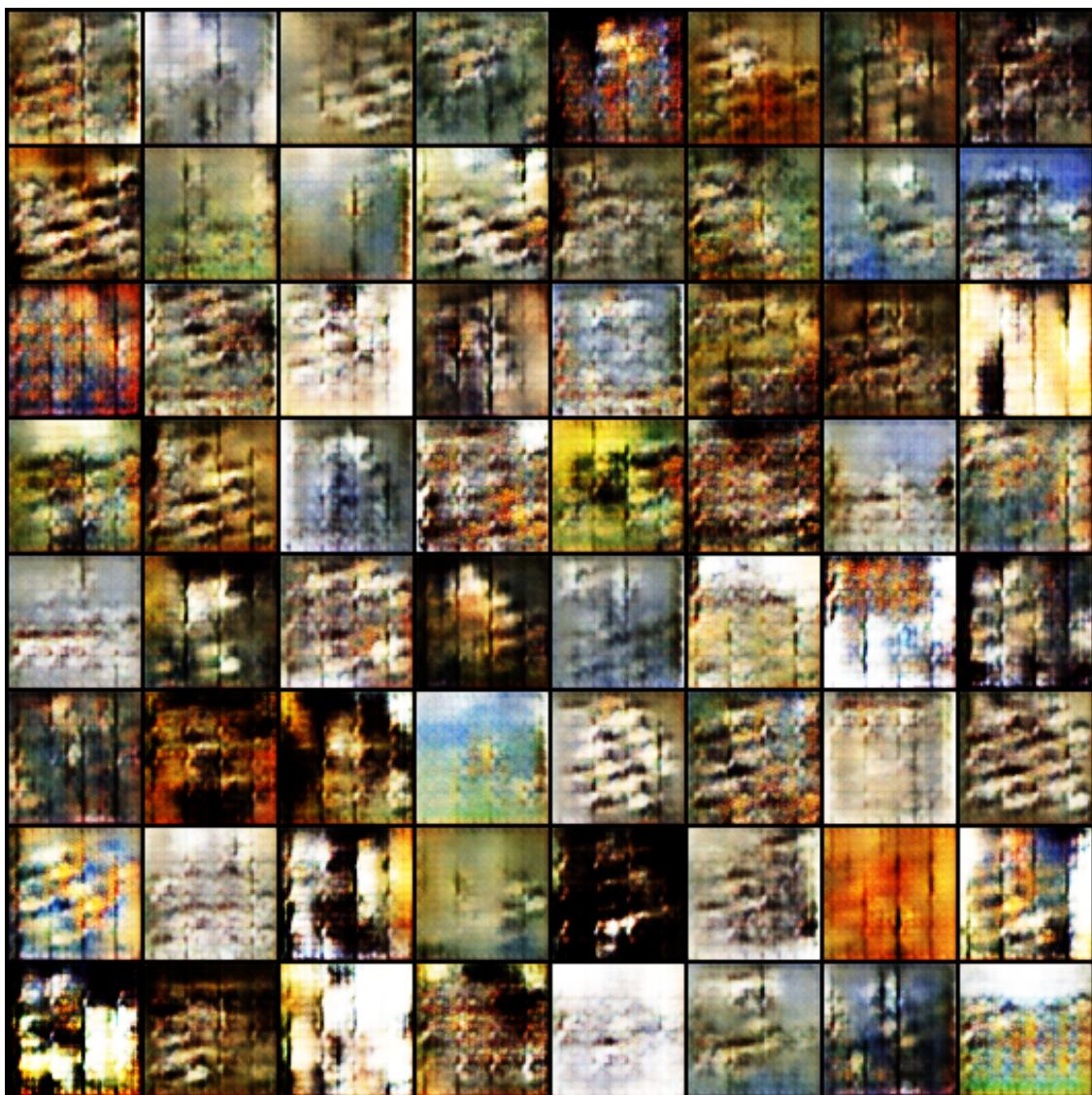
```
[ ]: Image('./generated/generated-images-0001.png')
```

```
[ ]:
```



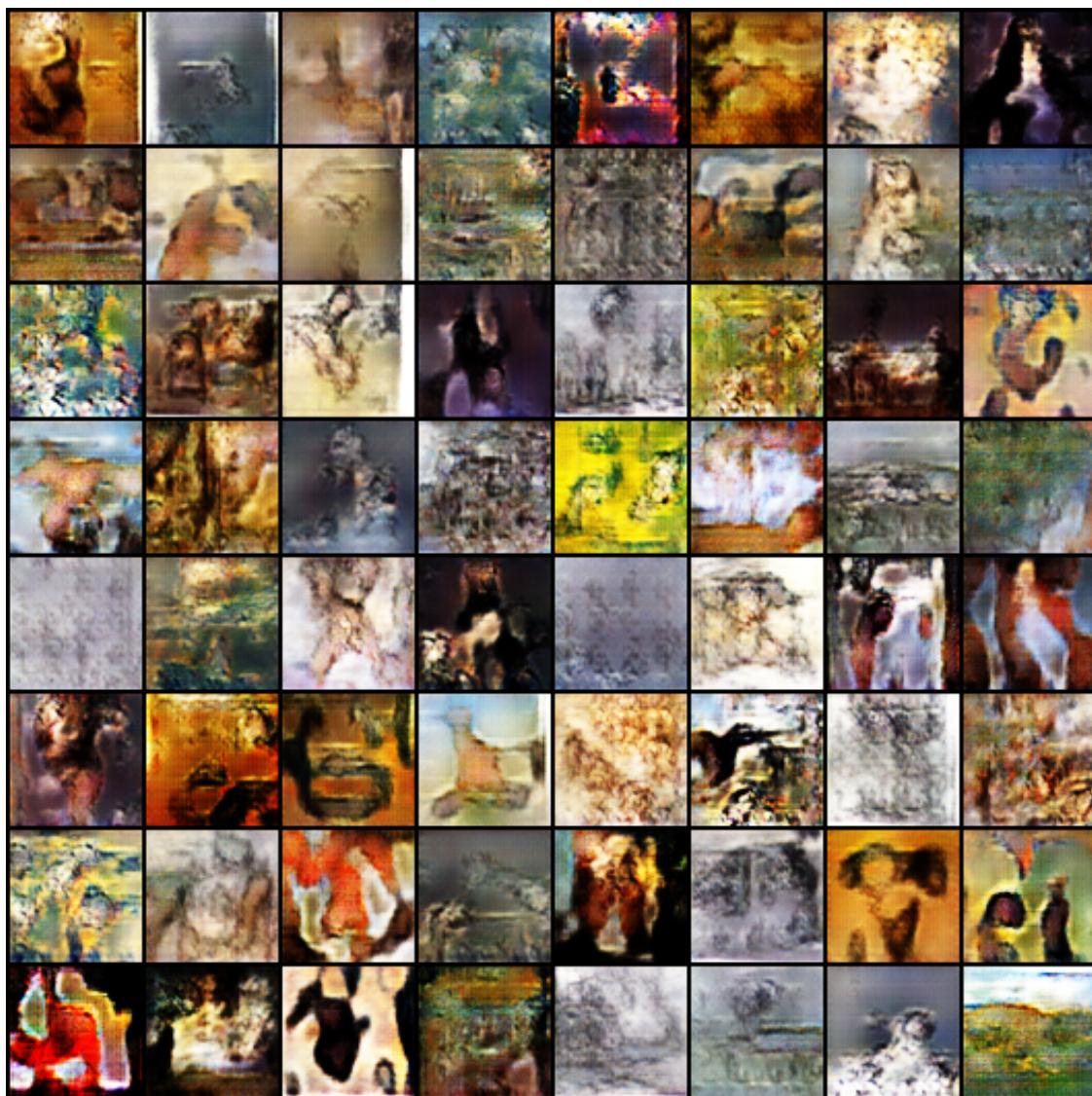
```
[ ]: Image('./generated/generated-images-0031.png')
