MLP GAN

```
In [ ]: import time
        import numpy as np
        import torch
        import torch.nn.functional as F
        from torchvision import datasets
        from torchvision import transforms
        import torch.nn as nn
        from torch.utils.data import DataLoader


        if torch.cuda.is_available():
            torch.backends.cudnn.deterministic = True
```

```
In [ ]: # Device
        device = torch.device("cuda:0" if torch.cuda.is_available() else "cpu")

        # Hyperparameters
        random_seed = 123
        generator_learning_rate = 0.001
        discriminator_learning_rate = 0.001
        num_epochs = 100
        batch_size = 128
        LATENT_DIM = 100
        IMG_SHAPE = (1, 28, 28)
        IMG_SIZE = 1
        for x in IMG_SHAPE:
            IMG_SIZE *= x
```

```
In [ ]:  train_dataset = datasets.MNIST(root='data',
                                         train=True,
                                         transform=transforms.ToTensor(),
                                         download=True)

         test_dataset = datasets.MNIST(root='data',
                                       train=False,
                                       transform=transforms.ToTensor())


         train_loader = DataLoader(dataset=train_dataset,
                                   batch_size=batch_size,
                                   shuffle=True)

         test_loader = DataLoader(dataset=test_dataset,
                                  batch_size=batch_size,
                                  shuffle=False)

         # Checking the dataset
         for images, labels in train_loader:
             print('Image batch dimensions:', images.shape)
             print('Image label dimensions:', labels.shape)
             break
```

```
Downloading http://yann.lecun.com/exdb/mnist/train-images-idx3-ubyte.gz
Downloading http://yann.lecun.com/exdb/mnist/train-images-idx3-ubyte.gz to data/MNIST/r
aw/train-images-idx3-ubyte.gz

Extracting data/MNIST/raw/train-images-idx3-ubyte.gz to data/MNIST/raw

Downloading http://yann.lecun.com/exdb/mnist/train-labels-idx1-ubyte.gz
Downloading http://yann.lecun.com/exdb/mnist/train-labels-idx1-ubyte.gz to data/MNIST/r
aw/train-labels-idx1-ubyte.gz

Extracting data/MNIST/raw/train-labels-idx1-ubyte.gz to data/MNIST/raw

Downloading http://yann.lecun.com/exdb/mnist/t10k-images-idx3-ubyte.gz
Downloading http://yann.lecun.com/exdb/mnist/t10k-images-idx3-ubyte.gz to data/MNIST/ra
w/t10k-images-idx3-ubyte.gz

Extracting data/MNIST/raw/t10k-images-idx3-ubyte.gz to data/MNIST/raw

Downloading http://yann.lecun.com/exdb/mnist/t10k-labels-idx1-ubyte.gz
Downloading http://yann.lecun.com/exdb/mnist/t10k-labels-idx1-ubyte.gz to data/MNIST/ra
w/t10k-labels-idx1-ubyte.gz

Extracting data/MNIST/raw/t10k-labels-idx1-ubyte.gz to data/MNIST/raw

Processing...
Done!
Image batch dimensions: torch.Size([128, 1, 28, 28])
Image label dimensions: torch.Size([128])

/usr/local/lib/python3.7/dist-packages/torchvision/datasets/mnist.py:502: UserWarning:
The given NumPy array is not writeable, and PyTorch does not support non-writeable tens
ors. This means you can write to the underlying (supposedly non-writeable) NumPy array
using the tensor. You may want to copy the array to protect its data or make it writeab
le before converting it to a tensor. This type of warning will be suppressed for the re
st of this program. (Triggered internally at  /pytorch/torch/csrc/utils/tensor_numpy.cp
p:143.)
  return torch.from_numpy(parsed.astype(m[2], copy=False)).view(*s)
```

```python
class GAN(torch.nn.Module):

    def __init__(self):
        super(GAN, self).__init__()


        self.generator = nn.Sequential(
            nn.Linear(LATENT_DIM, 128),
            nn.LeakyReLU(inplace=True),
            nn.Dropout(p=0.5),
            nn.Linear(128, IMG_SIZE),
            nn.Tanh()
        )

        self.discriminator = nn.Sequential(
            nn.Linear(IMG_SIZE, 128),
            nn.LeakyReLU(inplace=True),
            nn.Dropout(p=0.5),
            nn.Linear(128, 1),
            nn.Sigmoid()
        )


    def generator_forward(self, z):
        img = self.generator(z)
        return img

    def discriminator_forward(self, img):
        pred = model.discriminator(img)
        return pred.view(-1)
```

```python
torch.manual_seed(random_seed)

model = GAN()
model = model.to(device)

optim_gener = torch.optim.Adam(model.generator.parameters(), lr=generator_learning_rate)
optim_discr = torch.optim.Adam(model.discriminator.parameters(), lr=discriminator_learning_rate)
```

```python
In [ ]:  start_time = time.time()

         discr_costs = []
         gener_costs = []
         for epoch in range(num_epochs):
             model = model.train()
             for batch_idx, (features, targets) in enumerate(train_loader):


                 features = (features - 0.5)*2.
                 features = features.view(-1, IMG_SIZE).to(device)
                 targets = targets.to(device)

                 valid = torch.ones(targets.size(0)).float().to(device)
                 fake = torch.zeros(targets.size(0)).float().to(device)


                 ### FORWARD AND BACK PROP


                 # --------------------------
                 # Train Generator
                 # --------------------------

                 # Make new images
                 z = torch.zeros((targets.size(0), LATENT_DIM)).uniform_(-1.0, 1.0).to(device)
                 generated_features = model.generator_forward(z)

                 # Loss for fooling the discriminator
                 discr_pred = model.discriminator_forward(generated_features)

                 gener_loss = F.binary_cross_entropy(discr_pred, valid)

                 optim_gener.zero_grad()
                 gener_loss.backward()
                 optim_gener.step()

                 # --------------------------
                 # Train Discriminator
                 # --------------------------

                 discr_pred_real = model.discriminator_forward(features.view(-1, IMG_SIZE))
                 real_loss = F.binary_cross_entropy(discr_pred_real, valid)

                 discr_pred_fake = model.discriminator_forward(generated_features.detach())
                 fake_loss = F.binary_cross_entropy(discr_pred_fake, fake)

                 discr_loss = 0.5*(real_loss + fake_loss)

                 optim_discr.zero_grad()
                 discr_loss.backward()
                 optim_discr.step()

                 discr_costs.append(discr_loss.item())
                 gener_costs.append(gener_loss.item())


                 ### LOGGING
                 if not batch_idx % 100:
                     print ('Epoch: %03d/%03d | Batch %03d/%03d | Gen/Dis Loss: %.4f/%.4f'
```

```python
                      %(epoch+1, num_epochs, batch_idx,
                        len(train_loader), gener_loss, discr_loss))

    print('Time elapsed: %.2f min' % ((time.time() - start_time)/60))

print('Total Training Time: %.2f min' % ((time.time() - start_time)/60))
```

```
Epoch: 001/100 | Batch 000/469 | Gen/Dis Loss: 0.6821/0.7102
Epoch: 001/100 | Batch 100/469 | Gen/Dis Loss: 4.3656/0.0455
Epoch: 001/100 | Batch 200/469 | Gen/Dis Loss: 1.4268/0.1459
Epoch: 001/100 | Batch 300/469 | Gen/Dis Loss: 1.7206/0.1577
Epoch: 001/100 | Batch 400/469 | Gen/Dis Loss: 2.2282/0.1306
Time elapsed: 0.09 min
Epoch: 002/100 | Batch 000/469 | Gen/Dis Loss: 1.2843/0.2705
Epoch: 002/100 | Batch 100/469 | Gen/Dis Loss: 0.7821/0.5430
Epoch: 002/100 | Batch 200/469 | Gen/Dis Loss: 0.8501/0.4763
Epoch: 002/100 | Batch 300/469 | Gen/Dis Loss: 0.6614/0.5287
Epoch: 002/100 | Batch 400/469 | Gen/Dis Loss: 1.4604/0.3189
Time elapsed: 0.18 min
Epoch: 003/100 | Batch 000/469 | Gen/Dis Loss: 0.9164/0.4601
Epoch: 003/100 | Batch 100/469 | Gen/Dis Loss: 1.1258/0.3913
Epoch: 003/100 | Batch 200/469 | Gen/Dis Loss: 1.7097/0.2993
Epoch: 003/100 | Batch 300/469 | Gen/Dis Loss: 0.9697/0.4669
Epoch: 003/100 | Batch 400/469 | Gen/Dis Loss: 1.2395/0.3690
Time elapsed: 0.26 min
Epoch: 004/100 | Batch 000/469 | Gen/Dis Loss: 1.0636/0.4185
Epoch: 004/100 | Batch 100/469 | Gen/Dis Loss: 1.4494/0.3491
Epoch: 004/100 | Batch 200/469 | Gen/Dis Loss: 1.0870/0.3717
Epoch: 004/100 | Batch 300/469 | Gen/Dis Loss: 1.0536/0.4023
Epoch: 004/100 | Batch 400/469 | Gen/Dis Loss: 0.9493/0.5302
Time elapsed: 0.35 min
Epoch: 005/100 | Batch 000/469 | Gen/Dis Loss: 1.1207/0.4349
Epoch: 005/100 | Batch 100/469 | Gen/Dis Loss: 1.3271/0.4532
Epoch: 005/100 | Batch 200/469 | Gen/Dis Loss: 1.0324/0.5438
Epoch: 005/100 | Batch 300/469 | Gen/Dis Loss: 0.9537/0.5031
Epoch: 005/100 | Batch 400/469 | Gen/Dis Loss: 1.5886/0.4243
Time elapsed: 0.45 min
Epoch: 006/100 | Batch 000/469 | Gen/Dis Loss: 0.9711/0.5136
Epoch: 006/100 | Batch 100/469 | Gen/Dis Loss: 1.1375/0.4404
Epoch: 006/100 | Batch 200/469 | Gen/Dis Loss: 1.5206/0.4164
Epoch: 006/100 | Batch 300/469 | Gen/Dis Loss: 1.2033/0.4866
Epoch: 006/100 | Batch 400/469 | Gen/Dis Loss: 0.9311/0.4964
Time elapsed: 0.53 min
Epoch: 007/100 | Batch 000/469 | Gen/Dis Loss: 0.9211/0.5277
Epoch: 007/100 | Batch 100/469 | Gen/Dis Loss: 1.2507/0.4874
Epoch: 007/100 | Batch 200/469 | Gen/Dis Loss: 1.1685/0.4778
Epoch: 007/100 | Batch 300/469 | Gen/Dis Loss: 2.0098/0.3366
Epoch: 007/100 | Batch 400/469 | Gen/Dis Loss: 1.0802/0.4436
Time elapsed: 0.63 min
Epoch: 008/100 | Batch 000/469 | Gen/Dis Loss: 1.0881/0.5633
Epoch: 008/100 | Batch 100/469 | Gen/Dis Loss: 0.8748/0.5452
Epoch: 008/100 | Batch 200/469 | Gen/Dis Loss: 1.0185/0.5504
Epoch: 008/100 | Batch 300/469 | Gen/Dis Loss: 1.3129/0.5204
Epoch: 008/100 | Batch 400/469 | Gen/Dis Loss: 1.2623/0.5200
Time elapsed: 0.71 min
Epoch: 009/100 | Batch 000/469 | Gen/Dis Loss: 1.1195/0.5782
Epoch: 009/100 | Batch 100/469 | Gen/Dis Loss: 1.1188/0.4533
Epoch: 009/100 | Batch 200/469 | Gen/Dis Loss: 1.0589/0.5703
Epoch: 009/100 | Batch 300/469 | Gen/Dis Loss: 1.1272/0.5213
Epoch: 009/100 | Batch 400/469 | Gen/Dis Loss: 1.1502/0.4881
Time elapsed: 0.80 min
Epoch: 010/100 | Batch 000/469 | Gen/Dis Loss: 1.1234/0.4985
Epoch: 010/100 | Batch 100/469 | Gen/Dis Loss: 1.2264/0.5128
Epoch: 010/100 | Batch 200/469 | Gen/Dis Loss: 1.1173/0.5006
Epoch: 010/100 | Batch 300/469 | Gen/Dis Loss: 1.0889/0.5373
