dcgan

August 28, 2024

[1]:
```
import os
from timeit import default_timer as timer

import numpy as np
import pandas as pd
import torch
import torchvision
import torch.nn as nn
import torch.optim as optim
import torch.nn.functional as F
import torchvision.datasets as datasets
import torchvision.transforms as transforms
from torch.utils.data import DataLoader, random_split
from torchvision.datasets import MNIST
from torch.utils.tensorboard import SummaryWriter
import matplotlib.pyplot as plt

os.environ['KMP_DUPLICATE_LIB_OK'] = 'True'
torch.manual_seed(1)
device="cuda"
```

[2]:
```
#source: https://www.kaggle.com/datasets/oddrationale/mnist-in-csv
dat = pd.read_csv('./mnist_train.csv')
```

[ ]:
```

```

[3]:
```
class Discriminator(nn.Module):
    def __init__(self, dim = 32):
        super().__init__()
        self.dim = dim
        self.conv = nn.Sequential(
            nn.Conv2d(1, dim, 4, 2, 1),
            #nn.BatchNorm2d(dim),
            nn.LeakyReLU(0.2),
            nn.Dropout(0.2),

            nn.Conv2d(dim, dim*2, 3, 1, 1),
            nn.BatchNorm2d(dim*2),
```

```
            nn.LeakyReLU(0.2),
            nn.Dropout(0.2),

            nn.Conv2d(dim*2, dim*4, 3, 1, 1),
            nn.BatchNorm2d(dim*4),
            nn.LeakyReLU(0.2),
            nn.Dropout(0.2),

            nn.Conv2d(dim*4, dim*8, 4, 2, 1),
            nn.BatchNorm2d(dim*8),
            nn.LeakyReLU(0.2),
            nn.Dropout(0.2)
        )
        self.fc = nn.Linear(dim*8*7*7, 1)

    def forward(self, x):
        x = x.view(-1, 1, 28, 28)
        x = self.conv(x)
        x = x.view(-1, self.dim*8*7*7)
        x = self.fc(x)

        #x = torch.sigmoid(x)

        return x.view(-1)
```

[4]:
```
class Generator(nn.Module):

    def __init__(self, dim = 32, zdim = 100):
        super().__init__()
        self.dim = dim
        self.fc = nn.Linear(zdim, dim*8*7*7)
        self.conv = nn.Sequential(
            nn.ConvTranspose2d(dim*8, dim*4, 4, 2, 1),
            nn.BatchNorm2d(dim*4),
            nn.ReLU(),
            nn.Dropout(0.2),

            nn.ConvTranspose2d(dim*4, dim*2, 3, 1, 1),
            nn.BatchNorm2d(dim*2),
            nn.ReLU(),
            nn.Dropout(0.2),

            nn.ConvTranspose2d(dim*2, dim, 3, 1, 1),
            nn.BatchNorm2d(dim),
            nn.ReLU(),
            nn.Dropout(0.2),
```

```
            nn.ConvTranspose2d(dim, 1, 4, 2, 1),
            #nn.BatchNorm2d(1),
            #nn.ReLU(),
            #nn.Dropout(0.2),

            nn.Tanh()
        )

    def forward(self, x):
        x = self.fc(x)
        x = x.view(-1, self.dim*8, 7, 7)
        x = self.conv(x)

        return x
```

[5]:
```
def generate_images(val, batchsize=32, zdim=100, epochs=10, verbose=1):
    start=timer()
    train = torch.Tensor(dat[dat['label'] == val].values[:,1:].reshape(-1, 28,␣
↪28)/255)*2-1
    dataloader = DataLoader(train, batch_size = batchsize, shuffle = True)

    dis = Discriminator().to(device)
    gen = Generator().to(device)
    Loss = nn.BCEWithLogitsLoss()
    dis_optimizer = optim.Adam(dis.parameters(), lr = 0.0002, betas = (0.5, 0.
↪999))
    gen_optimizer = optim.Adam(gen.parameters(), lr = 0.0002, betas = (0.5, 0.
↪999))



    dis_loss = np.zeros(epochs)
    gen_loss = np.zeros(epochs)

    fixed_samples = torch.randn(9, zdim)
    fixed_samples = fixed_samples.to(device)
    print("preprocessing time =", timer()-start)

    for epoch in range(epochs):

        for x in dataloader:
            dis.train()
            gen.train()
            noise = torch.randn(x.shape[0], zdim).to(device).float()

            dis_optimizer.zero_grad()
            y_real = dis(x.to(device).float())
```