```

```
[ ]:
```



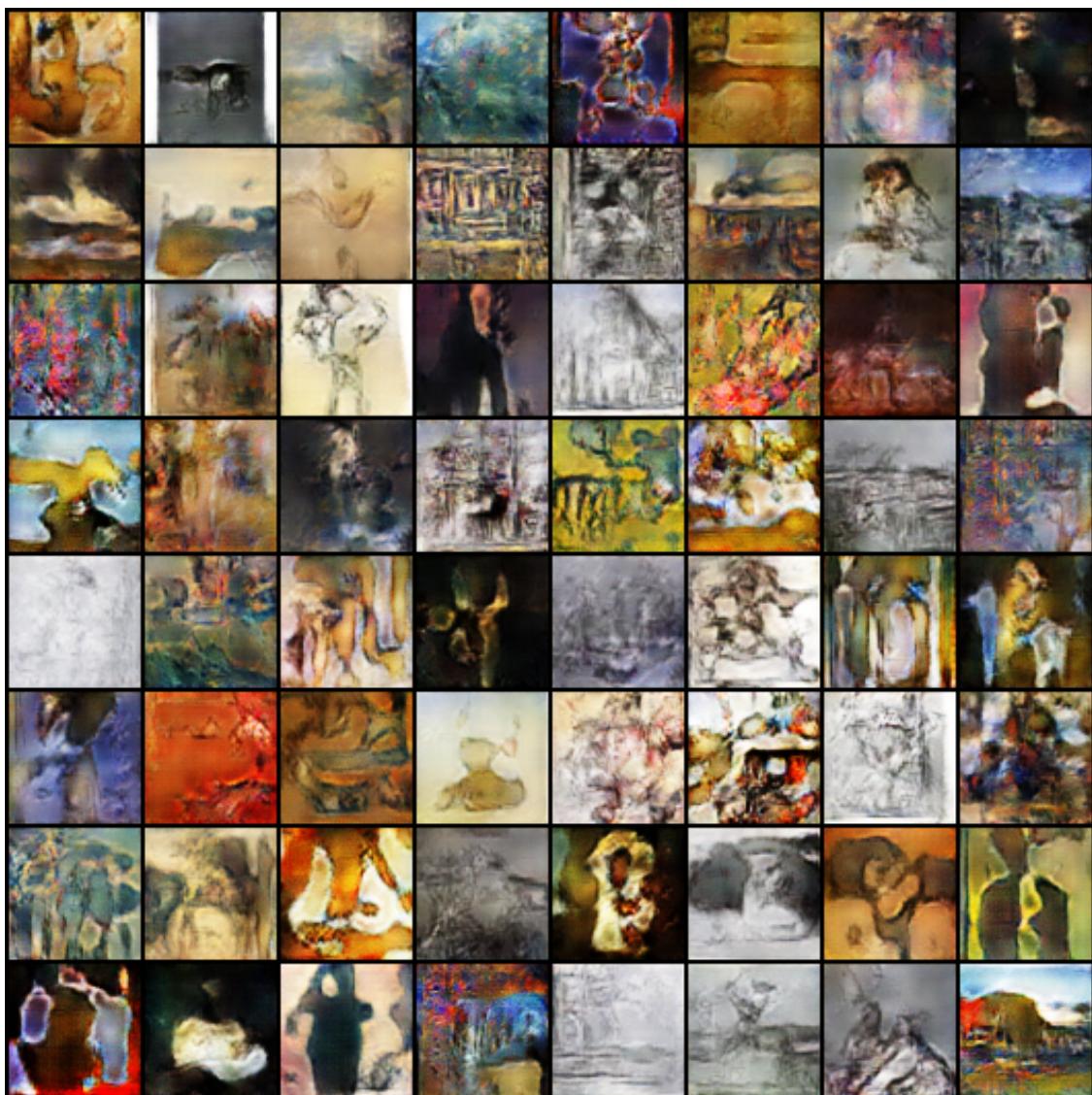
```
[ ]: Image('./generated/generated-images-0090.png')
```

```
[ ]:
```



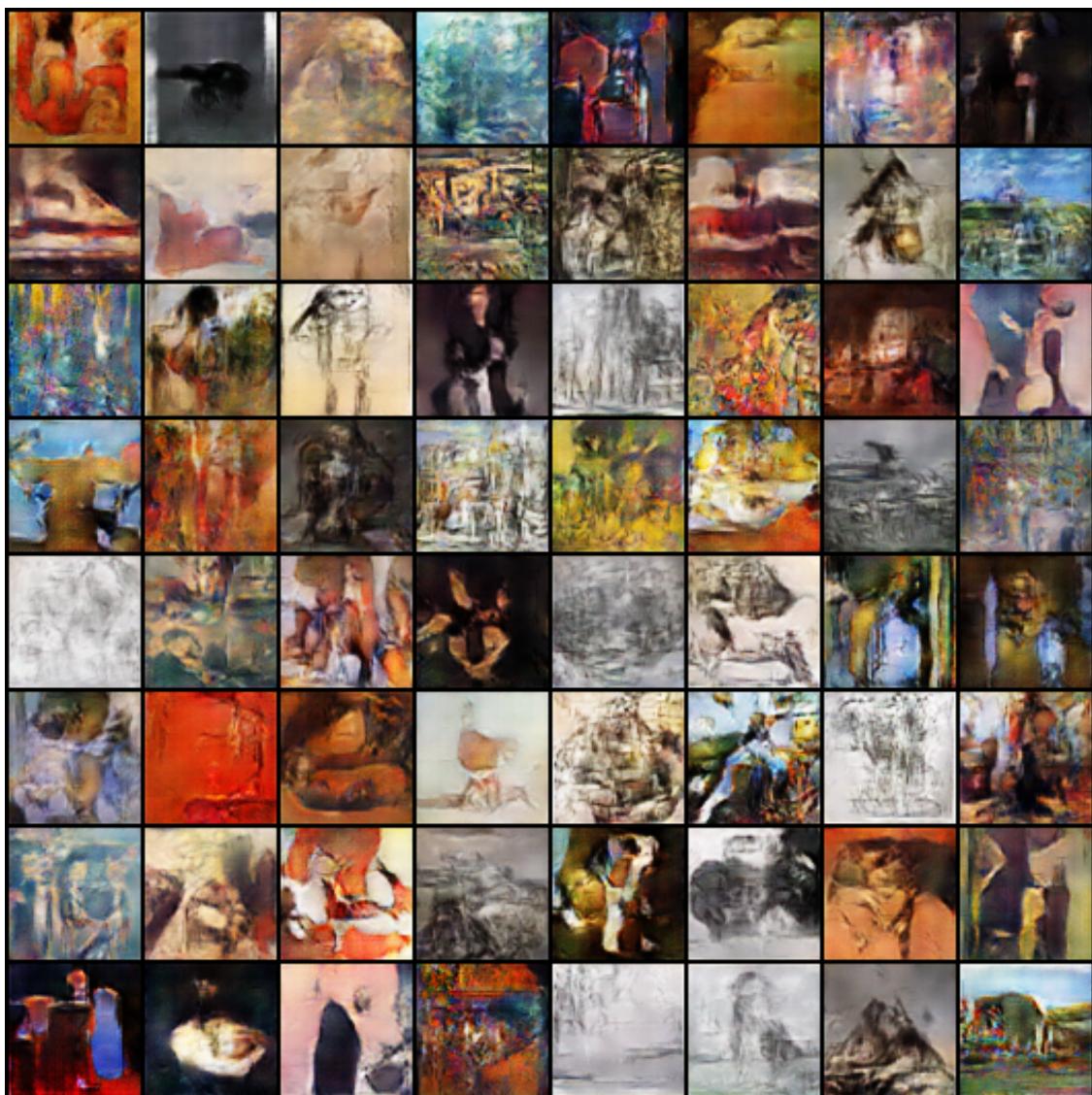
```