Epoch: 010/100 | Batch 400/469 | Gen/Dis Loss: 0.9005/0.5821
Time elapsed: 0.89 min
Epoch: 011/100 | Batch 000/469 | Gen/Dis Loss: 1.0690/0.5497
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Epoch: 011/100 | Batch 100/469 | Gen/Dis Loss: 0.9484/0.5863
Epoch: 011/100 | Batch 200/469 | Gen/Dis Loss: 0.9423/0.5659
Epoch: 011/100 | Batch 300/469 | Gen/Dis Loss: 0.9910/0.5421
Epoch: 011/100 | Batch 400/469 | Gen/Dis Loss: 1.1109/0.5217
Time elapsed: 0.97 min
Epoch: 012/100 | Batch 000/469 | Gen/Dis Loss: 1.1307/0.5180
Epoch: 012/100 | Batch 100/469 | Gen/Dis Loss: 1.4518/0.5380
Epoch: 012/100 | Batch 200/469 | Gen/Dis Loss: 1.6226/0.5296
Epoch: 012/100 | Batch 300/469 | Gen/Dis Loss: 0.9031/0.5266
Epoch: 012/100 | Batch 400/469 | Gen/Dis Loss: 0.9476/0.5815
Time elapsed: 1.06 min
Epoch: 013/100 | Batch 000/469 | Gen/Dis Loss: 0.9416/0.5556
Epoch: 013/100 | Batch 100/469 | Gen/Dis Loss: 1.6634/0.5459
Epoch: 013/100 | Batch 200/469 | Gen/Dis Loss: 0.9941/0.5355
Epoch: 013/100 | Batch 300/469 | Gen/Dis Loss: 1.0218/0.5625
Epoch: 013/100 | Batch 400/469 | Gen/Dis Loss: 1.0345/0.5756
Time elapsed: 1.15 min
Epoch: 014/100 | Batch 000/469 | Gen/Dis Loss: 0.9894/0.5271
Epoch: 014/100 | Batch 100/469 | Gen/Dis Loss: 1.0857/0.5541
Epoch: 014/100 | Batch 200/469 | Gen/Dis Loss: 1.0663/0.5851
Epoch: 014/100 | Batch 300/469 | Gen/Dis Loss: 1.1364/0.5648
Epoch: 014/100 | Batch 400/469 | Gen/Dis Loss: 1.0376/0.5692
Time elapsed: 1.24 min
Epoch: 015/100 | Batch 000/469 | Gen/Dis Loss: 1.3200/0.4942
Epoch: 015/100 | Batch 100/469 | Gen/Dis Loss: 1.1608/0.4629
Epoch: 015/100 | Batch 200/469 | Gen/Dis Loss: 1.2447/0.5581
Epoch: 015/100 | Batch 300/469 | Gen/Dis Loss: 1.1400/0.5177
Epoch: 015/100 | Batch 400/469 | Gen/Dis Loss: 1.0401/0.5955
Time elapsed: 1.33 min
Epoch: 016/100 | Batch 000/469 | Gen/Dis Loss: 1.2955/0.5683
Epoch: 016/100 | Batch 100/469 | Gen/Dis Loss: 0.9906/0.5713
Epoch: 016/100 | Batch 200/469 | Gen/Dis Loss: 1.2129/0.5555
Epoch: 016/100 | Batch 300/469 | Gen/Dis Loss: 1.0657/0.5566
Epoch: 016/100 | Batch 400/469 | Gen/Dis Loss: 1.6042/0.4767
Time elapsed: 1.41 min
Epoch: 017/100 | Batch 000/469 | Gen/Dis Loss: 1.2473/0.5009
Epoch: 017/100 | Batch 100/469 | Gen/Dis Loss: 1.1337/0.5937
Epoch: 017/100 | Batch 200/469 | Gen/Dis Loss: 1.4959/0.5078
Epoch: 017/100 | Batch 300/469 | Gen/Dis Loss: 1.3999/0.5805
Epoch: 017/100 | Batch 400/469 | Gen/Dis Loss: 1.0728/0.5655
Time elapsed: 1.50 min
Epoch: 018/100 | Batch 000/469 | Gen/Dis Loss: 1.4441/0.5318
Epoch: 018/100 | Batch 100/469 | Gen/Dis Loss: 1.2731/0.5665
Epoch: 018/100 | Batch 200/469 | Gen/Dis Loss: 0.9451/0.6297
Epoch: 018/100 | Batch 300/469 | Gen/Dis Loss: 0.9998/0.5734
Epoch: 018/100 | Batch 400/469 | Gen/Dis Loss: 0.9852/0.5121
Time elapsed: 1.58 min
Epoch: 019/100 | Batch 000/469 | Gen/Dis Loss: 0.9326/0.5256
Epoch: 019/100 | Batch 100/469 | Gen/Dis Loss: 1.0495/0.6407
Epoch: 019/100 | Batch 200/469 | Gen/Dis Loss: 0.8813/0.5949
Epoch: 019/100 | Batch 300/469 | Gen/Dis Loss: 0.8739/0.5982
Epoch: 019/100 | Batch 400/469 | Gen/Dis Loss: 1.1865/0.5569
Time elapsed: 1.67 min
Epoch: 020/100 | Batch 000/469 | Gen/Dis Loss: 1.5574/0.5164
Epoch: 020/100 | Batch 100/469 | Gen/Dis Loss: 0.9700/0.5787
Epoch: 020/100 | Batch 200/469 | Gen/Dis Loss: 0.9381/0.5884
Epoch: 020/100 | Batch 300/469 | Gen/Dis Loss: 1.2750/0.6417
Epoch: 020/100 | Batch 400/469 | Gen/Dis Loss: 0.8350/0.5717
Time elapsed: 1.76 min
Epoch: 021/100 | Batch 000/469 | Gen/Dis Loss: 1.2552/0.5475
Epoch: 021/100 | Batch 100/469 | Gen/Dis Loss: 1.0940/0.5864
Epoch: 021/100 | Batch 200/469 | Gen/Dis Loss: 1.3474/0.5360
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Epoch: 021/100 | Batch 300/469 | Gen/Dis Loss: 0.7890/0.5978
Epoch: 021/100 | Batch 400/469 | Gen/Dis Loss: 0.9383/0.6133
Time elapsed: 1.85 min
Epoch: 022/100 | Batch 000/469 | Gen/Dis Loss: 0.9232/0.6130
Epoch: 022/100 | Batch 100/469 | Gen/Dis Loss: 0.9213/0.5562
Epoch: 022/100 | Batch 200/469 | Gen/Dis Loss: 0.8821/0.5966
Epoch: 022/100 | Batch 300/469 | Gen/Dis Loss: 0.9143/0.5510
Epoch: 022/100 | Batch 400/469 | Gen/Dis Loss: 1.0647/0.5351
Time elapsed: 1.94 min
Epoch: 023/100 | Batch 000/469 | Gen/Dis Loss: 1.1075/0.5709
Epoch: 023/100 | Batch 100/469 | Gen/Dis Loss: 1.0681/0.5701
Epoch: 023/100 | Batch 200/469 | Gen/Dis Loss: 0.9695/0.5782
Epoch: 023/100 | Batch 300/469 | Gen/Dis Loss: 0.9849/0.5996
Epoch: 023/100 | Batch 400/469 | Gen/Dis Loss: 0.8874/0.6046
Time elapsed: 2.03 min
Epoch: 024/100 | Batch 000/469 | Gen/Dis Loss: 0.9453/0.6154
Epoch: 024/100 | Batch 100/469 | Gen/Dis Loss: 0.8854/0.6081
Epoch: 024/100 | Batch 200/469 | Gen/Dis Loss: 0.9514/0.5845
Epoch: 024/100 | Batch 300/469 | Gen/Dis Loss: 0.9800/0.6073
Epoch: 024/100 | Batch 400/469 | Gen/Dis Loss: 1.0529/0.5704
Time elapsed: 2.12 min
Epoch: 025/100 | Batch 000/469 | Gen/Dis Loss: 1.2109/0.6237
Epoch: 025/100 | Batch 100/469 | Gen/Dis Loss: 1.1130/0.5865
Epoch: 025/100 | Batch 200/469 | Gen/Dis Loss: 0.8167/0.5928
Epoch: 025/100 | Batch 300/469 | Gen/Dis Loss: 1.0362/0.6054
Epoch: 025/100 | Batch 400/469 | Gen/Dis Loss: 1.2419/0.5580
Time elapsed: 2.20 min
Epoch: 026/100 | Batch 000/469 | Gen/Dis Loss: 1.2591/0.5490
Epoch: 026/100 | Batch 100/469 | Gen/Dis Loss: 0.8101/0.5763
Epoch: 026/100 | Batch 200/469 | Gen/Dis Loss: 1.0598/0.6228
Epoch: 026/100 | Batch 300/469 | Gen/Dis Loss: 0.9921/0.5895
Epoch: 026/100 | Batch 400/469 | Gen/Dis Loss: 1.1724/0.5854
Time elapsed: 2.29 min
Epoch: 027/100 | Batch 000/469 | Gen/Dis Loss: 0.9783/0.6028
Epoch: 027/100 | Batch 100/469 | Gen/Dis Loss: 1.2360/0.5824
Epoch: 027/100 | Batch 200/469 | Gen/Dis Loss: 1.1438/0.5258
Epoch: 027/100 | Batch 300/469 | Gen/Dis Loss: 0.9328/0.5753
Epoch: 027/100 | Batch 400/469 | Gen/Dis Loss: 1.3901/0.6223
Time elapsed: 2.37 min
Epoch: 028/100 | Batch 000/469 | Gen/Dis Loss: 1.2030/0.5923
Epoch: 028/100 | Batch 100/469 | Gen/Dis Loss: 1.0838/0.5508
Epoch: 028/100 | Batch 200/469 | Gen/Dis Loss: 0.8945/0.6258
Epoch: 028/100 | Batch 300/469 | Gen/Dis Loss: 1.0040/0.6038
Epoch: 028/100 | Batch 400/469 | Gen/Dis Loss: 0.9995/0.5538
Time elapsed: 2.46 min
Epoch: 029/100 | Batch 000/469 | Gen/Dis Loss: 0.9356/0.5555
Epoch: 029/100 | Batch 100/469 | Gen/Dis Loss: 0.9159/0.6177
Epoch: 029/100 | Batch 200/469 | Gen/Dis Loss: 0.8776/0.5921
Epoch: 029/100 | Batch 300/469 | Gen/Dis Loss: 0.9292/0.6128
Epoch: 029/100 | Batch 400/469 | Gen/Dis Loss: 1.0625/0.5865
Time elapsed: 2.55 min
Epoch: 030/100 | Batch 000/469 | Gen/Dis Loss: 0.9149/0.5868
Epoch: 030/100 | Batch 100/469 | Gen/Dis Loss: 0.7896/0.6441
Epoch: 030/100 | Batch 200/469 | Gen/Dis Loss: 0.9083/0.6442
Epoch: 030/100 | Batch 300/469 | Gen/Dis Loss: 0.8816/0.6167
Epoch: 030/100 | Batch 400/469 | Gen/Dis Loss: 0.9874/0.6342
Time elapsed: 2.63 min
Epoch: 031/100 | Batch 000/469 | Gen/Dis Loss: 0.7510/0.6121
Epoch: 031/100 | Batch 100/469 | Gen/Dis Loss: 1.0223/0.5842
Epoch: 031/100 | Batch 200/469 | Gen/Dis Loss: 0.8745/0.6209
Epoch: 031/100 | Batch 300/469 | Gen/Dis Loss: 0.8519/0.6311
Epoch: 031/100 | Batch 400/469 | Gen/Dis Loss: 0.9447/0.6085
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Time elapsed: 2.73 min
Epoch: 032/100 | Batch 000/469 | Gen/Dis Loss: 0.9478/0.6130
Epoch: 032/100 | Batch 100/469 | Gen/Dis Loss: 0.8713/0.6240
Epoch: 032/100 | Batch 200/469 | Gen/Dis Loss: 0.9425/0.6559
Epoch: 032/100 | Batch 300/469 | Gen/Dis Loss: 1.0483/0.5821
Epoch: 032/100 | Batch 400/469 | Gen/Dis Loss: 0.8854/0.6366
Time elapsed: 2.81 min
Epoch: 033/100 | Batch 000/469 | Gen/Dis Loss: 0.8094/0.6054
Epoch: 033/100 | Batch 100/469 | Gen/Dis Loss: 1.0816/0.5862
Epoch: 033/100 | Batch 200/469 | Gen/Dis Loss: 0.7969/0.6428
Epoch: 033/100 | Batch 300/469 | Gen/Dis Loss: 0.7696/0.6088
Epoch: 033/100 | Batch 400/469 | Gen/Dis Loss: 0.7928/0.6633
Time elapsed: 2.90 min
Epoch: 034/100 | Batch 000/469 | Gen/Dis Loss: 0.9060/0.5681
Epoch: 034/100 | Batch 100/469 | Gen/Dis Loss: 1.1241/0.6482
Epoch: 034/100 | Batch 200/469 | Gen/Dis Loss: 1.0308/0.5708
Epoch: 034/100 | Batch 300/469 | Gen/Dis Loss: 0.9607/0.6549
Epoch: 034/100 | Batch 400/469 | Gen/Dis Loss: 0.9535/0.5813
Time elapsed: 2.98 min
Epoch: 035/100 | Batch 000/469 | Gen/Dis Loss: 0.8247/0.6125
Epoch: 035/100 | Batch 100/469 | Gen/Dis Loss: 0.9917/0.5842
Epoch: 035/100 | Batch 200/469 | Gen/Dis Loss: 0.8571/0.6176
Epoch: 035/100 | Batch 300/469 | Gen/Dis Loss: 0.8443/0.6025
Epoch: 035/100 | Batch 400/469 | Gen/Dis Loss: 1.2219/0.5640
Time elapsed: 3.07 min
Epoch: 036/100 | Batch 000/469 | Gen/Dis Loss: 0.9200/0.6090
Epoch: 036/100 | Batch 100/469 | Gen/Dis Loss: 0.8992/0.5988
Epoch: 036/100 | Batch 200/469 | Gen/Dis Loss: 0.8484/0.6144
Epoch: 036/100 | Batch 300/469 | Gen/Dis Loss: 0.9346/0.6124
Epoch: 036/100 | Batch 400/469 | Gen/Dis Loss: 0.7757/0.6365
Time elapsed: 3.16 min
Epoch: 037/100 | Batch 000/469 | Gen/Dis Loss: 1.0447/0.6249
Epoch: 037/100 | Batch 100/469 | Gen/Dis Loss: 0.8899/0.6298
Epoch: 037/100 | Batch 200/469 | Gen/Dis Loss: 1.0798/0.5282
Epoch: 037/100 | Batch 300/469 | Gen/Dis Loss: 0.9852/0.6192
Epoch: 037/100 | Batch 400/469 | Gen/Dis Loss: 1.1938/0.6186
Time elapsed: 3.24 min
Epoch: 038/100 | Batch 000/469 | Gen/Dis Loss: 0.8325/0.6308
Epoch: 038/100 | Batch 100/469 | Gen/Dis Loss: 0.9320/0.6167
Epoch: 038/100 | Batch 200/469 | Gen/Dis Loss: 0.8564/0.6194
Epoch: 038/100 | Batch 300/469 | Gen/Dis Loss: 0.9858/0.5833
Epoch: 038/100 | Batch 400/469 | Gen/Dis Loss: 1.1408/0.5897
Time elapsed: 3.33 min
Epoch: 039/100 | Batch 000/469 | Gen/Dis Loss: 0.8454/0.5874
Epoch: 039/100 | Batch 100/469 | Gen/Dis Loss: 1.0083/0.6298
Epoch: 039/100 | Batch 200/469 | Gen/Dis Loss: 0.8235/0.6495
Epoch: 039/100 | Batch 300/469 | Gen/Dis Loss: 0.9518/0.6171
Epoch: 039/100 | Batch 400/469 | Gen/Dis Loss: 0.9896/0.6337
Time elapsed: 3.42 min
Epoch: 040/100 | Batch 000/469 | Gen/Dis Loss: 0.9212/0.6542
Epoch: 040/100 | Batch 100/469 | Gen/Dis Loss: 0.8324/0.6058
Epoch: 040/100 | Batch 200/469 | Gen/Dis Loss: 0.8437/0.6280
Epoch: 040/100 | Batch 300/469 | Gen/Dis Loss: 0.8440/0.6300
Epoch: 040/100 | Batch 400/469 | Gen/Dis Loss: 0.8274/0.6696
Time elapsed: 3.51 min
Epoch: 041/100 | Batch 000/469 | Gen/Dis Loss: 0.8642/0.6094
Epoch: 041/100 | Batch 100/469 | Gen/Dis Loss: 1.1372/0.5768