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            fake_imgs = gen(noise).detach()
            y_fake = dis(fake_imgs.float())

            loss = Loss(y_real, torch.ones(x.shape[0]).to(device)) +␣
↪Loss(y_fake, torch.zeros(x.shape[0]).to(device))
            dis_loss[epoch] += loss.item()
            loss.backward()
            dis_optimizer.step()


            gen_optimizer.zero_grad()
            fake_imgs = gen(noise)
            y = dis(fake_imgs.float())

            loss = Loss(y, torch.ones(x.shape[0]).to(device))
            gen_loss[epoch] += loss.item()
            loss.backward()
            gen_optimizer.step()

        dis_loss/=len(dataloader)
        gen_loss/=len(dataloader)

        if (verbose>=2 or (verbose==1 and epoch==epochs-1)):
            gen.eval()
            samples = gen(fixed_samples.float())

            fig, axes = plt.subplots(3,3)
            for i in range(9):
                img = samples[i].cpu().detach()[0]
                axes[i//3,i%3].imshow(img, cmap='Greys_r')

        if (verbose>=1):
            print("Epoch", epoch, "time =", timer()-start,
                  "Dis loss =", dis_loss[epoch],
                  "Gen loss =", gen_loss[epoch])

    if (verbose>=2):
        plt.clf()
        plt.plot(range(epochs),dis_loss,label="discriminator loss")
        plt.plot(range(epochs),gen_loss,label="generator loss")
        plt.title("loss plot")
        plt.legend()
        plt.ylabel("loss")
        plt.xlabel("epoch")
        plt.ylim([0,0.1+np.max([dis_loss,gen_loss])])
        plt.show()
```

[6]:
```
torch.manual_seed(1)
for i in range(10):
    generate_images(i)
```