[ ]: Image('./generated/generated-images-0141.png')
```

```
[ ]:
```



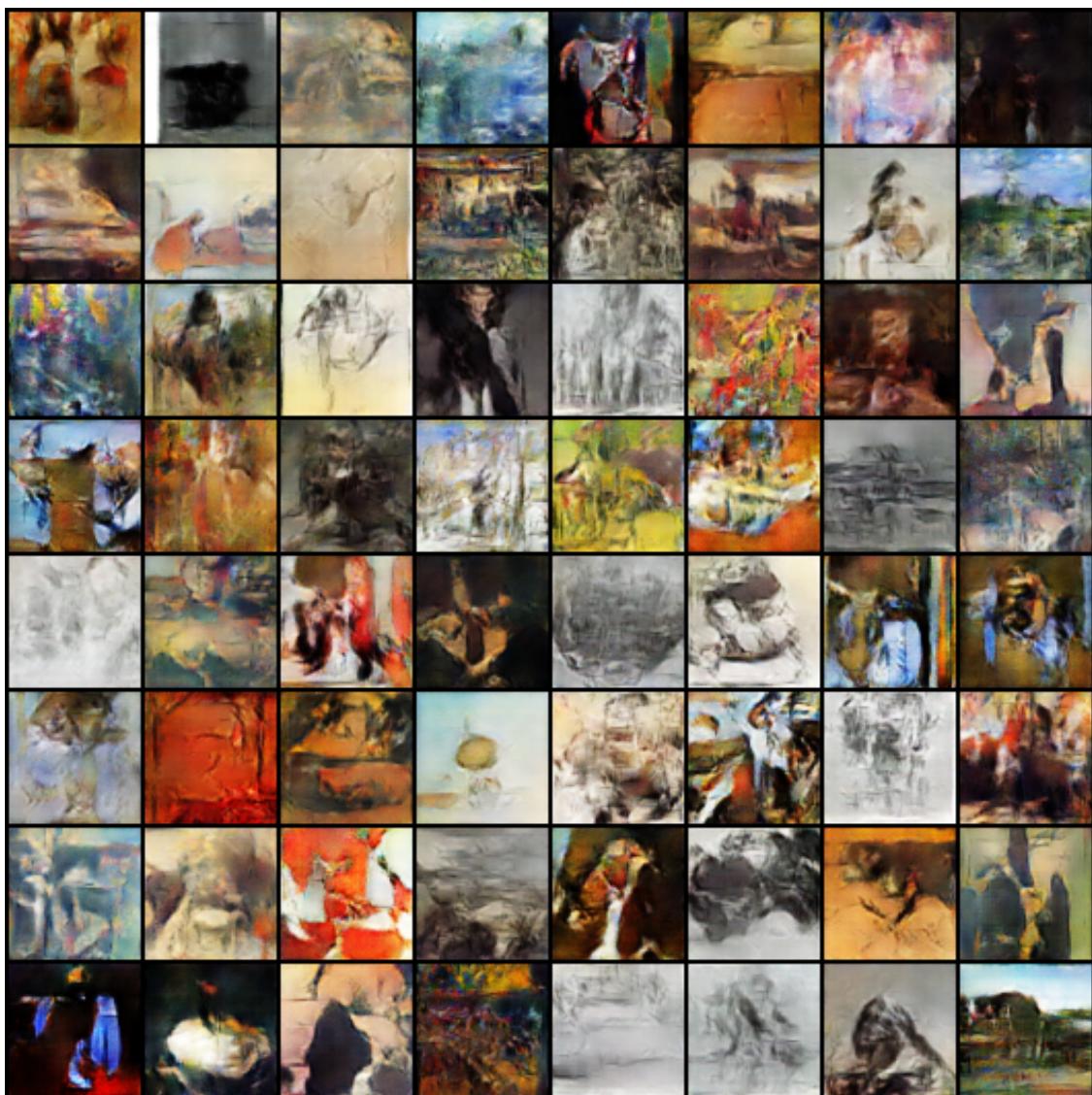
```
[ ]: Image('./generated/generated-images-0201.png')
```

```
[ ]:
```