Epoch: 041/100 | Batch 200/469 | Gen/Dis Loss: 1.1628/0.5671
Epoch: 041/100 | Batch 300/469 | Gen/Dis Loss: 0.9350/0.6594
Epoch: 041/100 | Batch 400/469 | Gen/Dis Loss: 0.9146/0.5873
Time elapsed: 3.59 min
Epoch: 042/100 | Batch 000/469 | Gen/Dis Loss: 1.0306/0.6447
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Epoch: 042/100 | Batch 100/469 | Gen/Dis Loss: 0.8554/0.6375
Epoch: 042/100 | Batch 200/469 | Gen/Dis Loss: 0.8252/0.6099
Epoch: 042/100 | Batch 300/469 | Gen/Dis Loss: 1.0373/0.5731
Epoch: 042/100 | Batch 400/469 | Gen/Dis Loss: 0.8100/0.6324
Time elapsed: 3.68 min
Epoch: 043/100 | Batch 000/469 | Gen/Dis Loss: 0.9739/0.6205
Epoch: 043/100 | Batch 100/469 | Gen/Dis Loss: 0.9901/0.5925
Epoch: 043/100 | Batch 200/469 | Gen/Dis Loss: 1.1854/0.6172
Epoch: 043/100 | Batch 300/469 | Gen/Dis Loss: 1.0765/0.5754
Epoch: 043/100 | Batch 400/469 | Gen/Dis Loss: 0.9156/0.5969
Time elapsed: 3.76 min
Epoch: 044/100 | Batch 000/469 | Gen/Dis Loss: 0.9099/0.6359
Epoch: 044/100 | Batch 100/469 | Gen/Dis Loss: 0.9124/0.6241
Epoch: 044/100 | Batch 200/469 | Gen/Dis Loss: 0.8947/0.6377
Epoch: 044/100 | Batch 300/469 | Gen/Dis Loss: 0.8843/0.6369
Epoch: 044/100 | Batch 400/469 | Gen/Dis Loss: 0.7317/0.5879
Time elapsed: 3.85 min
Epoch: 045/100 | Batch 000/469 | Gen/Dis Loss: 0.9129/0.6397
Epoch: 045/100 | Batch 100/469 | Gen/Dis Loss: 0.9024/0.6064
Epoch: 045/100 | Batch 200/469 | Gen/Dis Loss: 0.8122/0.6065
Epoch: 045/100 | Batch 300/469 | Gen/Dis Loss: 0.9572/0.6533
Epoch: 045/100 | Batch 400/469 | Gen/Dis Loss: 0.9229/0.6343
Time elapsed: 3.94 min
Epoch: 046/100 | Batch 000/469 | Gen/Dis Loss: 1.3215/0.6195
Epoch: 046/100 | Batch 100/469 | Gen/Dis Loss: 0.8524/0.6438
Epoch: 046/100 | Batch 200/469 | Gen/Dis Loss: 0.7778/0.6630
Epoch: 046/100 | Batch 300/469 | Gen/Dis Loss: 0.8403/0.6301
Epoch: 046/100 | Batch 400/469 | Gen/Dis Loss: 1.1085/0.6267
Time elapsed: 4.03 min
Epoch: 047/100 | Batch 000/469 | Gen/Dis Loss: 0.8875/0.6480
Epoch: 047/100 | Batch 100/469 | Gen/Dis Loss: 0.8462/0.6335
Epoch: 047/100 | Batch 200/469 | Gen/Dis Loss: 0.7980/0.6669
Epoch: 047/100 | Batch 300/469 | Gen/Dis Loss: 0.7420/0.6426
Epoch: 047/100 | Batch 400/469 | Gen/Dis Loss: 1.0467/0.6882
Time elapsed: 4.12 min
Epoch: 048/100 | Batch 000/469 | Gen/Dis Loss: 0.8108/0.6306
Epoch: 048/100 | Batch 100/469 | Gen/Dis Loss: 0.7835/0.6608
Epoch: 048/100 | Batch 200/469 | Gen/Dis Loss: 0.9552/0.5932
Epoch: 048/100 | Batch 300/469 | Gen/Dis Loss: 0.8113/0.6572
Epoch: 048/100 | Batch 400/469 | Gen/Dis Loss: 0.8986/0.6463
Time elapsed: 4.20 min
Epoch: 049/100 | Batch 000/469 | Gen/Dis Loss: 0.9569/0.6153
Epoch: 049/100 | Batch 100/469 | Gen/Dis Loss: 0.7994/0.6203
Epoch: 049/100 | Batch 200/469 | Gen/Dis Loss: 0.8854/0.6264
Epoch: 049/100 | Batch 300/469 | Gen/Dis Loss: 0.8802/0.5987
Epoch: 049/100 | Batch 400/469 | Gen/Dis Loss: 0.7673/0.6361
Time elapsed: 4.29 min
Epoch: 050/100 | Batch 000/469 | Gen/Dis Loss: 0.8474/0.6634
Epoch: 050/100 | Batch 100/469 | Gen/Dis Loss: 0.7327/0.6261
Epoch: 050/100 | Batch 200/469 | Gen/Dis Loss: 0.9541/0.6045
Epoch: 050/100 | Batch 300/469 | Gen/Dis Loss: 0.8578/0.6096
Epoch: 050/100 | Batch 400/469 | Gen/Dis Loss: 0.9576/0.5976
Time elapsed: 4.38 min
Epoch: 051/100 | Batch 000/469 | Gen/Dis Loss: 0.9268/0.6523
Epoch: 051/100 | Batch 100/469 | Gen/Dis Loss: 0.8399/0.6491
Epoch: 051/100 | Batch 200/469 | Gen/Dis Loss: 0.9618/0.6050
Epoch: 051/100 | Batch 300/469 | Gen/Dis Loss: 0.7919/0.6521
Epoch: 051/100 | Batch 400/469 | Gen/Dis Loss: 0.8610/0.6683
Time elapsed: 4.46 min
Epoch: 052/100 | Batch 000/469 | Gen/Dis Loss: 1.0119/0.5984
Epoch: 052/100 | Batch 100/469 | Gen/Dis Loss: 0.8073/0.6741
Epoch: 052/100 | Batch 200/469 | Gen/Dis Loss: 0.8356/0.6117
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Epoch: 052/100 | Batch 300/469 | Gen/Dis Loss: 0.8816/0.6303
Epoch: 052/100 | Batch 400/469 | Gen/Dis Loss: 0.8657/0.5977
Time elapsed: 4.55 min
Epoch: 053/100 | Batch 000/469 | Gen/Dis Loss: 0.9065/0.6457
Epoch: 053/100 | Batch 100/469 | Gen/Dis Loss: 0.8219/0.6204
Epoch: 053/100 | Batch 200/469 | Gen/Dis Loss: 0.8587/0.6579
Epoch: 053/100 | Batch 300/469 | Gen/Dis Loss: 0.7968/0.6201
Epoch: 053/100 | Batch 400/469 | Gen/Dis Loss: 0.8750/0.6269
Time elapsed: 4.64 min
Epoch: 054/100 | Batch 000/469 | Gen/Dis Loss: 0.9697/0.6202
Epoch: 054/100 | Batch 100/469 | Gen/Dis Loss: 0.8059/0.6356
Epoch: 054/100 | Batch 200/469 | Gen/Dis Loss: 0.8941/0.6170
Epoch: 054/100 | Batch 300/469 | Gen/Dis Loss: 0.8584/0.6432
Epoch: 054/100 | Batch 400/469 | Gen/Dis Loss: 0.8637/0.5984
Time elapsed: 4.73 min
Epoch: 055/100 | Batch 000/469 | Gen/Dis Loss: 0.7673/0.7025
Epoch: 055/100 | Batch 100/469 | Gen/Dis Loss: 0.8800/0.6274
Epoch: 055/100 | Batch 200/469 | Gen/Dis Loss: 0.8458/0.6837
Epoch: 055/100 | Batch 300/469 | Gen/Dis Loss: 0.9717/0.5960
Epoch: 055/100 | Batch 400/469 | Gen/Dis Loss: 0.9977/0.5905
Time elapsed: 4.82 min
Epoch: 056/100 | Batch 000/469 | Gen/Dis Loss: 1.0271/0.5949
Epoch: 056/100 | Batch 100/469 | Gen/Dis Loss: 0.8294/0.6609
Epoch: 056/100 | Batch 200/469 | Gen/Dis Loss: 0.8726/0.6242
Epoch: 056/100 | Batch 300/469 | Gen/Dis Loss: 0.8135/0.6417
Epoch: 056/100 | Batch 400/469 | Gen/Dis Loss: 0.8715/0.6237
Time elapsed: 4.90 min
Epoch: 057/100 | Batch 000/469 | Gen/Dis Loss: 0.8463/0.6509
Epoch: 057/100 | Batch 100/469 | Gen/Dis Loss: 1.0144/0.6169
Epoch: 057/100 | Batch 200/469 | Gen/Dis Loss: 0.8913/0.6354
Epoch: 057/100 | Batch 300/469 | Gen/Dis Loss: 0.9376/0.6321
Epoch: 057/100 | Batch 400/469 | Gen/Dis Loss: 0.7949/0.6657
Time elapsed: 4.99 min
Epoch: 058/100 | Batch 000/469 | Gen/Dis Loss: 0.8119/0.6179
Epoch: 058/100 | Batch 100/469 | Gen/Dis Loss: 1.0457/0.5894
Epoch: 058/100 | Batch 200/469 | Gen/Dis Loss: 0.9231/0.6434
Epoch: 058/100 | Batch 300/469 | Gen/Dis Loss: 0.7279/0.6438
Epoch: 058/100 | Batch 400/469 | Gen/Dis Loss: 0.8279/0.6232
Time elapsed: 5.08 min
Epoch: 059/100 | Batch 000/469 | Gen/Dis Loss: 0.8513/0.6530
Epoch: 059/100 | Batch 100/469 | Gen/Dis Loss: 0.9106/0.6225
Epoch: 059/100 | Batch 200/469 | Gen/Dis Loss: 0.7841/0.6518
Epoch: 059/100 | Batch 300/469 | Gen/Dis Loss: 0.9627/0.5944
Epoch: 059/100 | Batch 400/469 | Gen/Dis Loss: 0.8372/0.6232
Time elapsed: 5.16 min
Epoch: 060/100 | Batch 000/469 | Gen/Dis Loss: 0.8089/0.6566
Epoch: 060/100 | Batch 100/469 | Gen/Dis Loss: 0.7873/0.6501
Epoch: 060/100 | Batch 200/469 | Gen/Dis Loss: 0.8971/0.6350
Epoch: 060/100 | Batch 300/469 | Gen/Dis Loss: 0.7374/0.6274
Epoch: 060/100 | Batch 400/469 | Gen/Dis Loss: 0.6772/0.6876
Time elapsed: 5.25 min
Epoch: 061/100 | Batch 000/469 | Gen/Dis Loss: 0.9642/0.6006
Epoch: 061/100 | Batch 100/469 | Gen/Dis Loss: 0.9109/0.6079
Epoch: 061/100 | Batch 200/469 | Gen/Dis Loss: 0.9486/0.6078
Epoch: 061/100 | Batch 300/469 | Gen/Dis Loss: 0.7939/0.6411
Epoch: 061/100 | Batch 400/469 | Gen/Dis Loss: 0.8950/0.6419
Time elapsed: 5.34 min
Epoch: 062/100 | Batch 000/469 | Gen/Dis Loss: 0.9492/0.6528
Epoch: 062/100 | Batch 100/469 | Gen/Dis Loss: 0.9092/0.6584
Epoch: 062/100 | Batch 200/469 | Gen/Dis Loss: 0.8786/0.6197
Epoch: 062/100 | Batch 300/469 | Gen/Dis Loss: 0.8437/0.6369
Epoch: 062/100 | Batch 400/469 | Gen/Dis Loss: 0.7490/0.6112
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Time elapsed: 5.42 min
Epoch: 063/100 | Batch 000/469 | Gen/Dis Loss: 0.9029/0.6150
Epoch: 063/100 | Batch 100/469 | Gen/Dis Loss: 0.8646/0.6518
Epoch: 063/100 | Batch 200/469 | Gen/Dis Loss: 0.8722/0.6209
Epoch: 063/100 | Batch 300/469 | Gen/Dis Loss: 0.8468/0.6139
Epoch: 063/100 | Batch 400/469 | Gen/Dis Loss: 0.7780/0.6629
Time elapsed: 5.51 min
Epoch: 064/100 | Batch 000/469 | Gen/Dis Loss: 0.8703/0.5961
Epoch: 064/100 | Batch 100/469 | Gen/Dis Loss: 0.9127/0.6190
Epoch: 064/100 | Batch 200/469 | Gen/Dis Loss: 0.8037/0.6146
Epoch: 064/100 | Batch 300/469 | Gen/Dis Loss: 0.8224/0.6124
Epoch: 064/100 | Batch 400/469 | Gen/Dis Loss: 0.9294/0.6242
Time elapsed: 5.60 min
Epoch: 065/100 | Batch 000/469 | Gen/Dis Loss: 0.8989/0.6325
Epoch: 065/100 | Batch 100/469 | Gen/Dis Loss: 0.7881/0.6156
Epoch: 065/100 | Batch 200/469 | Gen/Dis Loss: 0.9018/0.6275
Epoch: 065/100 | Batch 300/469 | Gen/Dis Loss: 0.8342/0.6387
Epoch: 065/100 | Batch 400/469 | Gen/Dis Loss: 0.8167/0.6568
Time elapsed: 5.69 min
Epoch: 066/100 | Batch 000/469 | Gen/Dis Loss: 0.7153/0.6189
Epoch: 066/100 | Batch 100/469 | Gen/Dis Loss: 0.8718/0.6276
Epoch: 066/100 | Batch 200/469 | Gen/Dis Loss: 0.8546/0.6527
Epoch: 066/100 | Batch 300/469 | Gen/Dis Loss: 0.8180/0.6337
Epoch: 066/100 | Batch 400/469 | Gen/Dis Loss: 0.8106/0.6181
Time elapsed: 5.77 min
Epoch: 067/100 | Batch 000/469 | Gen/Dis Loss: 0.8810/0.6176
Epoch: 067/100 | Batch 100/469 | Gen/Dis Loss: 1.1144/0.6387
Epoch: 067/100 | Batch 200/469 | Gen/Dis Loss: 0.8922/0.6545
Epoch: 067/100 | Batch 300/469 | Gen/Dis Loss: 0.9796/0.6039
Epoch: 067/100 | Batch 400/469 | Gen/Dis Loss: 1.0691/0.6673
Time elapsed: 5.86 min
Epoch: 068/100 | Batch 000/469 | Gen/Dis Loss: 0.8455/0.6181
Epoch: 068/100 | Batch 100/469 | Gen/Dis Loss: 0.9766/0.6224
Epoch: 068/100 | Batch 200/469 | Gen/Dis Loss: 0.8641/0.6654
Epoch: 068/100 | Batch 300/469 | Gen/Dis Loss: 0.9225/0.6410
Epoch: 068/100 | Batch 400/469 | Gen/Dis Loss: 0.8744/0.6288
Time elapsed: 5.94 min
Epoch: 069/100 | Batch 000/469 | Gen/Dis Loss: 0.9510/0.5931
Epoch: 069/100 | Batch 100/469 | Gen/Dis Loss: 0.9274/0.6100
Epoch: 069/100 | Batch 200/469 | Gen/Dis Loss: 0.8389/0.6232
Epoch: 069/100 | Batch 300/469 | Gen/Dis Loss: 0.8762/0.6398
Epoch: 069/100 | Batch 400/469 | Gen/Dis Loss: 0.8198/0.6521
Time elapsed: 6.03 min
Epoch: 070/100 | Batch 000/469 | Gen/Dis Loss: 0.9873/0.6260
Epoch: 070/100 | Batch 100/469 | Gen/Dis Loss: 0.7948/0.6452
Epoch: 070/100 | Batch 200/469 | Gen/Dis Loss: 0.8145/0.6458
Epoch: 070/100 | Batch 300/469 | Gen/Dis Loss: 0.8275/0.6243
Epoch: 070/100 | Batch 400/469 | Gen/Dis Loss: 0.9175/0.6478
Time elapsed: 6.12 min
Epoch: 071/100 | Batch 000/469 | Gen/Dis Loss: 0.9080/0.6716
Epoch: 071/100 | Batch 100/469 | Gen/Dis Loss: 0.8694/0.6156
Epoch: 071/100 | Batch 200/469 | Gen/Dis Loss: 0.8456/0.6358
Epoch: 071/100 | Batch 300/469 | Gen/Dis Loss: 1.0416/0.5617
Epoch: 071/100 | Batch 400/469 | Gen/Dis Loss: 0.7391/0.6233
Time elapsed: 6.21 min