```
preprocessing time = 0.2121671000495553
Epoch 0 time = 3.6422428999794647 Dis loss = 0.3114438025901715 Gen loss =
3.4030759833672994
Epoch 1 time = 6.16332210006658 Dis loss = 0.6784532299285294 Gen loss =
2.5234349882730873
Epoch 2 time = 8.68349930003751 Dis loss = 0.838957497830032 Gen loss =
2.1570002848422654
Epoch 3 time = 11.276596799958497 Dis loss = 0.9348445545922044 Gen loss =
1.7722680549467764
Epoch 4 time = 14.080173800000921 Dis loss = 1.0352893305081192 Gen loss =
1.5799581536682703
Epoch 5 time = 16.70521980000194 Dis loss = 1.0679099192862869 Gen loss =
1.4304699848095577
Epoch 6 time = 19.268723399960436 Dis loss = 1.105244440737591 Gen loss =
1.341899908678506
Epoch 7 time = 21.802384400041774 Dis loss = 1.1156921421968808 Gen loss =
1.2659540222857588
Epoch 8 time = 24.33496190002188 Dis loss = 1.1210206301622494 Gen loss =
1.2575721708677148
Epoch 9 time = 27.04979399999138 Dis loss = 1.1566157600572031 Gen loss =
1.2485946178115823
preprocessing time = 0.08455979998689145
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Epoch 1 time = 6.556705199996941 Dis loss = 0.9967022637055384 Gen loss =
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Epoch 2 time = 9.484984199982136 Dis loss = 1.0668272308263733 Gen loss =
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Epoch 3 time = 12.726346599985845 Dis loss = 1.125667931344272 Gen loss =
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Epoch 4 time = 15.797376699978486 Dis loss = 1.1635403246111213 Gen loss =
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Epoch 5 time = 18.964965200051665 Dis loss = 1.1992482311352735 Gen loss =
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Epoch 6 time = 22.64109210006427 Dis loss = 1.2202871385343832 Gen loss =
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Epoch 3 time = 11.584255599998869 Dis loss = 0.78696037413644 Gen loss =
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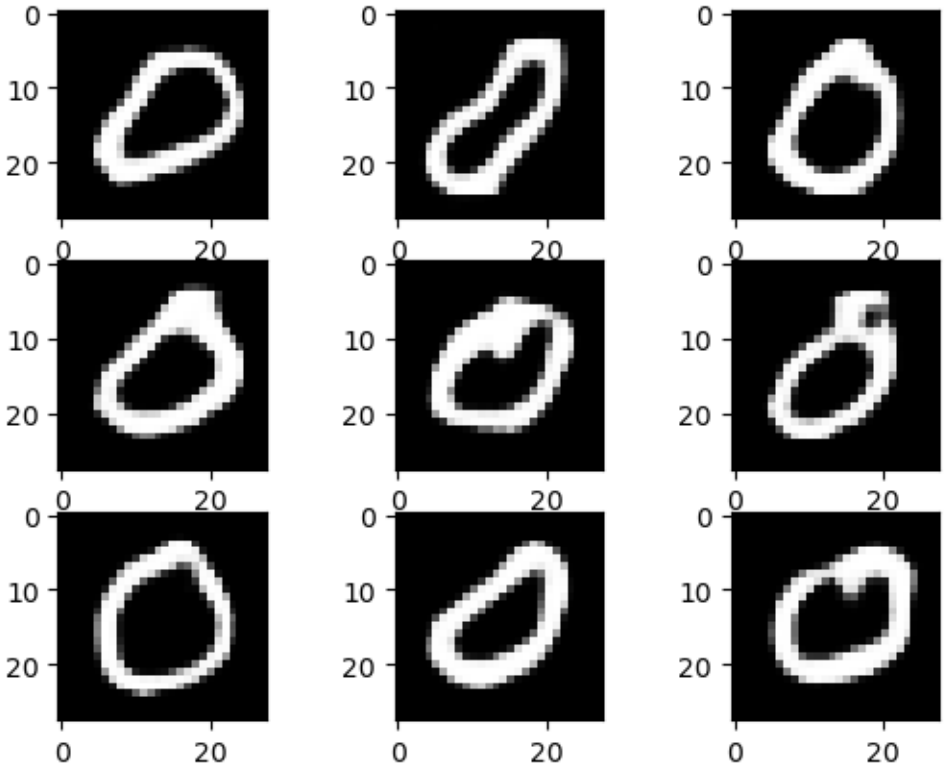