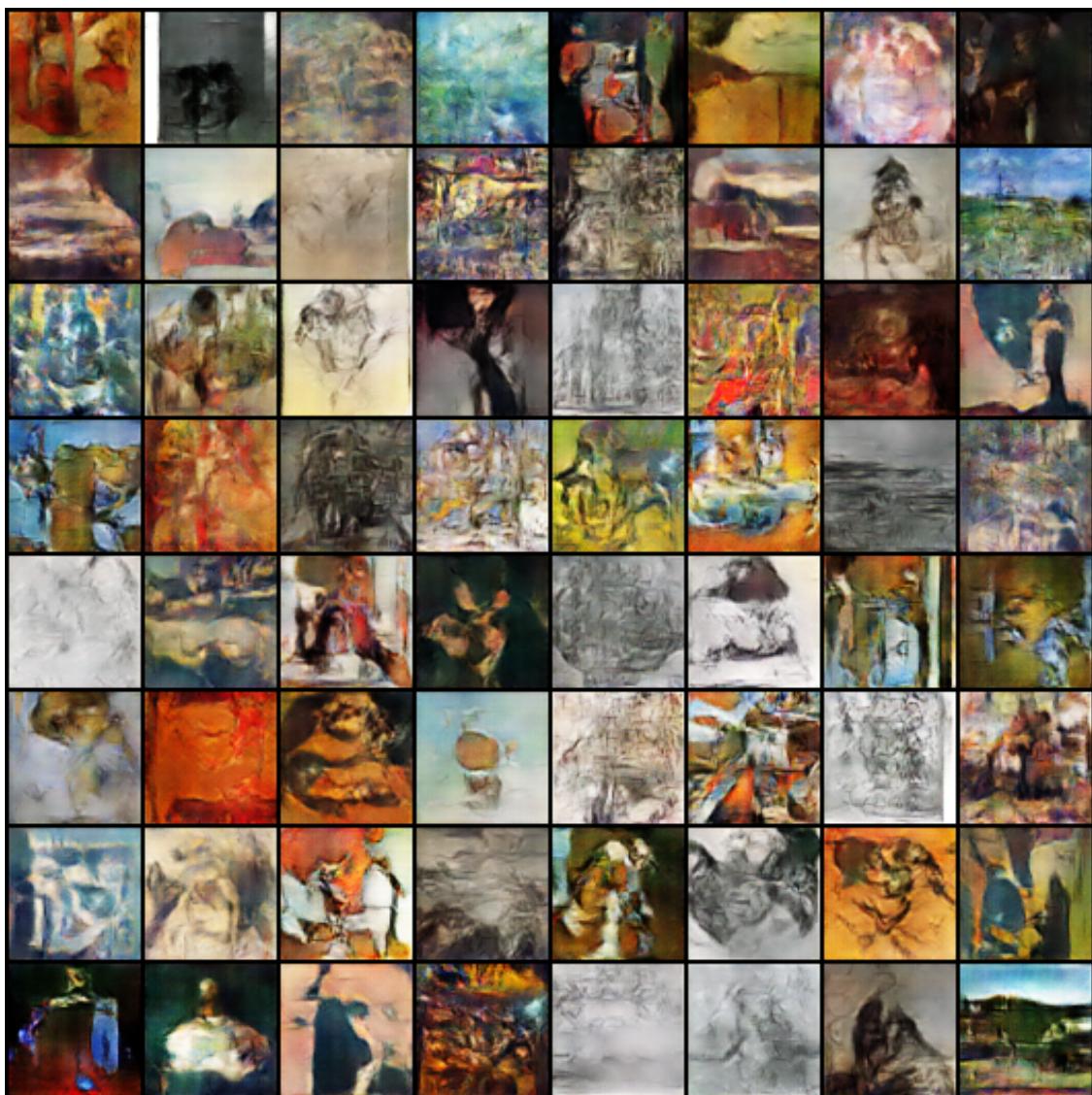
```
[ ]: Image('./generated/generated-images-0241.png')
```

```
[ ]:
```



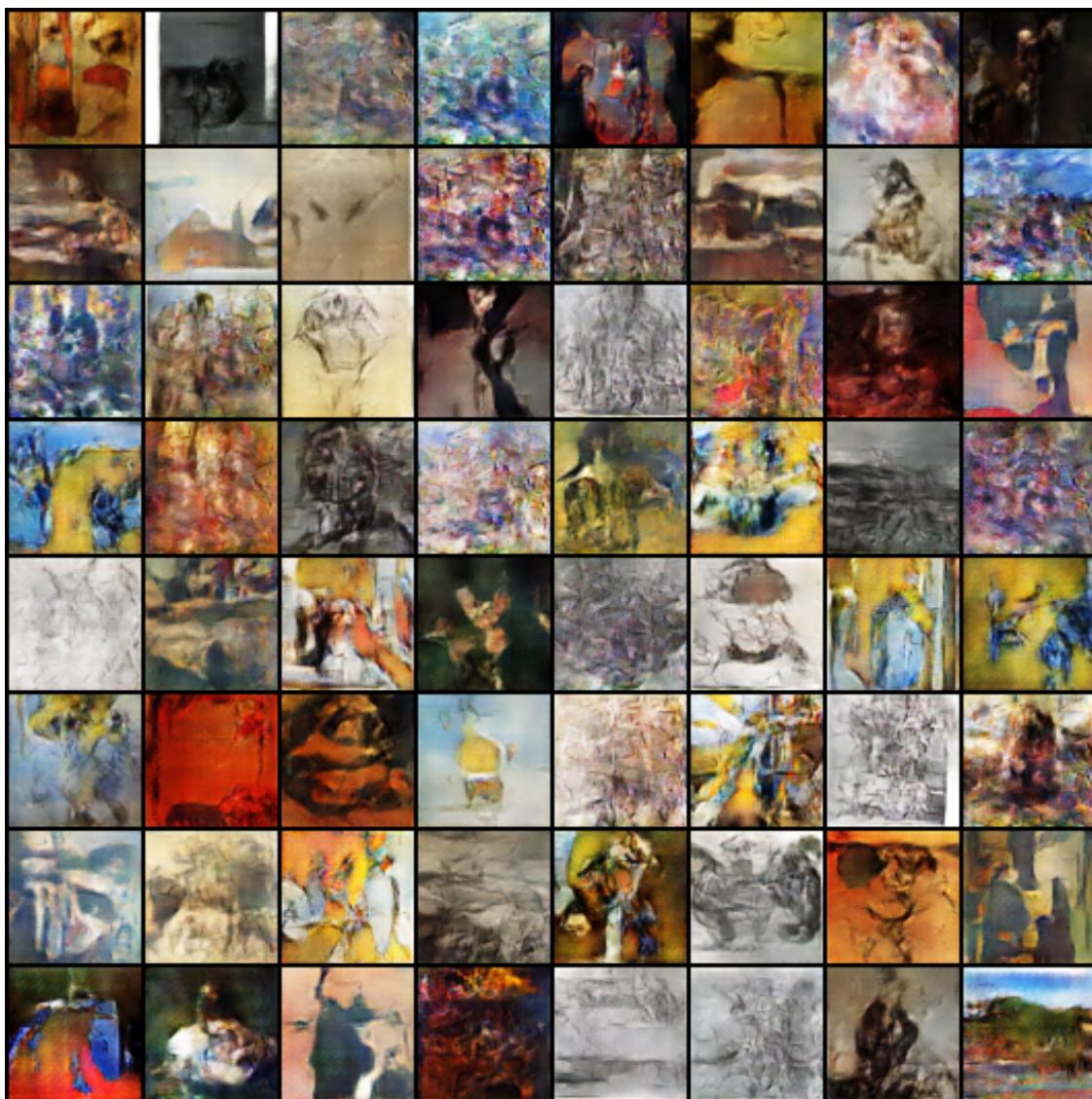
```
[ ]: Image('./generated/generated-images-0281.png')