Epoch: 072/100 | Batch 000/469 | Gen/Dis Loss: 0.9647/0.6066
Epoch: 072/100 | Batch 100/469 | Gen/Dis Loss: 0.9778/0.6460
Epoch: 072/100 | Batch 200/469 | Gen/Dis Loss: 0.8921/0.6369
Epoch: 072/100 | Batch 300/469 | Gen/Dis Loss: 0.7634/0.6266
Epoch: 072/100 | Batch 400/469 | Gen/Dis Loss: 1.1134/0.6701
Time elapsed: 6.30 min
Epoch: 073/100 | Batch 000/469 | Gen/Dis Loss: 0.7203/0.6641
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Epoch: 073/100 | Batch 100/469 | Gen/Dis Loss: 0.7475/0.6355
Epoch: 073/100 | Batch 200/469 | Gen/Dis Loss: 0.9039/0.6122
Epoch: 073/100 | Batch 300/469 | Gen/Dis Loss: 0.8807/0.6421
Epoch: 073/100 | Batch 400/469 | Gen/Dis Loss: 0.9272/0.5923
Time elapsed: 6.38 min
Epoch: 074/100 | Batch 000/469 | Gen/Dis Loss: 0.8599/0.5997
Epoch: 074/100 | Batch 100/469 | Gen/Dis Loss: 0.8854/0.6253
Epoch: 074/100 | Batch 200/469 | Gen/Dis Loss: 1.0078/0.6013
Epoch: 074/100 | Batch 300/469 | Gen/Dis Loss: 1.0913/0.6005
Epoch: 074/100 | Batch 400/469 | Gen/Dis Loss: 0.8361/0.6705
Time elapsed: 6.47 min
Epoch: 075/100 | Batch 000/469 | Gen/Dis Loss: 1.0325/0.6311
Epoch: 075/100 | Batch 100/469 | Gen/Dis Loss: 0.9071/0.6339
Epoch: 075/100 | Batch 200/469 | Gen/Dis Loss: 1.1822/0.6435
Epoch: 075/100 | Batch 300/469 | Gen/Dis Loss: 0.7851/0.6614
Epoch: 075/100 | Batch 400/469 | Gen/Dis Loss: 0.8338/0.6040
Time elapsed: 6.56 min
Epoch: 076/100 | Batch 000/469 | Gen/Dis Loss: 0.8390/0.6372
Epoch: 076/100 | Batch 100/469 | Gen/Dis Loss: 0.8929/0.6349
Epoch: 076/100 | Batch 200/469 | Gen/Dis Loss: 0.8291/0.6294
Epoch: 076/100 | Batch 300/469 | Gen/Dis Loss: 0.8534/0.6359
Epoch: 076/100 | Batch 400/469 | Gen/Dis Loss: 0.8899/0.6507
Time elapsed: 6.65 min
Epoch: 077/100 | Batch 000/469 | Gen/Dis Loss: 0.9207/0.6244
Epoch: 077/100 | Batch 100/469 | Gen/Dis Loss: 0.7412/0.6695
Epoch: 077/100 | Batch 200/469 | Gen/Dis Loss: 0.8025/0.6298
Epoch: 077/100 | Batch 300/469 | Gen/Dis Loss: 0.7706/0.6377
Epoch: 077/100 | Batch 400/469 | Gen/Dis Loss: 0.8374/0.6331
Time elapsed: 6.74 min
Epoch: 078/100 | Batch 000/469 | Gen/Dis Loss: 0.9790/0.6710
Epoch: 078/100 | Batch 100/469 | Gen/Dis Loss: 0.8205/0.6408
Epoch: 078/100 | Batch 200/469 | Gen/Dis Loss: 0.8921/0.6359
Epoch: 078/100 | Batch 300/469 | Gen/Dis Loss: 0.9558/0.6105
Epoch: 078/100 | Batch 400/469 | Gen/Dis Loss: 0.9470/0.6258
Time elapsed: 6.82 min
Epoch: 079/100 | Batch 000/469 | Gen/Dis Loss: 0.8768/0.6115
Epoch: 079/100 | Batch 100/469 | Gen/Dis Loss: 0.8024/0.6348
Epoch: 079/100 | Batch 200/469 | Gen/Dis Loss: 0.9502/0.5544
Epoch: 079/100 | Batch 300/469 | Gen/Dis Loss: 1.1550/0.6058
Epoch: 079/100 | Batch 400/469 | Gen/Dis Loss: 0.9138/0.6231
Time elapsed: 6.91 min
Epoch: 080/100 | Batch 000/469 | Gen/Dis Loss: 0.8440/0.6307
Epoch: 080/100 | Batch 100/469 | Gen/Dis Loss: 0.9261/0.6452
Epoch: 080/100 | Batch 200/469 | Gen/Dis Loss: 0.9168/0.6294
Epoch: 080/100 | Batch 300/469 | Gen/Dis Loss: 0.8834/0.6092
Epoch: 080/100 | Batch 400/469 | Gen/Dis Loss: 0.8143/0.6235
Time elapsed: 7.00 min
Epoch: 081/100 | Batch 000/469 | Gen/Dis Loss: 0.9698/0.5884
Epoch: 081/100 | Batch 100/469 | Gen/Dis Loss: 0.8811/0.6386
Epoch: 081/100 | Batch 200/469 | Gen/Dis Loss: 0.9398/0.6287
Epoch: 081/100 | Batch 300/469 | Gen/Dis Loss: 0.8443/0.6017
Epoch: 081/100 | Batch 400/469 | Gen/Dis Loss: 0.8314/0.6420
Time elapsed: 7.09 min
Epoch: 082/100 | Batch 000/469 | Gen/Dis Loss: 0.8221/0.6155
Epoch: 082/100 | Batch 100/469 | Gen/Dis Loss: 1.0019/0.6121
Epoch: 082/100 | Batch 200/469 | Gen/Dis Loss: 0.8966/0.6221
Epoch: 082/100 | Batch 300/469 | Gen/Dis Loss: 0.9131/0.6309
Epoch: 082/100 | Batch 400/469 | Gen/Dis Loss: 0.7911/0.6243
Time elapsed: 7.18 min
Epoch: 083/100 | Batch 000/469 | Gen/Dis Loss: 0.9284/0.6215
Epoch: 083/100 | Batch 100/469 | Gen/Dis Loss: 0.7478/0.6615
Epoch: 083/100 | Batch 200/469 | Gen/Dis Loss: 0.8304/0.6414
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Epoch: 083/100 | Batch 300/469 | Gen/Dis Loss: 1.0367/0.5819
Epoch: 083/100 | Batch 400/469 | Gen/Dis Loss: 0.8655/0.6473
Time elapsed: 7.27 min
Epoch: 084/100 | Batch 000/469 | Gen/Dis Loss: 0.8738/0.6311
Epoch: 084/100 | Batch 100/469 | Gen/Dis Loss: 1.0368/0.5684
Epoch: 084/100 | Batch 200/469 | Gen/Dis Loss: 0.8352/0.6317
Epoch: 084/100 | Batch 300/469 | Gen/Dis Loss: 0.8861/0.6446
Epoch: 084/100 | Batch 400/469 | Gen/Dis Loss: 0.9369/0.6121
Time elapsed: 7.35 min
Epoch: 085/100 | Batch 000/469 | Gen/Dis Loss: 0.7131/0.6882
Epoch: 085/100 | Batch 100/469 | Gen/Dis Loss: 0.8630/0.6272
Epoch: 085/100 | Batch 200/469 | Gen/Dis Loss: 0.8158/0.6473
Epoch: 085/100 | Batch 300/469 | Gen/Dis Loss: 1.0636/0.5883
Epoch: 085/100 | Batch 400/469 | Gen/Dis Loss: 1.1485/0.5923
Time elapsed: 7.44 min
Epoch: 086/100 | Batch 000/469 | Gen/Dis Loss: 0.8108/0.6370
Epoch: 086/100 | Batch 100/469 | Gen/Dis Loss: 0.8512/0.6377
Epoch: 086/100 | Batch 200/469 | Gen/Dis Loss: 1.0646/0.6677
Epoch: 086/100 | Batch 300/469 | Gen/Dis Loss: 0.9786/0.6736
Epoch: 086/100 | Batch 400/469 | Gen/Dis Loss: 0.8244/0.6285
Time elapsed: 7.53 min
Epoch: 087/100 | Batch 000/469 | Gen/Dis Loss: 0.7447/0.6344
Epoch: 087/100 | Batch 100/469 | Gen/Dis Loss: 0.7752/0.6415
Epoch: 087/100 | Batch 200/469 | Gen/Dis Loss: 0.9159/0.6323
Epoch: 087/100 | Batch 300/469 | Gen/Dis Loss: 0.8834/0.6400
Epoch: 087/100 | Batch 400/469 | Gen/Dis Loss: 0.9746/0.5697
Time elapsed: 7.62 min
Epoch: 088/100 | Batch 000/469 | Gen/Dis Loss: 0.7899/0.6556
Epoch: 088/100 | Batch 100/469 | Gen/Dis Loss: 0.7880/0.6393
Epoch: 088/100 | Batch 200/469 | Gen/Dis Loss: 0.8724/0.6435
Epoch: 088/100 | Batch 300/469 | Gen/Dis Loss: 0.8225/0.6316
Epoch: 088/100 | Batch 400/469 | Gen/Dis Loss: 0.9227/0.6362
Time elapsed: 7.71 min
Epoch: 089/100 | Batch 000/469 | Gen/Dis Loss: 0.8907/0.6332
Epoch: 089/100 | Batch 100/469 | Gen/Dis Loss: 0.8442/0.6071
Epoch: 089/100 | Batch 200/469 | Gen/Dis Loss: 0.8986/0.6613
Epoch: 089/100 | Batch 300/469 | Gen/Dis Loss: 1.1025/0.6052
Epoch: 089/100 | Batch 400/469 | Gen/Dis Loss: 0.8887/0.6450
Time elapsed: 7.81 min
Epoch: 090/100 | Batch 000/469 | Gen/Dis Loss: 0.8239/0.6512
Epoch: 090/100 | Batch 100/469 | Gen/Dis Loss: 1.0216/0.6502
Epoch: 090/100 | Batch 200/469 | Gen/Dis Loss: 0.8250/0.6008
Epoch: 090/100 | Batch 300/469 | Gen/Dis Loss: 0.9151/0.6527
Epoch: 090/100 | Batch 400/469 | Gen/Dis Loss: 0.9196/0.6467
Time elapsed: 7.89 min
Epoch: 091/100 | Batch 000/469 | Gen/Dis Loss: 0.7834/0.6694
Epoch: 091/100 | Batch 100/469 | Gen/Dis Loss: 0.8458/0.6921
Epoch: 091/100 | Batch 200/469 | Gen/Dis Loss: 0.8765/0.6427
Epoch: 091/100 | Batch 300/469 | Gen/Dis Loss: 0.8419/0.6266
Epoch: 091/100 | Batch 400/469 | Gen/Dis Loss: 0.8396/0.6674
Time elapsed: 7.98 min
Epoch: 092/100 | Batch 000/469 | Gen/Dis Loss: 1.1049/0.6195
Epoch: 092/100 | Batch 100/469 | Gen/Dis Loss: 0.7207/0.6846
Epoch: 092/100 | Batch 200/469 | Gen/Dis Loss: 0.6787/0.6221
Epoch: 092/100 | Batch 300/469 | Gen/Dis Loss: 1.0711/0.6425
Epoch: 092/100 | Batch 400/469 | Gen/Dis Loss: 0.8250/0.6337
Time elapsed: 8.07 min
Epoch: 093/100 | Batch 000/469 | Gen/Dis Loss: 1.2840/0.6265
Epoch: 093/100 | Batch 100/469 | Gen/Dis Loss: 0.8397/0.6228
Epoch: 093/100 | Batch 200/469 | Gen/Dis Loss: 0.8214/0.6540
Epoch: 093/100 | Batch 300/469 | Gen/Dis Loss: 0.8660/0.6223
Epoch: 093/100 | Batch 400/469 | Gen/Dis Loss: 0.8083/0.6722
```

```
Time elapsed: 8.15 min
Epoch: 094/100 | Batch 000/469 | Gen/Dis Loss: 0.8851/0.6370
Epoch: 094/100 | Batch 100/469 | Gen/Dis Loss: 0.7380/0.6493
Epoch: 094/100 | Batch 200/469 | Gen/Dis Loss: 1.1825/0.6019
Epoch: 094/100 | Batch 300/469 | Gen/Dis Loss: 0.9712/0.6244
Epoch: 094/100 | Batch 400/469 | Gen/Dis Loss: 0.7888/0.6325
Time elapsed: 8.25 min
Epoch: 095/100 | Batch 000/469 | Gen/Dis Loss: 0.9225/0.6295
Epoch: 095/100 | Batch 100/469 | Gen/Dis Loss: 0.8656/0.6453
Epoch: 095/100 | Batch 200/469 | Gen/Dis Loss: 0.8676/0.6559
Epoch: 095/100 | Batch 300/469 | Gen/Dis Loss: 0.8579/0.6419
Epoch: 095/100 | Batch 400/469 | Gen/Dis Loss: 0.9331/0.6338
Time elapsed: 8.34 min
Epoch: 096/100 | Batch 000/469 | Gen/Dis Loss: 0.8661/0.6386
Epoch: 096/100 | Batch 100/469 | Gen/Dis Loss: 0.8072/0.6355
Epoch: 096/100 | Batch 200/469 | Gen/Dis Loss: 0.9638/0.6579
Epoch: 096/100 | Batch 300/469 | Gen/Dis Loss: 0.8895/0.6260
Epoch: 096/100 | Batch 400/469 | Gen/Dis Loss: 0.9571/0.6612
Time elapsed: 8.43 min
Epoch: 097/100 | Batch 000/469 | Gen/Dis Loss: 0.8328/0.5930
Epoch: 097/100 | Batch 100/469 | Gen/Dis Loss: 0.8220/0.6272
Epoch: 097/100 | Batch 200/469 | Gen/Dis Loss: 0.8136/0.6450
Epoch: 097/100 | Batch 300/469 | Gen/Dis Loss: 0.8624/0.6322
Epoch: 097/100 | Batch 400/469 | Gen/Dis Loss: 1.0491/0.6029
Time elapsed: 8.53 min
Epoch: 098/100 | Batch 000/469 | Gen/Dis Loss: 0.8542/0.6765
Epoch: 098/100 | Batch 100/469 | Gen/Dis Loss: 0.9414/0.6403
Epoch: 098/100 | Batch 200/469 | Gen/Dis Loss: 0.7404/0.6375
Epoch: 098/100 | Batch 300/469 | Gen/Dis Loss: 0.8368/0.6414
Epoch: 098/100 | Batch 400/469 | Gen/Dis Loss: 0.7687/0.6304
Time elapsed: 8.61 min
Epoch: 099/100 | Batch 000/469 | Gen/Dis Loss: 0.8757/0.6362
Epoch: 099/100 | Batch 100/469 | Gen/Dis Loss: 0.8963/0.6196
Epoch: 099/100 | Batch 200/469 | Gen/Dis Loss: 0.7621/0.7012
Epoch: 099/100 | Batch 300/469 | Gen/Dis Loss: 0.9056/0.6196
Epoch: 099/100 | Batch 400/469 | Gen/Dis Loss: 1.0287/0.6205
Time elapsed: 8.70 min
Epoch: 100/100 | Batch 000/469 | Gen/Dis Loss: 0.8541/0.6118
Epoch: 100/100 | Batch 100/469 | Gen/Dis Loss: 0.7820/0.5999
Epoch: 100/100 | Batch 200/469 | Gen/Dis Loss: 0.8043/0.6057
Epoch: 100/100 | Batch 300/469 | Gen/Dis Loss: 0.7666/0.6453
Epoch: 100/100 | Batch 400/469 | Gen/Dis Loss: 0.8143/0.6582
Time elapsed: 8.79 min
Total Training Time: 8.79 min
```

```python
In [ ]: import matplotlib.pyplot as plt

        model.eval()
        # Make new images
        z = torch.zeros((5, LATENT_DIM)).uniform_(-1.0, 1.0).to(device)
        generated_features = model.generator_forward(z)
        imgs = generated_features.view(-1, 28, 28)

        fig, axes = plt.subplots(nrows=1, ncols=5, figsize=(20, 2.5))


        for i, ax in enumerate(axes):
            axes[i].imshow(imgs[i].to(torch.device('cpu')).detach(), cmap='binary')
```