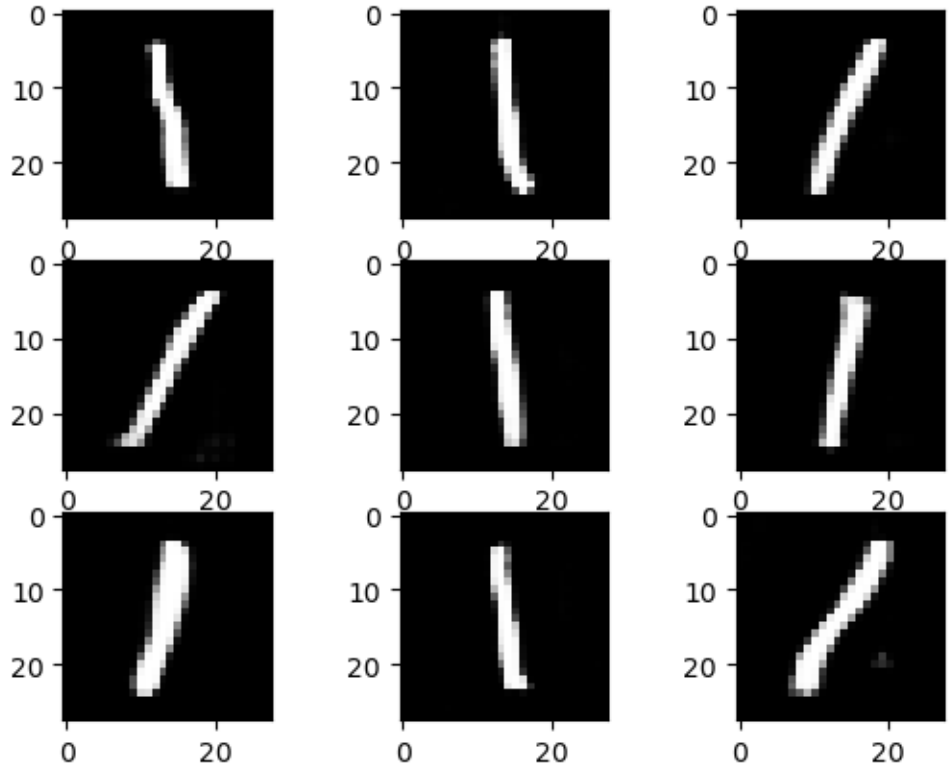

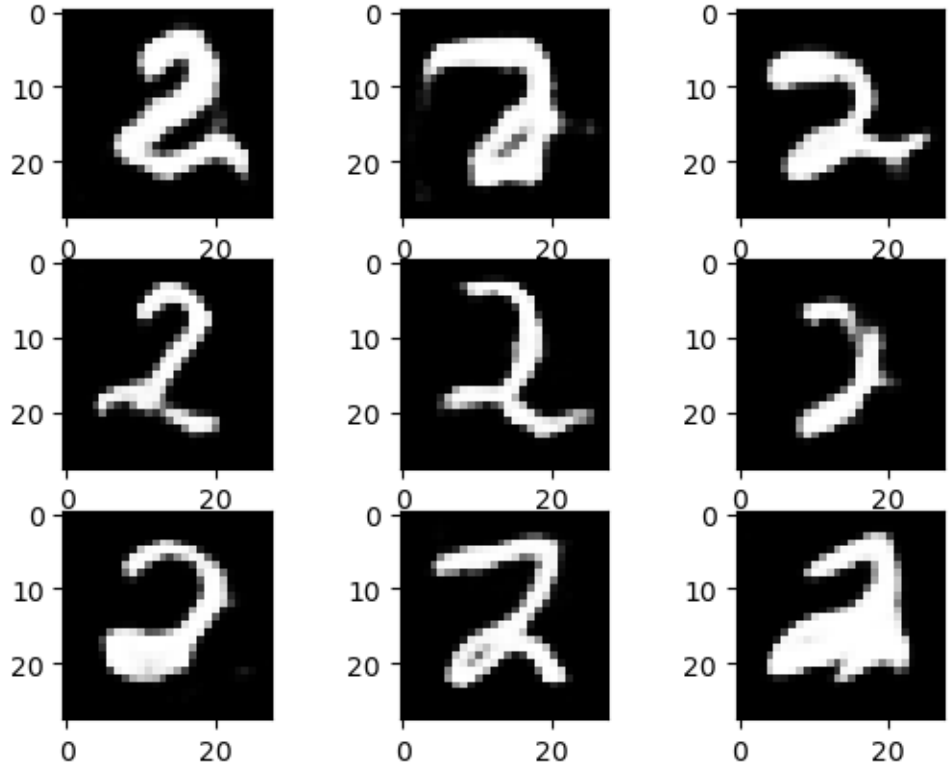

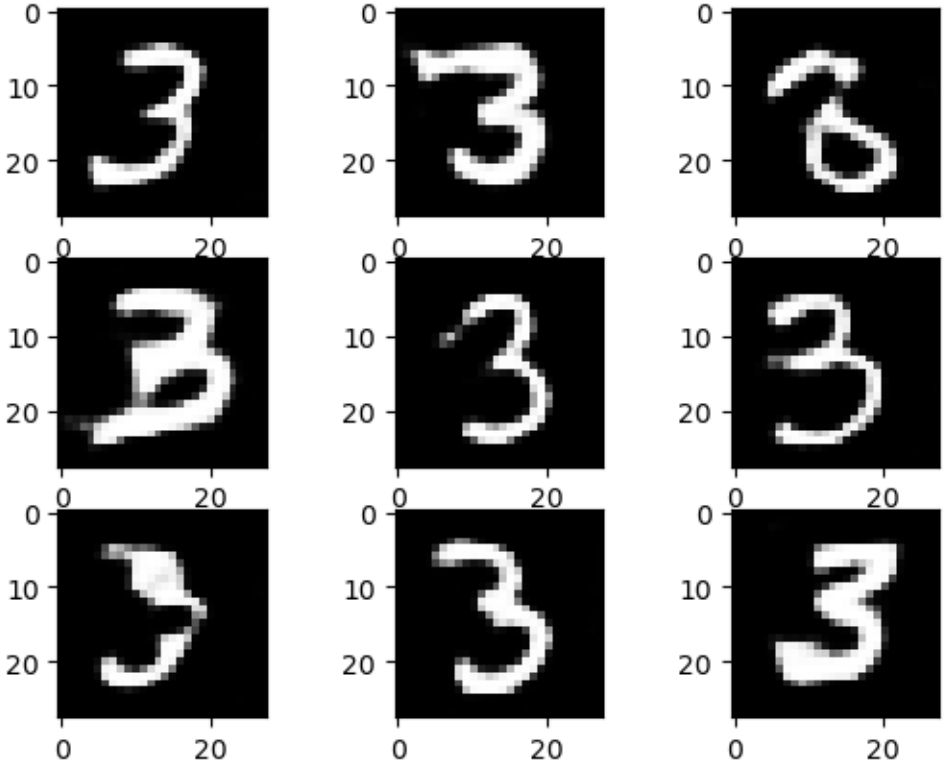