```

```
[ ]:
```



```
[ ]: Image('./generated/generated-images-0300.png')
```

```
[ ]:
```



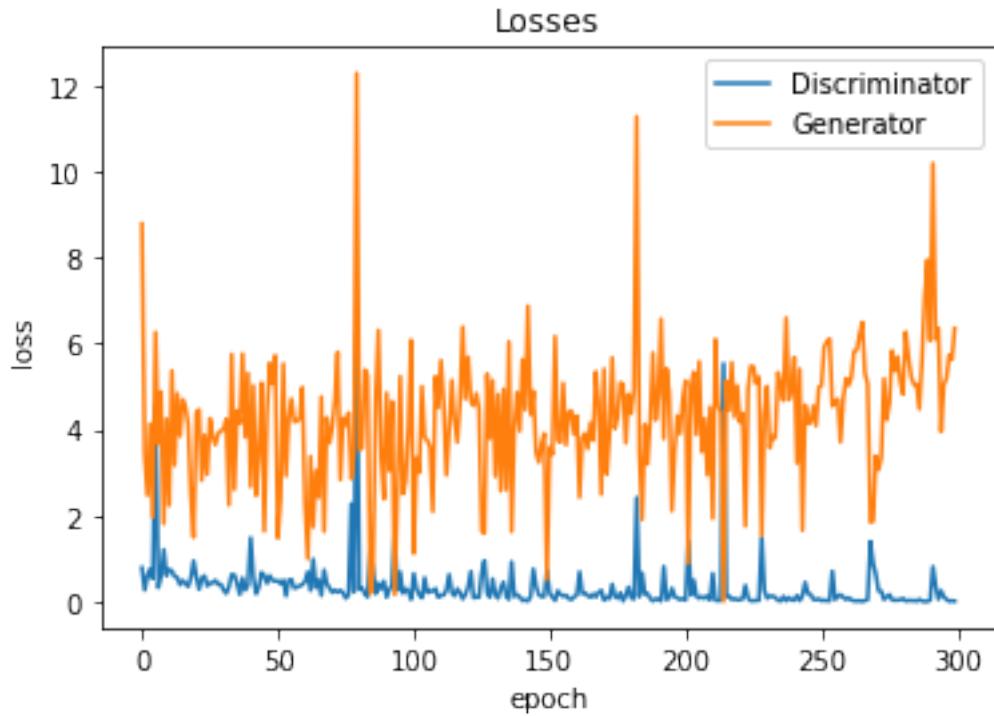
```
[ ]: import cv2
import os

vid_fname = 'art_gans_training.avi'

files = [os.path.join(sample_dir, f) for f in os.listdir(sample_dir) if
         ~'generated' in f]
files.sort()

out = cv2.VideoWriter(vid_fname, cv2.VideoWriter_fourcc(*'MP4V'), 5, (530,530))
[out.write(cv2.imread(fname)) for fname in files]
out.release()
```

```
[ ]: plt.plot(losses_d, '-')
plt.plot(losses_g, '-')
plt.xlabel('epoch')
plt.ylabel('loss')
plt.legend(['Discriminator', 'Generator'])
plt.title('Losses');
```



```
[ ]: plt.plot(real_scores, '-')
plt.plot(fake_scores, '-')
plt.xlabel('epoch')
plt.ylabel('score')
plt.legend(['Real', 'Fake'])
plt.title('Scores');
```