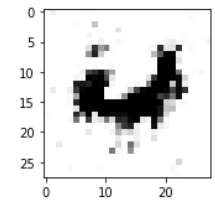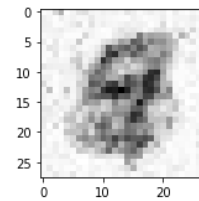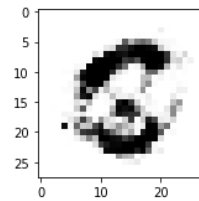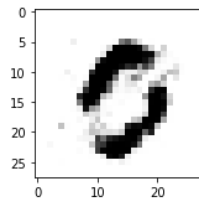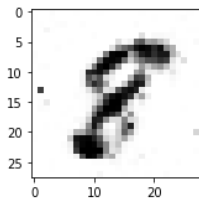

CNN GANs

```python
class Flatten(nn.Module):
    def forward(self, input):
        return input.view(input.size(0), -1)

class Reshape1(nn.Module):
    def forward(self, input):
        return input.view(input.size(0), 64, 7, 7)


class GAN(torch.nn.Module):

    def __init__(self):
        super(GAN, self).__init__()


        self.generator = nn.Sequential(

            nn.Linear(LATENT_DIM, 3136, bias=False),
            nn.BatchNorm1d(num_features=3136),
            nn.LeakyReLU(inplace=True, negative_slope=0.0001),
            Reshape1(),

            nn.ConvTranspose2d(in_channels=64, out_channels=32, kernel_size=(3, 3), stri
de=(2, 2), padding=1, bias=False),
            nn.BatchNorm2d(num_features=32),
            nn.LeakyReLU(inplace=True, negative_slope=0.0001),
            #nn.Dropout2d(p=0.2),

            nn.ConvTranspose2d(in_channels=32, out_channels=16, kernel_size=(3, 3), stri
de=(2, 2), padding=1, bias=False),
            nn.BatchNorm2d(num_features=16),
            nn.LeakyReLU(inplace=True, negative_slope=0.0001),
            #nn.Dropout2d(p=0.2),

            nn.ConvTranspose2d(in_channels=16, out_channels=8, kernel_size=(3, 3), strid
e=(1, 1), padding=0, bias=False),
            nn.BatchNorm2d(num_features=8),
            nn.LeakyReLU(inplace=True, negative_slope=0.0001),
            #nn.Dropout2d(p=0.2),

            nn.ConvTranspose2d(in_channels=8, out_channels=1, kernel_size=(2, 2), stride
=(1, 1), padding=0, bias=False),
            nn.Tanh()
        )

        self.discriminator = nn.Sequential(
            nn.Conv2d(in_channels=1, out_channels=8, padding=1, kernel_size=(3, 3), stri
de=(2, 2), bias=False),
            nn.BatchNorm2d(num_features=8),
            nn.LeakyReLU(inplace=True, negative_slope=0.0001),
            #nn.Dropout2d(p=0.2),

            nn.Conv2d(in_channels=8, out_channels=32, padding=1, kernel_size=(3, 3), str
ide=(2, 2), bias=False),
            nn.BatchNorm2d(num_features=32),
            nn.LeakyReLU(inplace=True, negative_slope=0.0001),
            #nn.Dropout2d(p=0.2),

            Flatten(),

            nn.Linear(7*7*32, 1),
```

```
                    #nn.Sigmoid()
            )


    def generator_forward(self, z):
        img = self.generator(z)
        return img

    def discriminator_forward(self, img):
        pred = model.discriminator(img)
        return pred.view(-1)
```

In [ ]:
```
torch.manual_seed(random_seed)


model = GAN()
model = model.to(device)

print(model)
```

```
GAN(
  (generator): Sequential(
    (0): Linear(in_features=100, out_features=3136, bias=False)
    (1): BatchNorm1d(3136, eps=1e-05, momentum=0.1, affine=True, track_running_stats=Tr
ue)
    (2): LeakyReLU(negative_slope=0.0001, inplace=True)
    (3): Reshape1()
    (4): ConvTranspose2d(64, 32, kernel_size=(3, 3), stride=(2, 2), padding=(1, 1), bia
s=False)
    (5): BatchNorm2d(32, eps=1e-05, momentum=0.1, affine=True, track_running_stats=Tru
e)
    (6): LeakyReLU(negative_slope=0.0001, inplace=True)
    (7): ConvTranspose2d(32, 16, kernel_size=(3, 3), stride=(2, 2), padding=(1, 1), bia
s=False)
    (8): BatchNorm2d(16, eps=1e-05, momentum=0.1, affine=True, track_running_stats=Tru
e)
    (9): LeakyReLU(negative_slope=0.0001, inplace=True)
    (10): ConvTranspose2d(16, 8, kernel_size=(3, 3), stride=(1, 1), bias=False)
    (11): BatchNorm2d(8, eps=1e-05, momentum=0.1, affine=True, track_running_stats=Tru
e)
    (12): LeakyReLU(negative_slope=0.0001, inplace=True)
    (13): ConvTranspose2d(8, 1, kernel_size=(2, 2), stride=(1, 1), bias=False)
    (14): Tanh()
  )
  (discriminator): Sequential(
    (0): Conv2d(1, 8, kernel_size=(3, 3), stride=(2, 2), padding=(1, 1), bias=False)
    (1): BatchNorm2d(8, eps=1e-05, momentum=0.1, affine=True, track_running_stats=True)
    (2): LeakyReLU(negative_slope=0.0001, inplace=True)
    (3): Conv2d(8, 32, kernel_size=(3, 3), stride=(2, 2), padding=(1, 1), bias=False)
    (4): BatchNorm2d(32, eps=1e-05, momentum=0.1, affine=True, track_running_stats=Tru
e)
    (5): LeakyReLU(negative_slope=0.0001, inplace=True)
    (6): Flatten()
    (7): Linear(in_features=1568, out_features=1, bias=True)
  )
)
```

In [ ]:
```
optim_gener = torch.optim.Adam(model.generator.parameters(), lr=generator_learning_rate)
optim_discr = torch.optim.Adam(model.discriminator.parameters(), lr=discriminator_learni
ng_rate)
```

```python
In [ ]:  start_time = time.time()

         discr_costs = []
         gener_costs = []
         for epoch in range(num_epochs):
             model = model.train()
             for batch_idx, (features, targets) in enumerate(train_loader):


                 # Normalize images to [-1, 1] range
                 features = (features - 0.5)*2.
                 features = features.view(-1, IMG_SIZE).to(device)

                 targets = targets.to(device)

                 valid = torch.ones(targets.size(0)).float().to(device)
                 fake = torch.zeros(targets.size(0)).float().to(device)


                 ### FORWARD AND BACK PROP


                 # --------------------------
                 # Train Generator
                 # --------------------------

                 # Make new images
                 z = torch.zeros((targets.size(0), LATENT_DIM)).uniform_(-1.0, 1.0).to(device)
                 generated_features = model.generator_forward(z)

                 # Loss for fooling the discriminator
                 discr_pred = model.discriminator_forward(generated_features.view(targets.size(0
         ), 1, 28, 28))

                 gener_loss = F.binary_cross_entropy_with_logits(discr_pred, valid)

                 optim_gener.zero_grad()
                 gener_loss.backward()
                 optim_gener.step()

                 # --------------------------
                 # Train Discriminator
                 # --------------------------

                 discr_pred_real = model.discriminator_forward(features.view(targets.size(0), 1,
         28, 28))
                 real_loss = F.binary_cross_entropy_with_logits(discr_pred_real, valid)

                 discr_pred_fake = model.discriminator_forward(generated_features.view(targets.si
         ze(0), 1, 28, 28).detach())
                 fake_loss = F.binary_cross_entropy_with_logits(discr_pred_fake, fake)

                 discr_loss = 0.5*(real_loss + fake_loss)

                 optim_discr.zero_grad()
                 discr_loss.backward()
                 optim_discr.step()

                 discr_costs.append(discr_loss.item())
                 gener_costs.append(gener_loss.item())
```

```python
        ### LOGGING
        if not batch_idx % 100:
            print ('Epoch: %03d/%03d | Batch %03d/%03d | Gen/Dis Loss: %.4f/%.4f'
                   %(epoch+1, num_epochs, batch_idx,
                     len(train_loader), gener_loss, discr_loss))

    print('Time elapsed: %.2f min' % ((time.time() - start_time)/60))

print('Total Training Time: %.2f min' % ((time.time() - start_time)/60))
```

```
Epoch: 001/100 | Batch 000/469 | Gen/Dis Loss: 0.8577/0.7474
Epoch: 001/100 | Batch 100/469 | Gen/Dis Loss: 2.0150/0.1504
Epoch: 001/100 | Batch 200/469 | Gen/Dis Loss: 1.2088/0.5333
Epoch: 001/100 | Batch 300/469 | Gen/Dis Loss: 1.8864/0.2602
Epoch: 001/100 | Batch 400/469 | Gen/Dis Loss: 2.0510/0.2274
Time elapsed: 0.12 min
Epoch: 002/100 | Batch 000/469 | Gen/Dis Loss: 2.1090/0.1578
Epoch: 002/100 | Batch 100/469 | Gen/Dis Loss: 2.7736/0.1041
Epoch: 002/100 | Batch 200/469 | Gen/Dis Loss: 1.5742/0.2465
Epoch: 002/100 | Batch 300/469 | Gen/Dis Loss: 2.0744/0.2254
Epoch: 002/100 | Batch 400/469 | Gen/Dis Loss: 2.9648/0.0951
Time elapsed: 0.24 min
Epoch: 003/100 | Batch 000/469 | Gen/Dis Loss: 2.6614/0.1520
Epoch: 003/100 | Batch 100/469 | Gen/Dis Loss: 2.1929/0.1856
Epoch: 003/100 | Batch 200/469 | Gen/Dis Loss: 1.2879/0.3299
Epoch: 003/100 | Batch 300/469 | Gen/Dis Loss: 2.1022/0.1821
Epoch: 003/100 | Batch 400/469 | Gen/Dis Loss: 2.4418/0.1458
Time elapsed: 0.35 min
Epoch: 004/100 | Batch 000/469 | Gen/Dis Loss: 2.4678/0.1964
Epoch: 004/100 | Batch 100/469 | Gen/Dis Loss: 1.5043/0.2705
Epoch: 004/100 | Batch 200/469 | Gen/Dis Loss: 2.0149/0.2537
Epoch: 004/100 | Batch 300/469 | Gen/Dis Loss: 2.5256/0.1278
Epoch: 004/100 | Batch 400/469 | Gen/Dis Loss: 1.5665/0.2655
Time elapsed: 0.46 min
Epoch: 005/100 | Batch 000/469 | Gen/Dis Loss: 1.5100/0.4147
Epoch: 005/100 | Batch 100/469 | Gen/Dis Loss: 1.9807/0.5421
Epoch: 005/100 | Batch 200/469 | Gen/Dis Loss: 2.9367/0.1125
Epoch: 005/100 | Batch 300/469 | Gen/Dis Loss: 2.7155/0.1432
Epoch: 005/100 | Batch 400/469 | Gen/Dis Loss: 1.9758/0.2717
Time elapsed: 0.58 min
Epoch: 006/100 | Batch 000/469 | Gen/Dis Loss: 2.3471/0.1761
Epoch: 006/100 | Batch 100/469 | Gen/Dis Loss: 2.0902/0.3583
Epoch: 006/100 | Batch 200/469 | Gen/Dis Loss: 1.5575/0.5820
Epoch: 006/100 | Batch 300/469 | Gen/Dis Loss: 2.5068/0.2578
Epoch: 006/100 | Batch 400/469 | Gen/Dis Loss: 1.3552/0.7059
Time elapsed: 0.70 min
Epoch: 007/100 | Batch 000/469 | Gen/Dis Loss: 1.9422/0.3574
Epoch: 007/100 | Batch 100/469 | Gen/Dis Loss: 1.8357/0.2137
Epoch: 007/100 | Batch 200/469 | Gen/Dis Loss: 1.4684/0.3443
Epoch: 007/100 | Batch 300/469 | Gen/Dis Loss: 2.2495/0.2134
Epoch: 007/100 | Batch 400/469 | Gen/Dis Loss: 1.9542/0.3930
Time elapsed: 0.82 min
Epoch: 008/100 | Batch 000/469 | Gen/Dis Loss: 1.8189/0.3922
Epoch: 008/100 | Batch 100/469 | Gen/Dis Loss: 2.2240/0.2901
Epoch: 008/100 | Batch 200/469 | Gen/Dis Loss: 2.2037/0.2627
Epoch: 008/100 | Batch 300/469 | Gen/Dis Loss: 1.4979/0.4725
Epoch: 008/100 | Batch 400/469 | Gen/Dis Loss: 1.8699/0.3880
Time elapsed: 0.94 min
Epoch: 009/100 | Batch 000/469 | Gen/Dis Loss: 1.4208/0.4123
Epoch: 009/100 | Batch 100/469 | Gen/Dis Loss: 2.2618/0.2538
Epoch: 009/100 | Batch 200/469 | Gen/Dis Loss: 2.0840/0.2893
Epoch: 009/100 | Batch 300/469 | Gen/Dis Loss: 0.9046/0.6528
Epoch: 009/100 | Batch 400/469 | Gen/Dis Loss: 1.9894/0.4253
Time elapsed: 1.05 min
Epoch: 010/100 | Batch 000/469 | Gen/Dis Loss: 1.9989/0.3626
Epoch: 010/100 | Batch 100/469 | Gen/Dis Loss: 1.9633/0.3602