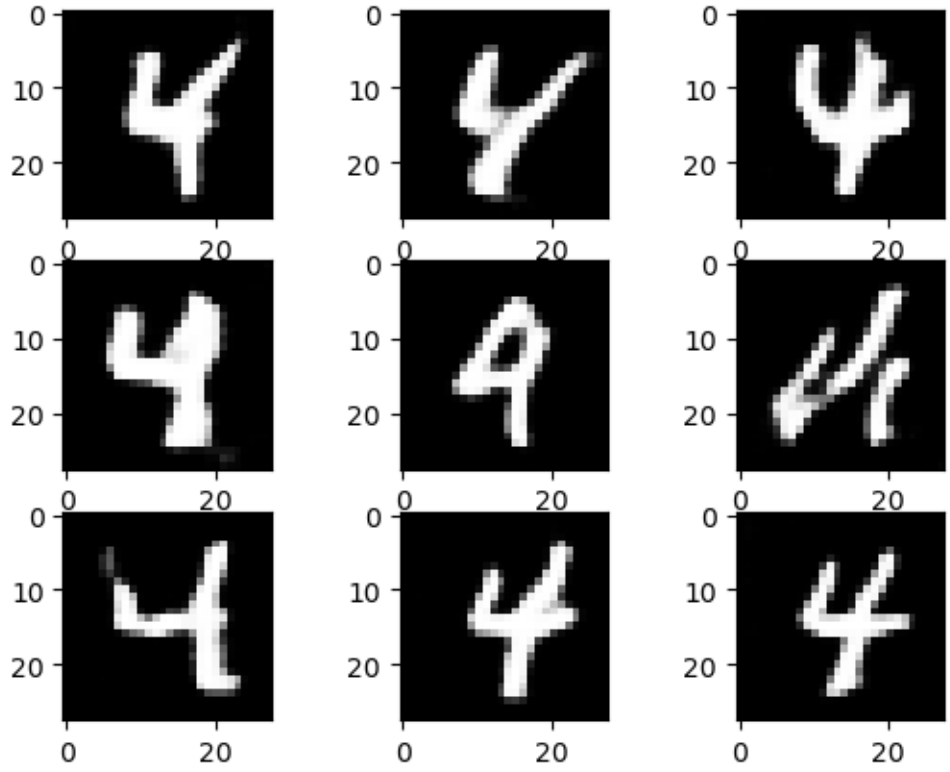

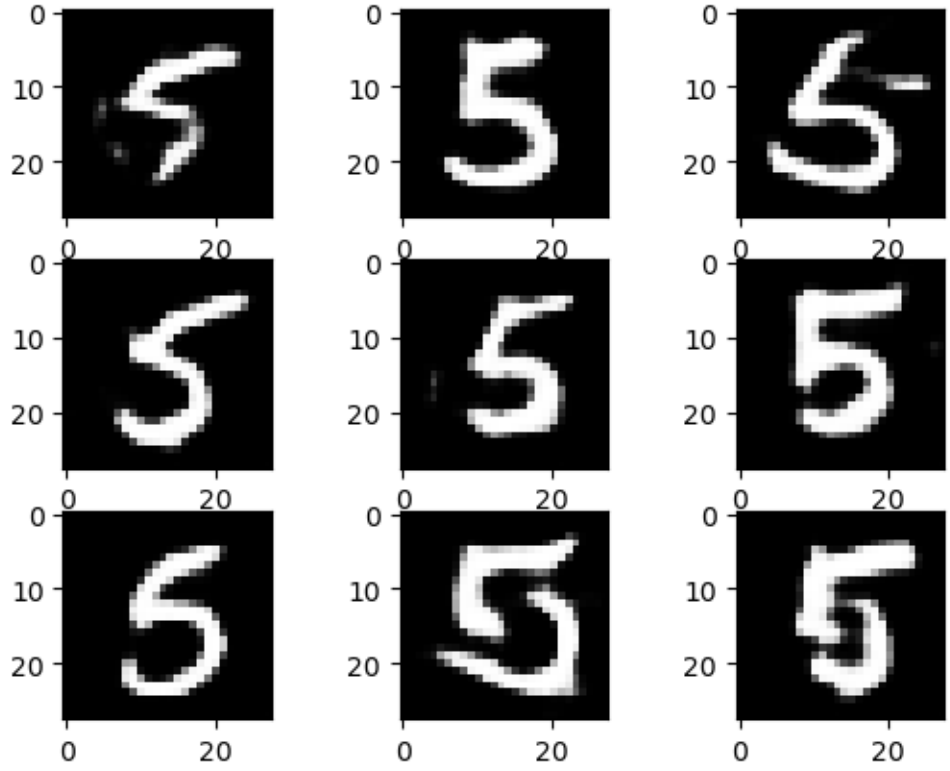

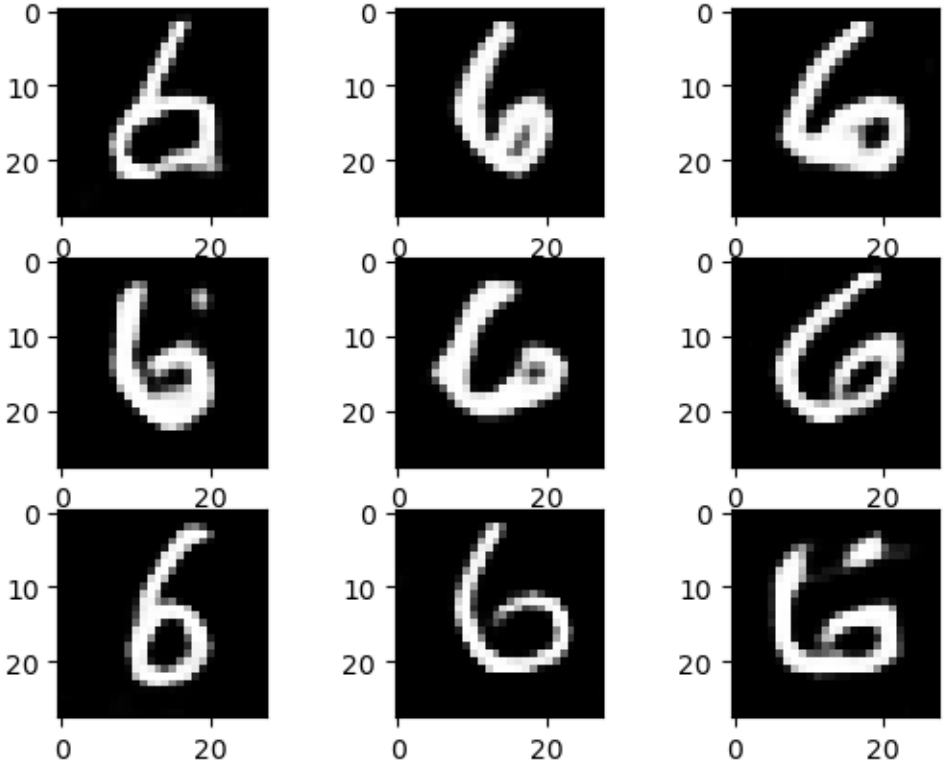
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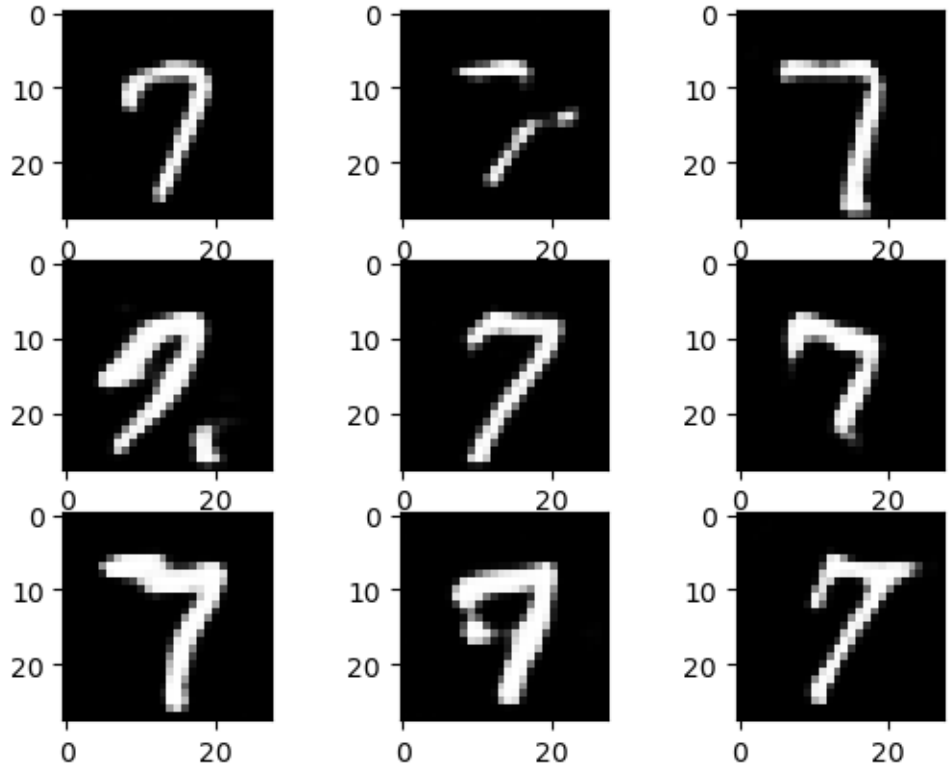