Epoch: 010/100 | Batch 200/469 | Gen/Dis Loss: 2.0278/0.3686
Epoch: 010/100 | Batch 300/469 | Gen/Dis Loss: 1.6109/0.3234
Epoch: 010/100 | Batch 400/469 | Gen/Dis Loss: 1.8728/0.4579
Time elapsed: 1.16 min
Epoch: 011/100 | Batch 000/469 | Gen/Dis Loss: 0.9647/1.1457
```

```
Epoch: 011/100 | Batch 100/469 | Gen/Dis Loss: 1.3759/0.4685
Epoch: 011/100 | Batch 200/469 | Gen/Dis Loss: 1.9088/0.3477
Epoch: 011/100 | Batch 300/469 | Gen/Dis Loss: 1.6512/0.4161
Epoch: 011/100 | Batch 400/469 | Gen/Dis Loss: 1.7328/0.3511
Time elapsed: 1.28 min
Epoch: 012/100 | Batch 000/469 | Gen/Dis Loss: 1.4509/0.5056
Epoch: 012/100 | Batch 100/469 | Gen/Dis Loss: 1.1985/0.7424
Epoch: 012/100 | Batch 200/469 | Gen/Dis Loss: 0.9659/0.6838
Epoch: 012/100 | Batch 300/469 | Gen/Dis Loss: 1.5090/0.5506
Epoch: 012/100 | Batch 400/469 | Gen/Dis Loss: 1.6912/0.6113
Time elapsed: 1.39 min
Epoch: 013/100 | Batch 000/469 | Gen/Dis Loss: 1.7715/0.3276
Epoch: 013/100 | Batch 100/469 | Gen/Dis Loss: 1.8206/0.3846
Epoch: 013/100 | Batch 200/469 | Gen/Dis Loss: 1.2362/0.5899
Epoch: 013/100 | Batch 300/469 | Gen/Dis Loss: 1.9697/0.2668
Epoch: 013/100 | Batch 400/469 | Gen/Dis Loss: 2.2468/0.2921
Time elapsed: 1.50 min
Epoch: 014/100 | Batch 000/469 | Gen/Dis Loss: 1.7557/0.4715
Epoch: 014/100 | Batch 100/469 | Gen/Dis Loss: 1.8672/0.5066
Epoch: 014/100 | Batch 200/469 | Gen/Dis Loss: 1.5715/0.5461
Epoch: 014/100 | Batch 300/469 | Gen/Dis Loss: 1.1599/0.5647
Epoch: 014/100 | Batch 400/469 | Gen/Dis Loss: 0.7479/0.8016
Time elapsed: 1.62 min
Epoch: 015/100 | Batch 000/469 | Gen/Dis Loss: 1.5937/0.5865
Epoch: 015/100 | Batch 100/469 | Gen/Dis Loss: 1.5419/0.5094
Epoch: 015/100 | Batch 200/469 | Gen/Dis Loss: 1.6264/0.4992
Epoch: 015/100 | Batch 300/469 | Gen/Dis Loss: 1.1079/0.5602
Epoch: 015/100 | Batch 400/469 | Gen/Dis Loss: 0.7993/0.9080
Time elapsed: 1.74 min
Epoch: 016/100 | Batch 000/469 | Gen/Dis Loss: 0.8467/0.7059
Epoch: 016/100 | Batch 100/469 | Gen/Dis Loss: 1.3266/0.5190
Epoch: 016/100 | Batch 200/469 | Gen/Dis Loss: 1.0728/0.5719
Epoch: 016/100 | Batch 300/469 | Gen/Dis Loss: 1.5227/0.4620
Epoch: 016/100 | Batch 400/469 | Gen/Dis Loss: 1.9741/0.3744
Time elapsed: 1.85 min
Epoch: 017/100 | Batch 000/469 | Gen/Dis Loss: 1.0835/0.5579
Epoch: 017/100 | Batch 100/469 | Gen/Dis Loss: 1.2616/0.5091
Epoch: 017/100 | Batch 200/469 | Gen/Dis Loss: 0.7950/0.9695
Epoch: 017/100 | Batch 300/469 | Gen/Dis Loss: 1.2656/0.8055
Epoch: 017/100 | Batch 400/469 | Gen/Dis Loss: 0.5703/1.1187
Time elapsed: 1.97 min
Epoch: 018/100 | Batch 000/469 | Gen/Dis Loss: 1.6457/0.4188
Epoch: 018/100 | Batch 100/469 | Gen/Dis Loss: 1.3202/0.3813
Epoch: 018/100 | Batch 200/469 | Gen/Dis Loss: 1.6850/0.3905
Epoch: 018/100 | Batch 300/469 | Gen/Dis Loss: 1.2411/0.4780
Epoch: 018/100 | Batch 400/469 | Gen/Dis Loss: 1.6190/0.3583
Time elapsed: 2.08 min
Epoch: 019/100 | Batch 000/469 | Gen/Dis Loss: 1.3203/0.5677
Epoch: 019/100 | Batch 100/469 | Gen/Dis Loss: 1.2014/0.8038
Epoch: 019/100 | Batch 200/469 | Gen/Dis Loss: 1.0801/0.8112
Epoch: 019/100 | Batch 300/469 | Gen/Dis Loss: 1.2715/0.5618
Epoch: 019/100 | Batch 400/469 | Gen/Dis Loss: 1.2539/0.7038
Time elapsed: 2.20 min
Epoch: 020/100 | Batch 000/469 | Gen/Dis Loss: 1.7739/0.4579
Epoch: 020/100 | Batch 100/469 | Gen/Dis Loss: 1.0348/0.5380
Epoch: 020/100 | Batch 200/469 | Gen/Dis Loss: 1.6691/0.5162
Epoch: 020/100 | Batch 300/469 | Gen/Dis Loss: 1.4507/0.4116
Epoch: 020/100 | Batch 400/469 | Gen/Dis Loss: 1.0686/0.8793
Time elapsed: 2.32 min
Epoch: 021/100 | Batch 000/469 | Gen/Dis Loss: 0.9162/0.8028
Epoch: 021/100 | Batch 100/469 | Gen/Dis Loss: 0.7711/0.8294
Epoch: 021/100 | Batch 200/469 | Gen/Dis Loss: 1.3238/0.4744
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Epoch: 021/100 | Batch 300/469 | Gen/Dis Loss: 1.1657/0.5941
Epoch: 021/100 | Batch 400/469 | Gen/Dis Loss: 1.2904/0.3905
Time elapsed: 2.44 min
Epoch: 022/100 | Batch 000/469 | Gen/Dis Loss: 0.5098/1.1579
Epoch: 022/100 | Batch 100/469 | Gen/Dis Loss: 0.8726/0.7731
Epoch: 022/100 | Batch 200/469 | Gen/Dis Loss: 0.8413/0.7031
Epoch: 022/100 | Batch 300/469 | Gen/Dis Loss: 1.6201/0.3401
Epoch: 022/100 | Batch 400/469 | Gen/Dis Loss: 1.1811/0.5370
Time elapsed: 2.56 min
Epoch: 023/100 | Batch 000/469 | Gen/Dis Loss: 1.0439/0.5955
Epoch: 023/100 | Batch 100/469 | Gen/Dis Loss: 1.1383/0.5957
Epoch: 023/100 | Batch 200/469 | Gen/Dis Loss: 1.1861/0.5150
Epoch: 023/100 | Batch 300/469 | Gen/Dis Loss: 1.0958/0.6238
Epoch: 023/100 | Batch 400/469 | Gen/Dis Loss: 0.9446/0.6209
Time elapsed: 2.67 min
Epoch: 024/100 | Batch 000/469 | Gen/Dis Loss: 0.8679/0.6752
Epoch: 024/100 | Batch 100/469 | Gen/Dis Loss: 0.5561/0.9756
Epoch: 024/100 | Batch 200/469 | Gen/Dis Loss: 1.3540/0.4962
Epoch: 024/100 | Batch 300/469 | Gen/Dis Loss: 1.3037/0.4716
Epoch: 024/100 | Batch 400/469 | Gen/Dis Loss: 1.3834/0.5906
Time elapsed: 2.79 min
Epoch: 025/100 | Batch 000/469 | Gen/Dis Loss: 0.9179/0.5090
Epoch: 025/100 | Batch 100/469 | Gen/Dis Loss: 0.7491/0.6694
Epoch: 025/100 | Batch 200/469 | Gen/Dis Loss: 0.8578/0.7993
Epoch: 025/100 | Batch 300/469 | Gen/Dis Loss: 1.0292/0.7553
Epoch: 025/100 | Batch 400/469 | Gen/Dis Loss: 1.0271/0.6571
Time elapsed: 2.90 min
Epoch: 026/100 | Batch 000/469 | Gen/Dis Loss: 0.7800/0.6328
Epoch: 026/100 | Batch 100/469 | Gen/Dis Loss: 1.4906/0.4608
Epoch: 026/100 | Batch 200/469 | Gen/Dis Loss: 0.6729/0.6617
Epoch: 026/100 | Batch 300/469 | Gen/Dis Loss: 1.0013/0.5691
Epoch: 026/100 | Batch 400/469 | Gen/Dis Loss: 1.0407/0.4961
Time elapsed: 3.01 min
Epoch: 027/100 | Batch 000/469 | Gen/Dis Loss: 1.0982/0.5235
Epoch: 027/100 | Batch 100/469 | Gen/Dis Loss: 1.3427/0.5730
Epoch: 027/100 | Batch 200/469 | Gen/Dis Loss: 1.0349/0.5866
Epoch: 027/100 | Batch 300/469 | Gen/Dis Loss: 0.9094/0.7077
Epoch: 027/100 | Batch 400/469 | Gen/Dis Loss: 1.0580/0.5444
Time elapsed: 3.13 min
Epoch: 028/100 | Batch 000/469 | Gen/Dis Loss: 0.6686/0.7881
Epoch: 028/100 | Batch 100/469 | Gen/Dis Loss: 1.0261/0.5999
Epoch: 028/100 | Batch 200/469 | Gen/Dis Loss: 1.4843/0.3806
Epoch: 028/100 | Batch 300/469 | Gen/Dis Loss: 1.0606/0.5751
Epoch: 028/100 | Batch 400/469 | Gen/Dis Loss: 0.6269/0.8353
Time elapsed: 3.25 min
Epoch: 029/100 | Batch 000/469 | Gen/Dis Loss: 0.9137/0.5968
Epoch: 029/100 | Batch 100/469 | Gen/Dis Loss: 0.7966/0.7920
Epoch: 029/100 | Batch 200/469 | Gen/Dis Loss: 0.8969/0.6437
Epoch: 029/100 | Batch 300/469 | Gen/Dis Loss: 1.0324/0.6810
Epoch: 029/100 | Batch 400/469 | Gen/Dis Loss: 0.7525/0.7116
Time elapsed: 3.37 min
Epoch: 030/100 | Batch 000/469 | Gen/Dis Loss: 0.7933/0.5694
Epoch: 030/100 | Batch 100/469 | Gen/Dis Loss: 1.0287/0.7196
Epoch: 030/100 | Batch 200/469 | Gen/Dis Loss: 0.7116/0.7455
Epoch: 030/100 | Batch 300/469 | Gen/Dis Loss: 0.8701/0.7009
Epoch: 030/100 | Batch 400/469 | Gen/Dis Loss: 0.8563/0.8247
Time elapsed: 3.48 min
Epoch: 031/100 | Batch 000/469 | Gen/Dis Loss: 0.9866/0.5686
Epoch: 031/100 | Batch 100/469 | Gen/Dis Loss: 0.8435/0.7639
Epoch: 031/100 | Batch 200/469 | Gen/Dis Loss: 0.6224/0.7517
Epoch: 031/100 | Batch 300/469 | Gen/Dis Loss: 0.8313/0.6499
Epoch: 031/100 | Batch 400/469 | Gen/Dis Loss: 0.9463/0.5924
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Time elapsed: 3.59 min
Epoch: 032/100 | Batch 000/469 | Gen/Dis Loss: 0.7930/0.6501
Epoch: 032/100 | Batch 100/469 | Gen/Dis Loss: 0.8468/0.6468
Epoch: 032/100 | Batch 200/469 | Gen/Dis Loss: 1.1206/0.5132
Epoch: 032/100 | Batch 300/469 | Gen/Dis Loss: 1.0348/0.5460
Epoch: 032/100 | Batch 400/469 | Gen/Dis Loss: 0.8577/0.6967
Time elapsed: 3.70 min
Epoch: 033/100 | Batch 000/469 | Gen/Dis Loss: 1.2615/0.6051
Epoch: 033/100 | Batch 100/469 | Gen/Dis Loss: 0.8835/0.6558
Epoch: 033/100 | Batch 200/469 | Gen/Dis Loss: 0.8320/0.7434
Epoch: 033/100 | Batch 300/469 | Gen/Dis Loss: 0.6628/0.8620
Epoch: 033/100 | Batch 400/469 | Gen/Dis Loss: 1.2602/0.4198
Time elapsed: 3.82 min
Epoch: 034/100 | Batch 000/469 | Gen/Dis Loss: 1.0688/0.5062
Epoch: 034/100 | Batch 100/469 | Gen/Dis Loss: 1.1821/0.4743
Epoch: 034/100 | Batch 200/469 | Gen/Dis Loss: 0.8673/0.6278
Epoch: 034/100 | Batch 300/469 | Gen/Dis Loss: 0.9332/0.6629
Epoch: 034/100 | Batch 400/469 | Gen/Dis Loss: 0.8075/0.6363
Time elapsed: 3.94 min
Epoch: 035/100 | Batch 000/469 | Gen/Dis Loss: 0.9230/0.6521
Epoch: 035/100 | Batch 100/469 | Gen/Dis Loss: 0.8445/0.7154
Epoch: 035/100 | Batch 200/469 | Gen/Dis Loss: 1.1034/0.5554
Epoch: 035/100 | Batch 300/469 | Gen/Dis Loss: 0.9060/0.5812
Epoch: 035/100 | Batch 400/469 | Gen/Dis Loss: 0.8813/0.8359
Time elapsed: 4.05 min
Epoch: 036/100 | Batch 000/469 | Gen/Dis Loss: 0.8007/0.7844
Epoch: 036/100 | Batch 100/469 | Gen/Dis Loss: 0.9288/0.7265
Epoch: 036/100 | Batch 200/469 | Gen/Dis Loss: 0.6026/0.9229
Epoch: 036/100 | Batch 300/469 | Gen/Dis Loss: 0.8957/0.7201
Epoch: 036/100 | Batch 400/469 | Gen/Dis Loss: 0.9508/0.5932
Time elapsed: 4.16 min
Epoch: 037/100 | Batch 000/469 | Gen/Dis Loss: 1.0411/0.5520
Epoch: 037/100 | Batch 100/469 | Gen/Dis Loss: 0.9653/0.6629
Epoch: 037/100 | Batch 200/469 | Gen/Dis Loss: 0.7558/0.7144
Epoch: 037/100 | Batch 300/469 | Gen/Dis Loss: 0.9631/0.6463
Epoch: 037/100 | Batch 400/469 | Gen/Dis Loss: 0.8681/0.6097
Time elapsed: 4.28 min
Epoch: 038/100 | Batch 000/469 | Gen/Dis Loss: 0.9692/0.5345
Epoch: 038/100 | Batch 100/469 | Gen/Dis Loss: 0.9089/0.6766
Epoch: 038/100 | Batch 200/469 | Gen/Dis Loss: 0.7960/0.7300
Epoch: 038/100 | Batch 300/469 | Gen/Dis Loss: 0.7425/0.7516
Epoch: 038/100 | Batch 400/469 | Gen/Dis Loss: 0.9333/0.5340
Time elapsed: 4.40 min
Epoch: 039/100 | Batch 000/469 | Gen/Dis Loss: 0.8610/0.6048
Epoch: 039/100 | Batch 100/469 | Gen/Dis Loss: 0.9290/0.6187
Epoch: 039/100 | Batch 200/469 | Gen/Dis Loss: 1.0170/0.6220
Epoch: 039/100 | Batch 300/469 | Gen/Dis Loss: 0.5862/0.8787
Epoch: 039/100 | Batch 400/469 | Gen/Dis Loss: 0.7988/0.8648
Time elapsed: 4.52 min
Epoch: 040/100 | Batch 000/469 | Gen/Dis Loss: 0.6006/0.8884
Epoch: 040/100 | Batch 100/469 | Gen/Dis Loss: 0.7158/0.7747
Epoch: 040/100 | Batch 200/469 | Gen/Dis Loss: 0.7994/0.6296
Epoch: 040/100 | Batch 300/469 | Gen/Dis Loss: 0.8811/0.7235
Epoch: 040/100 | Batch 400/469 | Gen/Dis Loss: 0.7349/0.6890
Time elapsed: 4.64 min
Epoch: 041/100 | Batch 000/469 | Gen/Dis Loss: 1.0536/0.5823