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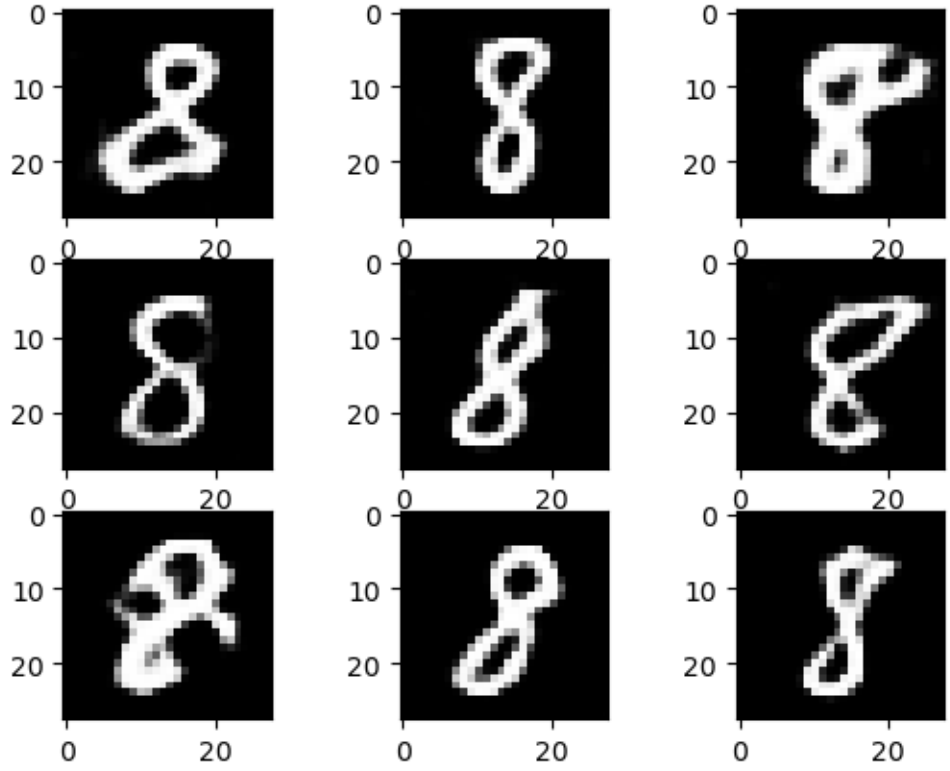
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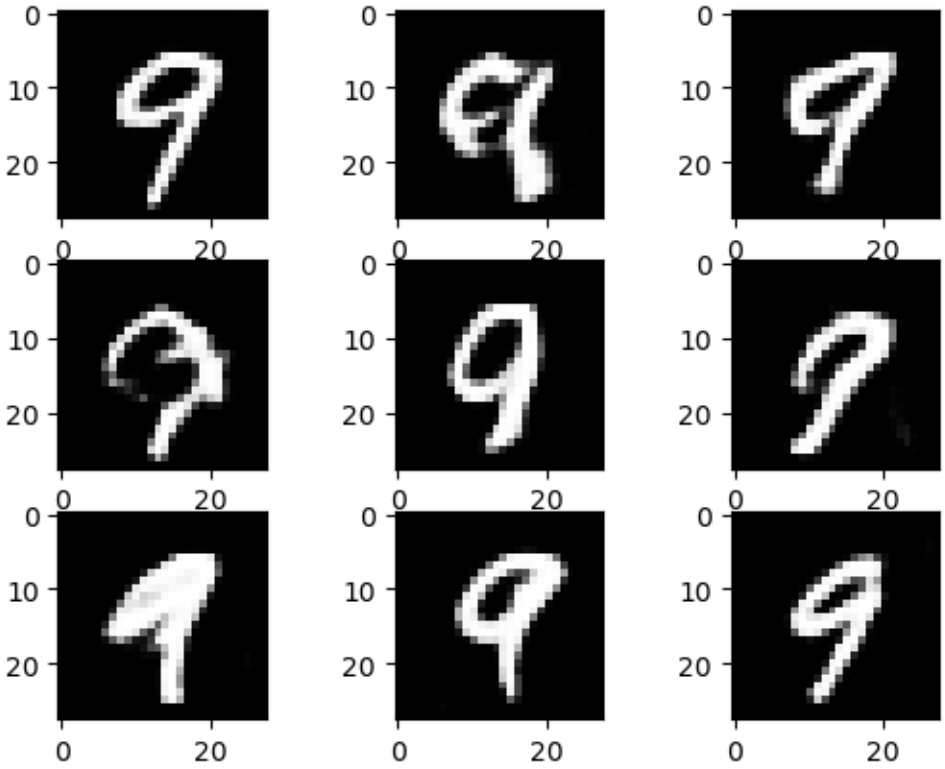

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