Epoch: 041/100 | Batch 100/469 | Gen/Dis Loss: 0.8193/0.7381
Epoch: 041/100 | Batch 200/469 | Gen/Dis Loss: 0.8009/0.6532
Epoch: 041/100 | Batch 300/469 | Gen/Dis Loss: 0.8517/0.6034
Epoch: 041/100 | Batch 400/469 | Gen/Dis Loss: 0.8050/0.6584
Time elapsed: 4.75 min
Epoch: 042/100 | Batch 000/469 | Gen/Dis Loss: 0.8437/0.7134
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Epoch: 042/100 | Batch 100/469 | Gen/Dis Loss: 0.7224/0.7202
Epoch: 042/100 | Batch 200/469 | Gen/Dis Loss: 0.6612/0.7953
Epoch: 042/100 | Batch 300/469 | Gen/Dis Loss: 0.9789/0.5666
Epoch: 042/100 | Batch 400/469 | Gen/Dis Loss: 0.7626/0.6312
Time elapsed: 4.87 min
Epoch: 043/100 | Batch 000/469 | Gen/Dis Loss: 0.6604/0.8660
Epoch: 043/100 | Batch 100/469 | Gen/Dis Loss: 0.9047/0.5741
Epoch: 043/100 | Batch 200/469 | Gen/Dis Loss: 0.9138/0.7049
Epoch: 043/100 | Batch 300/469 | Gen/Dis Loss: 0.7942/0.7082
Epoch: 043/100 | Batch 400/469 | Gen/Dis Loss: 0.9107/0.6775
Time elapsed: 4.98 min
Epoch: 044/100 | Batch 000/469 | Gen/Dis Loss: 0.9250/0.5844
Epoch: 044/100 | Batch 100/469 | Gen/Dis Loss: 0.8234/0.6493
Epoch: 044/100 | Batch 200/469 | Gen/Dis Loss: 0.8282/0.7681
Epoch: 044/100 | Batch 300/469 | Gen/Dis Loss: 1.0290/0.4993
Epoch: 044/100 | Batch 400/469 | Gen/Dis Loss: 0.7717/0.7942
Time elapsed: 5.09 min
Epoch: 045/100 | Batch 000/469 | Gen/Dis Loss: 0.8524/0.6300
Epoch: 045/100 | Batch 100/469 | Gen/Dis Loss: 0.6952/0.7244
Epoch: 045/100 | Batch 200/469 | Gen/Dis Loss: 0.8245/0.7690
Epoch: 045/100 | Batch 300/469 | Gen/Dis Loss: 1.0312/0.5944
Epoch: 045/100 | Batch 400/469 | Gen/Dis Loss: 0.8214/0.6806
Time elapsed: 5.21 min
Epoch: 046/100 | Batch 000/469 | Gen/Dis Loss: 0.7843/0.7214
Epoch: 046/100 | Batch 100/469 | Gen/Dis Loss: 0.9851/0.7014
Epoch: 046/100 | Batch 200/469 | Gen/Dis Loss: 0.8368/0.6898
Epoch: 046/100 | Batch 300/469 | Gen/Dis Loss: 0.8248/0.7272
Epoch: 046/100 | Batch 400/469 | Gen/Dis Loss: 0.7270/0.7276
Time elapsed: 5.33 min
Epoch: 047/100 | Batch 000/469 | Gen/Dis Loss: 0.8221/0.7137
Epoch: 047/100 | Batch 100/469 | Gen/Dis Loss: 1.0168/0.5989
Epoch: 047/100 | Batch 200/469 | Gen/Dis Loss: 0.9171/0.7205
Epoch: 047/100 | Batch 300/469 | Gen/Dis Loss: 0.8520/0.7304
Epoch: 047/100 | Batch 400/469 | Gen/Dis Loss: 1.0323/0.5417
Time elapsed: 5.45 min
Epoch: 048/100 | Batch 000/469 | Gen/Dis Loss: 1.0626/0.5709
Epoch: 048/100 | Batch 100/469 | Gen/Dis Loss: 0.7788/0.6880
Epoch: 048/100 | Batch 200/469 | Gen/Dis Loss: 0.8061/0.7325
Epoch: 048/100 | Batch 300/469 | Gen/Dis Loss: 0.8521/0.6500
Epoch: 048/100 | Batch 400/469 | Gen/Dis Loss: 1.0996/0.5458
Time elapsed: 5.56 min
Epoch: 049/100 | Batch 000/469 | Gen/Dis Loss: 0.9649/0.5725
Epoch: 049/100 | Batch 100/469 | Gen/Dis Loss: 0.7653/0.6491
Epoch: 049/100 | Batch 200/469 | Gen/Dis Loss: 0.6809/0.7973
Epoch: 049/100 | Batch 300/469 | Gen/Dis Loss: 0.8865/0.7105
Epoch: 049/100 | Batch 400/469 | Gen/Dis Loss: 0.8028/0.7082
Time elapsed: 5.68 min
Epoch: 050/100 | Batch 000/469 | Gen/Dis Loss: 0.7377/0.7357
Epoch: 050/100 | Batch 100/469 | Gen/Dis Loss: 0.6415/0.7814
Epoch: 050/100 | Batch 200/469 | Gen/Dis Loss: 0.7056/0.7370
Epoch: 050/100 | Batch 300/469 | Gen/Dis Loss: 0.7734/0.7215
Epoch: 050/100 | Batch 400/469 | Gen/Dis Loss: 0.7820/0.6581
Time elapsed: 5.79 min
Epoch: 051/100 | Batch 000/469 | Gen/Dis Loss: 0.7598/0.7766
Epoch: 051/100 | Batch 100/469 | Gen/Dis Loss: 0.7934/0.7437
Epoch: 051/100 | Batch 200/469 | Gen/Dis Loss: 0.7242/0.7254
Epoch: 051/100 | Batch 300/469 | Gen/Dis Loss: 0.7129/0.7084
Epoch: 051/100 | Batch 400/469 | Gen/Dis Loss: 1.0940/0.6716
Time elapsed: 5.91 min
Epoch: 052/100 | Batch 000/469 | Gen/Dis Loss: 0.7170/0.7620
Epoch: 052/100 | Batch 100/469 | Gen/Dis Loss: 0.8824/0.7417
Epoch: 052/100 | Batch 200/469 | Gen/Dis Loss: 0.7416/0.7311
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Epoch: 052/100 | Batch 300/469 | Gen/Dis Loss: 0.9133/0.6140
Epoch: 052/100 | Batch 400/469 | Gen/Dis Loss: 0.8137/0.7743
Time elapsed: 6.03 min
Epoch: 053/100 | Batch 000/469 | Gen/Dis Loss: 0.9405/0.5423
Epoch: 053/100 | Batch 100/469 | Gen/Dis Loss: 0.6817/0.7434
Epoch: 053/100 | Batch 200/469 | Gen/Dis Loss: 1.1219/0.6398
Epoch: 053/100 | Batch 300/469 | Gen/Dis Loss: 0.9192/0.6422
Epoch: 053/100 | Batch 400/469 | Gen/Dis Loss: 0.7531/0.7403
Time elapsed: 6.15 min
Epoch: 054/100 | Batch 000/469 | Gen/Dis Loss: 0.9128/0.5765
Epoch: 054/100 | Batch 100/469 | Gen/Dis Loss: 0.8075/0.6596
Epoch: 054/100 | Batch 200/469 | Gen/Dis Loss: 0.7010/0.7408
Epoch: 054/100 | Batch 300/469 | Gen/Dis Loss: 0.6824/0.7122
Epoch: 054/100 | Batch 400/469 | Gen/Dis Loss: 0.9340/0.6839
Time elapsed: 6.26 min
Epoch: 055/100 | Batch 000/469 | Gen/Dis Loss: 0.7514/0.7705
Epoch: 055/100 | Batch 100/469 | Gen/Dis Loss: 0.9019/0.6926
Epoch: 055/100 | Batch 200/469 | Gen/Dis Loss: 0.7293/0.7826
Epoch: 055/100 | Batch 300/469 | Gen/Dis Loss: 0.6422/0.7358
Epoch: 055/100 | Batch 400/469 | Gen/Dis Loss: 0.9066/0.6153
Time elapsed: 6.38 min
Epoch: 056/100 | Batch 000/469 | Gen/Dis Loss: 0.7511/0.6830
Epoch: 056/100 | Batch 100/469 | Gen/Dis Loss: 0.8447/0.6574
Epoch: 056/100 | Batch 200/469 | Gen/Dis Loss: 0.7922/0.6794
Epoch: 056/100 | Batch 300/469 | Gen/Dis Loss: 0.7087/0.6963
Epoch: 056/100 | Batch 400/469 | Gen/Dis Loss: 0.6711/0.7275
Time elapsed: 6.49 min
Epoch: 057/100 | Batch 000/469 | Gen/Dis Loss: 0.7459/0.6637
Epoch: 057/100 | Batch 100/469 | Gen/Dis Loss: 0.9922/0.6330
Epoch: 057/100 | Batch 200/469 | Gen/Dis Loss: 0.7998/0.6973
Epoch: 057/100 | Batch 300/469 | Gen/Dis Loss: 0.9312/0.6080
Epoch: 057/100 | Batch 400/469 | Gen/Dis Loss: 0.8376/0.6241
Time elapsed: 6.62 min
Epoch: 058/100 | Batch 000/469 | Gen/Dis Loss: 0.8957/0.5794
Epoch: 058/100 | Batch 100/469 | Gen/Dis Loss: 0.8278/0.6282
Epoch: 058/100 | Batch 200/469 | Gen/Dis Loss: 0.8847/0.6353
Epoch: 058/100 | Batch 300/469 | Gen/Dis Loss: 0.7770/0.7225
Epoch: 058/100 | Batch 400/469 | Gen/Dis Loss: 0.8859/0.6518
Time elapsed: 6.73 min
Epoch: 059/100 | Batch 000/469 | Gen/Dis Loss: 0.7770/0.6904
Epoch: 059/100 | Batch 100/469 | Gen/Dis Loss: 0.8802/0.6473
Epoch: 059/100 | Batch 200/469 | Gen/Dis Loss: 0.7387/0.7141
Epoch: 059/100 | Batch 300/469 | Gen/Dis Loss: 0.7915/0.6438
Epoch: 059/100 | Batch 400/469 | Gen/Dis Loss: 0.7703/0.5696
Time elapsed: 6.85 min
Epoch: 060/100 | Batch 000/469 | Gen/Dis Loss: 0.6944/0.8010
Epoch: 060/100 | Batch 100/469 | Gen/Dis Loss: 0.7683/0.7746
Epoch: 060/100 | Batch 200/469 | Gen/Dis Loss: 0.7649/0.7430
Epoch: 060/100 | Batch 300/469 | Gen/Dis Loss: 0.6155/0.7769
Epoch: 060/100 | Batch 400/469 | Gen/Dis Loss: 0.8118/0.7364
Time elapsed: 6.96 min
Epoch: 061/100 | Batch 000/469 | Gen/Dis Loss: 0.7334/0.6693
Epoch: 061/100 | Batch 100/469 | Gen/Dis Loss: 0.6890/0.7517
Epoch: 061/100 | Batch 200/469 | Gen/Dis Loss: 0.7972/0.6656
Epoch: 061/100 | Batch 300/469 | Gen/Dis Loss: 0.8160/0.6325
Epoch: 061/100 | Batch 400/469 | Gen/Dis Loss: 0.8377/0.6318
Time elapsed: 7.08 min
Epoch: 062/100 | Batch 000/469 | Gen/Dis Loss: 0.8007/0.6225
Epoch: 062/100 | Batch 100/469 | Gen/Dis Loss: 0.8457/0.6340
Epoch: 062/100 | Batch 200/469 | Gen/Dis Loss: 0.7167/0.7324
Epoch: 062/100 | Batch 300/469 | Gen/Dis Loss: 0.7214/0.7350
Epoch: 062/100 | Batch 400/469 | Gen/Dis Loss: 0.7077/0.6789
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Time elapsed: 7.20 min
Epoch: 063/100 | Batch 000/469 | Gen/Dis Loss: 0.7423/0.6751
Epoch: 063/100 | Batch 100/469 | Gen/Dis Loss: 0.7937/0.7194
Epoch: 063/100 | Batch 200/469 | Gen/Dis Loss: 0.7571/0.6986
Epoch: 063/100 | Batch 300/469 | Gen/Dis Loss: 0.7815/0.6357
Epoch: 063/100 | Batch 400/469 | Gen/Dis Loss: 0.7495/0.6708
Time elapsed: 7.31 min
Epoch: 064/100 | Batch 000/469 | Gen/Dis Loss: 0.7540/0.7575
Epoch: 064/100 | Batch 100/469 | Gen/Dis Loss: 0.6916/0.7209
Epoch: 064/100 | Batch 200/469 | Gen/Dis Loss: 0.6824/0.7091
Epoch: 064/100 | Batch 300/469 | Gen/Dis Loss: 0.7475/0.7317
Epoch: 064/100 | Batch 400/469 | Gen/Dis Loss: 0.6885/0.7812
Time elapsed: 7.43 min
Epoch: 065/100 | Batch 000/469 | Gen/Dis Loss: 0.8600/0.5887
Epoch: 065/100 | Batch 100/469 | Gen/Dis Loss: 0.8864/0.5957
Epoch: 065/100 | Batch 200/469 | Gen/Dis Loss: 0.9202/0.6221
Epoch: 065/100 | Batch 300/469 | Gen/Dis Loss: 0.7866/0.6764
Epoch: 065/100 | Batch 400/469 | Gen/Dis Loss: 0.7843/0.6555
Time elapsed: 7.54 min
Epoch: 066/100 | Batch 000/469 | Gen/Dis Loss: 0.7429/0.6884
Epoch: 066/100 | Batch 100/469 | Gen/Dis Loss: 0.7840/0.6850
Epoch: 066/100 | Batch 200/469 | Gen/Dis Loss: 0.8192/0.6780
Epoch: 066/100 | Batch 300/469 | Gen/Dis Loss: 0.7341/0.7182
Epoch: 066/100 | Batch 400/469 | Gen/Dis Loss: 0.7303/0.6662
Time elapsed: 7.65 min
Epoch: 067/100 | Batch 000/469 | Gen/Dis Loss: 0.7823/0.7179
Epoch: 067/100 | Batch 100/469 | Gen/Dis Loss: 0.7970/0.6635
Epoch: 067/100 | Batch 200/469 | Gen/Dis Loss: 0.8004/0.6760
Epoch: 067/100 | Batch 300/469 | Gen/Dis Loss: 0.6644/0.7160
Epoch: 067/100 | Batch 400/469 | Gen/Dis Loss: 0.7578/0.6770
Time elapsed: 7.77 min
Epoch: 068/100 | Batch 000/469 | Gen/Dis Loss: 0.8193/0.6816
Epoch: 068/100 | Batch 100/469 | Gen/Dis Loss: 0.7124/0.7073
Epoch: 068/100 | Batch 200/469 | Gen/Dis Loss: 0.8280/0.6145
Epoch: 068/100 | Batch 300/469 | Gen/Dis Loss: 0.8135/0.7032
Epoch: 068/100 | Batch 400/469 | Gen/Dis Loss: 0.8147/0.6401
Time elapsed: 7.88 min
Epoch: 069/100 | Batch 000/469 | Gen/Dis Loss: 0.8191/0.6842
Epoch: 069/100 | Batch 100/469 | Gen/Dis Loss: 0.7432/0.6744
Epoch: 069/100 | Batch 200/469 | Gen/Dis Loss: 0.7546/0.7079
Epoch: 069/100 | Batch 300/469 | Gen/Dis Loss: 0.7616/0.7043
Epoch: 069/100 | Batch 400/469 | Gen/Dis Loss: 0.8104/0.6255
Time elapsed: 8.00 min
Epoch: 070/100 | Batch 000/469 | Gen/Dis Loss: 0.6709/0.7705
Epoch: 070/100 | Batch 100/469 | Gen/Dis Loss: 0.8604/0.6842
Epoch: 070/100 | Batch 200/469 | Gen/Dis Loss: 0.8123/0.6776
Epoch: 070/100 | Batch 300/469 | Gen/Dis Loss: 0.8120/0.6741
Epoch: 070/100 | Batch 400/469 | Gen/Dis Loss: 0.7157/0.7131
Time elapsed: 8.12 min
Epoch: 071/100 | Batch 000/469 | Gen/Dis Loss: 0.7654/0.6531
Epoch: 071/100 | Batch 100/469 | Gen/Dis Loss: 0.7643/0.7463
Epoch: 071/100 | Batch 200/469 | Gen/Dis Loss: 0.7425/0.6914
Epoch: 071/100 | Batch 300/469 | Gen/Dis Loss: 0.8053/0.6551
Epoch: 071/100 | Batch 400/469 | Gen/Dis Loss: 0.7934/0.6510
Time elapsed: 8.24 min
Epoch: 072/100 | Batch 000/469 | Gen/Dis Loss: 0.7424/0.6650
Epoch: 072/100 | Batch 100/469 | Gen/Dis Loss: 0.7116/0.7569
Epoch: 072/100 | Batch 200/469 | Gen/Dis Loss: 0.7525/0.6856
Epoch: 072/100 | Batch 300/469 | Gen/Dis Loss: 0.7516/0.6886
Epoch: 072/100 | Batch 400/469 | Gen/Dis Loss: 0.7964/0.6662
Time elapsed: 8.36 min
Epoch: 073/100 | Batch 000/469 | Gen/Dis Loss: 0.7896/0.6615
```

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Epoch: 073/100 | Batch 100/469 | Gen/Dis Loss: 0.6857/0.6903
Epoch: 073/100 | Batch 200/469 | Gen/Dis Loss: 0.6909/0.7252
Epoch: 073/100 | Batch 300/469 | Gen/Dis Loss: 0.7061/0.7103
Epoch: 073/100 | Batch 400/469 | Gen/Dis Loss: 0.6764/0.6804
Time elapsed: 8.47 min
Epoch: 074/100 | Batch 000/469 | Gen/Dis Loss: 0.7928/0.6474
Epoch: 074/100 | Batch 100/469 | Gen/Dis Loss: 0.9367/0.5570
Epoch: 074/100 | Batch 200/469 | Gen/Dis Loss: 0.6999/0.7243
Epoch: 074/100 | Batch 300/469 | Gen/Dis Loss: 0.7455/0.7642
Epoch: 074/100 | Batch 400/469 | Gen/Dis Loss: 0.6612/0.7129
Time elapsed: 8.59 min
Epoch: 075/100 | Batch 000/469 | Gen/Dis Loss: 0.6702/0.7584
Epoch: 075/100 | Batch 100/469 | Gen/Dis Loss: 0.7379/0.6744
Epoch: 075/100 | Batch 200/469 | Gen/Dis Loss: 0.6825/0.7191
Epoch: 075/100 | Batch 300/469 | Gen/Dis Loss: 0.7125/0.7066
Epoch: 075/100 | Batch 400/469 | Gen/Dis Loss: 0.7219/0.7185
Time elapsed: 8.71 min
Epoch: 076/100 | Batch 000/469 | Gen/Dis Loss: 0.8015/0.6968
Epoch: 076/100 | Batch 100/469 | Gen/Dis Loss: 0.6643/0.7434
Epoch: 076/100 | Batch 200/469 | Gen/Dis Loss: 0.7864/0.6729
Epoch: 076/100 | Batch 300/469 | Gen/Dis Loss: 0.7397/0.7149
Epoch: 076/100 | Batch 400/469 | Gen/Dis Loss: 0.6865/0.7387
Time elapsed: 8.83 min
Epoch: 077/100 | Batch 000/469 | Gen/Dis Loss: 0.7306/0.6958
Epoch: 077/100 | Batch 100/469 | Gen/Dis Loss: 0.7188/0.6868
Epoch: 077/100 | Batch 200/469 | Gen/Dis Loss: 0.6856/0.7391
Epoch: 077/100 | Batch 300/469 | Gen/Dis Loss: 0.7675/0.6844
Epoch: 077/100 | Batch 400/469 | Gen/Dis Loss: 0.7257/0.6965
Time elapsed: 8.95 min
Epoch: 078/100 | Batch 000/469 | Gen/Dis Loss: 0.7412/0.6988
Epoch: 078/100 | Batch 100/469 | Gen/Dis Loss: 0.7283/0.6950
Epoch: 078/100 | Batch 200/469 | Gen/Dis Loss: 0.7481/0.6910
Epoch: 078/100 | Batch 300/469 | Gen/Dis Loss: 0.7118/0.6941
Epoch: 078/100 | Batch 400/469 | Gen/Dis Loss: 0.7650/0.6860
Time elapsed: 9.07 min
Epoch: 079/100 | Batch 000/469 | Gen/Dis Loss: 0.7249/0.6987
Epoch: 079/100 | Batch 100/469 | Gen/Dis Loss: 0.7422/0.6895
Epoch: 079/100 | Batch 200/469 | Gen/Dis Loss: 0.7708/0.6536
Epoch: 079/100 | Batch 300/469 | Gen/Dis Loss: 0.7860/0.6591
Epoch: 079/100 | Batch 400/469 | Gen/Dis Loss: 0.6946/0.7261
Time elapsed: 9.18 min
Epoch: 080/100 | Batch 000/469 | Gen/Dis Loss: 0.8157/0.6759
Epoch: 080/100 | Batch 100/469 | Gen/Dis Loss: 0.7097/0.6872
Epoch: 080/100 | Batch 200/469 | Gen/Dis Loss: 0.7478/0.6772
Epoch: 080/100 | Batch 300/469 | Gen/Dis Loss: 0.7840/0.6445
Epoch: 080/100 | Batch 400/469 | Gen/Dis Loss: 0.7685/0.6282
Time elapsed: 9.30 min
Epoch: 081/100 | Batch 000/469 | Gen/Dis Loss: 0.7139/0.6930
Epoch: 081/100 | Batch 100/469 | Gen/Dis Loss: 0.7592/0.6760
Epoch: 081/100 | Batch 200/469 | Gen/Dis Loss: 0.7053/0.7406
Epoch: 081/100 | Batch 300/469 | Gen/Dis Loss: 0.7445/0.6589
Epoch: 081/100 | Batch 400/469 | Gen/Dis Loss: 0.8534/0.6535
Time elapsed: 9.42 min
Epoch: 082/100 | Batch 000/469 | Gen/Dis Loss: 0.8091/0.6677
Epoch: 082/100 | Batch 100/469 | Gen/Dis Loss: 0.7140/0.7098
Epoch: 082/100 | Batch 200/469 | Gen/Dis Loss: 0.8215/0.6355
Epoch: 082/100 | Batch 300/469 | Gen/Dis Loss: 0.6740/0.6947
Epoch: 082/100 | Batch 400/469 | Gen/Dis Loss: 0.6674/0.7426
Time elapsed: 9.53 min
Epoch: 083/100 | Batch 000/469 | Gen/Dis Loss: 0.7781/0.6632
Epoch: 083/100 | Batch 100/469 | Gen/Dis Loss: 0.7685/0.6724
Epoch: 083/100 | Batch 200/469 | Gen/Dis Loss: 0.8129/0.6166
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Epoch: 083/100 | Batch 300/469 | Gen/Dis Loss: 0.7320/0.6992
Epoch: 083/100 | Batch 400/469 | Gen/Dis Loss: 0.6895/0.6907
Time elapsed: 9.65 min
Epoch: 084/100 | Batch 000/469 | Gen/Dis Loss: 0.7031/0.7077
Epoch: 084/100 | Batch 100/469 | Gen/Dis Loss: 0.7034/0.7459
Epoch: 084/100 | Batch 200/469 | Gen/Dis Loss: 0.6762/0.7335
Epoch: 084/100 | Batch 300/469 | Gen/Dis Loss: 0.7070/0.6836
Epoch: 084/100 | Batch 400/469 | Gen/Dis Loss: 0.7620/0.6979
Time elapsed: 9.76 min
Epoch: 085/100 | Batch 000/469 | Gen/Dis Loss: 0.7218/0.6953
Epoch: 085/100 | Batch 100/469 | Gen/Dis Loss: 0.7569/0.6856
Epoch: 085/100 | Batch 200/469 | Gen/Dis Loss: 0.7540/0.6725
Epoch: 085/100 | Batch 300/469 | Gen/Dis Loss: 0.7163/0.6762
Epoch: 085/100 | Batch 400/469 | Gen/Dis Loss: 0.8870/0.5994
Time elapsed: 9.88 min
Epoch: 086/100 | Batch 000/469 | Gen/Dis Loss: 0.6537/0.7170
Epoch: 086/100 | Batch 100/469 | Gen/Dis Loss: 0.7411/0.6677
Epoch: 086/100 | Batch 200/469 | Gen/Dis Loss: 0.7669/0.6695
Epoch: 086/100 | Batch 300/469 | Gen/Dis Loss: 0.7833/0.6745
Epoch: 086/100 | Batch 400/469 | Gen/Dis Loss: 0.7451/0.6438
Time elapsed: 9.99 min
Epoch: 087/100 | Batch 000/469 | Gen/Dis Loss: 0.6915/0.7326
Epoch: 087/100 | Batch 100/469 | Gen/Dis Loss: 0.7459/0.7194
Epoch: 087/100 | Batch 200/469 | Gen/Dis Loss: 0.7273/0.7009
Epoch: 087/100 | Batch 300/469 | Gen/Dis Loss: 0.7683/0.6562
Epoch: 087/100 | Batch 400/469 | Gen/Dis Loss: 0.7675/0.6867
Time elapsed: 10.11 min
Epoch: 088/100 | Batch 000/469 | Gen/Dis Loss: 0.7548/0.7268
Epoch: 088/100 | Batch 100/469 | Gen/Dis Loss: 0.7151/0.6826
Epoch: 088/100 | Batch 200/469 | Gen/Dis Loss: 0.7296/0.7313
Epoch: 088/100 | Batch 300/469 | Gen/Dis Loss: 0.7296/0.6786
Epoch: 088/100 | Batch 400/469 | Gen/Dis Loss: 0.6766/0.7292
Time elapsed: 10.23 min
Epoch: 089/100 | Batch 000/469 | Gen/Dis Loss: 0.6769/0.7265
Epoch: 089/100 | Batch 100/469 | Gen/Dis Loss: 0.7316/0.6484
Epoch: 089/100 | Batch 200/469 | Gen/Dis Loss: 0.7594/0.6602
Epoch: 089/100 | Batch 300/469 | Gen/Dis Loss: 0.7071/0.6949
Epoch: 089/100 | Batch 400/469 | Gen/Dis Loss: 0.7119/0.7076
Time elapsed: 10.35 min
Epoch: 090/100 | Batch 000/469 | Gen/Dis Loss: 0.7135/0.6803
Epoch: 090/100 | Batch 100/469 | Gen/Dis Loss: 0.7700/0.6424
Epoch: 090/100 | Batch 200/469 | Gen/Dis Loss: 0.7131/0.7010
Epoch: 090/100 | Batch 300/469 | Gen/Dis Loss: 0.7101/0.6814
Epoch: 090/100 | Batch 400/469 | Gen/Dis Loss: 0.6999/0.6923
Time elapsed: 10.47 min
Epoch: 091/100 | Batch 000/469 | Gen/Dis Loss: 0.7396/0.6832
Epoch: 091/100 | Batch 100/469 | Gen/Dis Loss: 0.7136/0.6825
Epoch: 091/100 | Batch 200/469 | Gen/Dis Loss: 0.7588/0.6557
Epoch: 091/100 | Batch 300/469 | Gen/Dis Loss: 0.7018/0.7017
Epoch: 091/100 | Batch 400/469 | Gen/Dis Loss: 0.7150/0.7164
Time elapsed: 10.58 min
Epoch: 092/100 | Batch 000/469 | Gen/Dis Loss: 0.7235/0.6979
Epoch: 092/100 | Batch 100/469 | Gen/Dis Loss: 0.7315/0.7132
Epoch: 092/100 | Batch 200/469 | Gen/Dis Loss: 0.7449/0.6708
Epoch: 092/100 | Batch 300/469 | Gen/Dis Loss: 0.7038/0.6807
Epoch: 092/100 | Batch 400/469 | Gen/Dis Loss: 0.7033/0.7255
Time elapsed: 10.69 min
Epoch: 093/100 | Batch 000/469 | Gen/Dis Loss: 0.6952/0.7013
Epoch: 093/100 | Batch 100/469 | Gen/Dis Loss: 0.7046/0.6862
Epoch: 093/100 | Batch 200/469 | Gen/Dis Loss: 0.6980/0.6920
Epoch: 093/100 | Batch 300/469 | Gen/Dis Loss: 0.7128/0.6855
Epoch: 093/100 | Batch 400/469 | Gen/Dis Loss: 0.7089/0.6765
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Time elapsed: 10.81 min
Epoch: 094/100 | Batch 000/469 | Gen/Dis Loss: 0.6759/0.7105
Epoch: 094/100 | Batch 100/469 | Gen/Dis Loss: 0.6993/0.6963
Epoch: 094/100 | Batch 200/469 | Gen/Dis Loss: 0.7765/0.6542
Epoch: 094/100 | Batch 300/469 | Gen/Dis Loss: 0.6935/0.6821
Epoch: 094/100 | Batch 400/469 | Gen/Dis Loss: 0.6937/0.6826
Time elapsed: 10.94 min
Epoch: 095/100 | Batch 000/469 | Gen/Dis Loss: 0.7768/0.6670
Epoch: 095/100 | Batch 100/469 | Gen/Dis Loss: 0.6933/0.7063
Epoch: 095/100 | Batch 200/469 | Gen/Dis Loss: 0.6896/0.6736
Epoch: 095/100 | Batch 300/469 | Gen/Dis Loss: 0.8158/0.6036
Epoch: 095/100 | Batch 400/469 | Gen/Dis Loss: 0.8755/0.6242
Time elapsed: 11.05 min
Epoch: 096/100 | Batch 000/469 | Gen/Dis Loss: 1.0719/0.5459
Epoch: 096/100 | Batch 100/469 | Gen/Dis Loss: 0.7696/0.7453
Epoch: 096/100 | Batch 200/469 | Gen/Dis Loss: 1.0635/0.4629
Epoch: 096/100 | Batch 300/469 | Gen/Dis Loss: 0.7895/0.6571
Epoch: 096/100 | Batch 400/469 | Gen/Dis Loss: 0.7061/0.6780
Time elapsed: 11.17 min
Epoch: 097/100 | Batch 000/469 | Gen/Dis Loss: 0.7321/0.7248
Epoch: 097/100 | Batch 100/469 | Gen/Dis Loss: 0.7001/0.7254
Epoch: 097/100 | Batch 200/469 | Gen/Dis Loss: 0.7020/0.7219
Epoch: 097/100 | Batch 300/469 | Gen/Dis Loss: 0.7225/0.7207
Epoch: 097/100 | Batch 400/469 | Gen/Dis Loss: 0.7752/0.6714
Time elapsed: 11.28 min
Epoch: 098/100 | Batch 000/469 | Gen/Dis Loss: 0.7079/0.6981
Epoch: 098/100 | Batch 100/469 | Gen/Dis Loss: 0.7263/0.6761
Epoch: 098/100 | Batch 200/469 | Gen/Dis Loss: 0.7192/0.7041
Epoch: 098/100 | Batch 300/469 | Gen/Dis Loss: 0.6914/0.6946
Epoch: 098/100 | Batch 400/469 | Gen/Dis Loss: 0.7224/0.6903
Time elapsed: 11.40 min
Epoch: 099/100 | Batch 000/469 | Gen/Dis Loss: 0.6888/0.7117
Epoch: 099/100 | Batch 100/469 | Gen/Dis Loss: 0.6730/0.6911
Epoch: 099/100 | Batch 200/469 | Gen/Dis Loss: 0.7894/0.6388
Epoch: 099/100 | Batch 300/469 | Gen/Dis Loss: 0.7230/0.6749
Epoch: 099/100 | Batch 400/469 | Gen/Dis Loss: 0.6603/0.7051
Time elapsed: 11.51 min
Epoch: 100/100 | Batch 000/469 | Gen/Dis Loss: 0.7191/0.6858
Epoch: 100/100 | Batch 100/469 | Gen/Dis Loss: 0.7046/0.6928
Epoch: 100/100 | Batch 200/469 | Gen/Dis Loss: 0.7044/0.7029
Epoch: 100/100 | Batch 300/469 | Gen/Dis Loss: 0.6907/0.6906
Epoch: 100/100 | Batch 400/469 | Gen/Dis Loss: 0.7018/0.6982
Time elapsed: 11.63 min
Total Training Time: 11.63 min
```

```
In [ ]:  model.eval()
         # Make new images
         z = torch.zeros((5, LATENT_DIM)).uniform_(-1.0, 1.0).to(device)
         generated_features = model.generator_forward(z)
         imgs = generated_features.view(-1, 28, 28)

         fig, axes = plt.subplots(nrows=1, ncols=5, figsize=(20, 2.5))


         for i, ax in enumerate(axes):
             axes[i].imshow(imgs[i].to(torch.device('cpu')).detach(), cmap='binary')
```