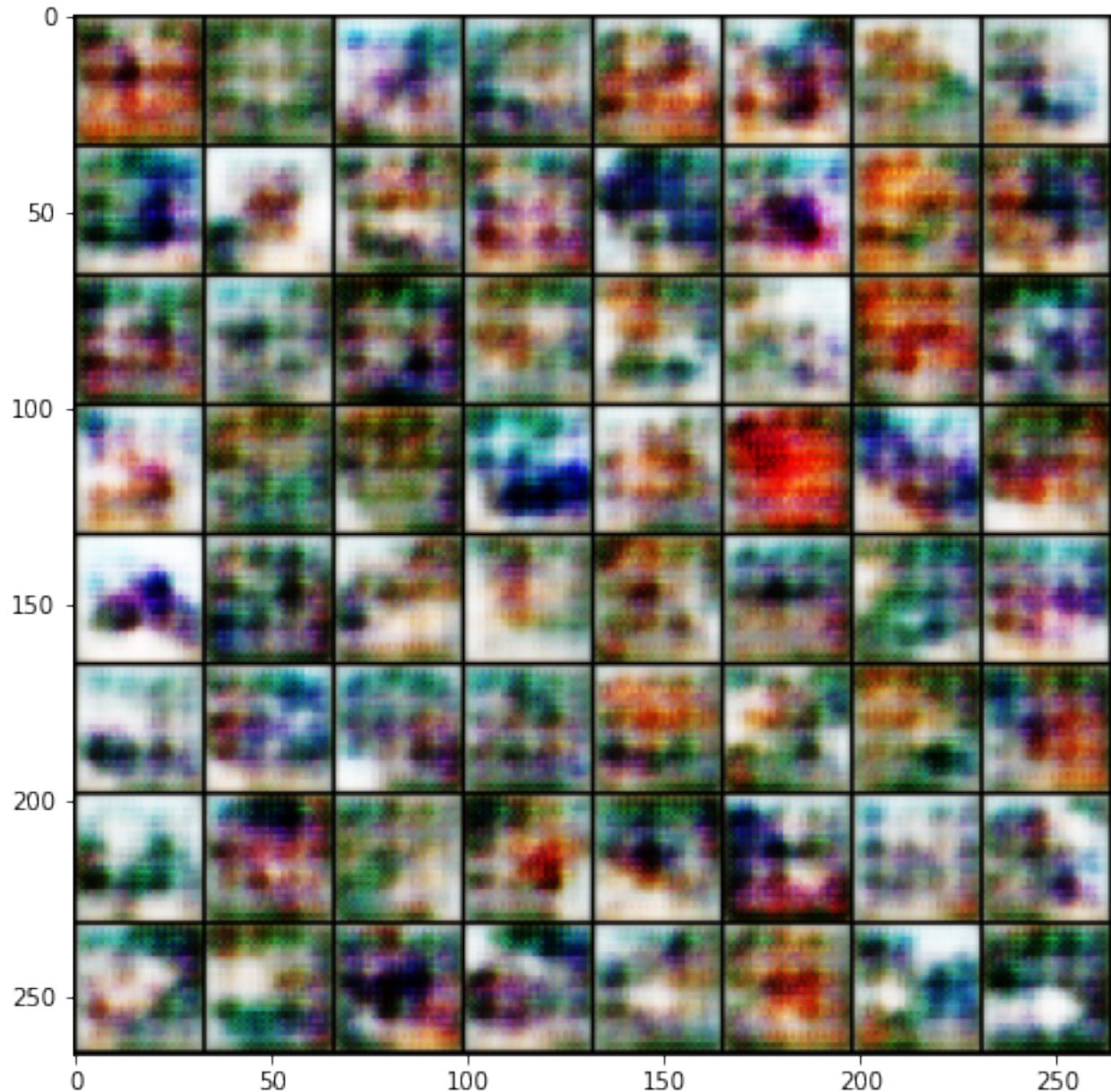
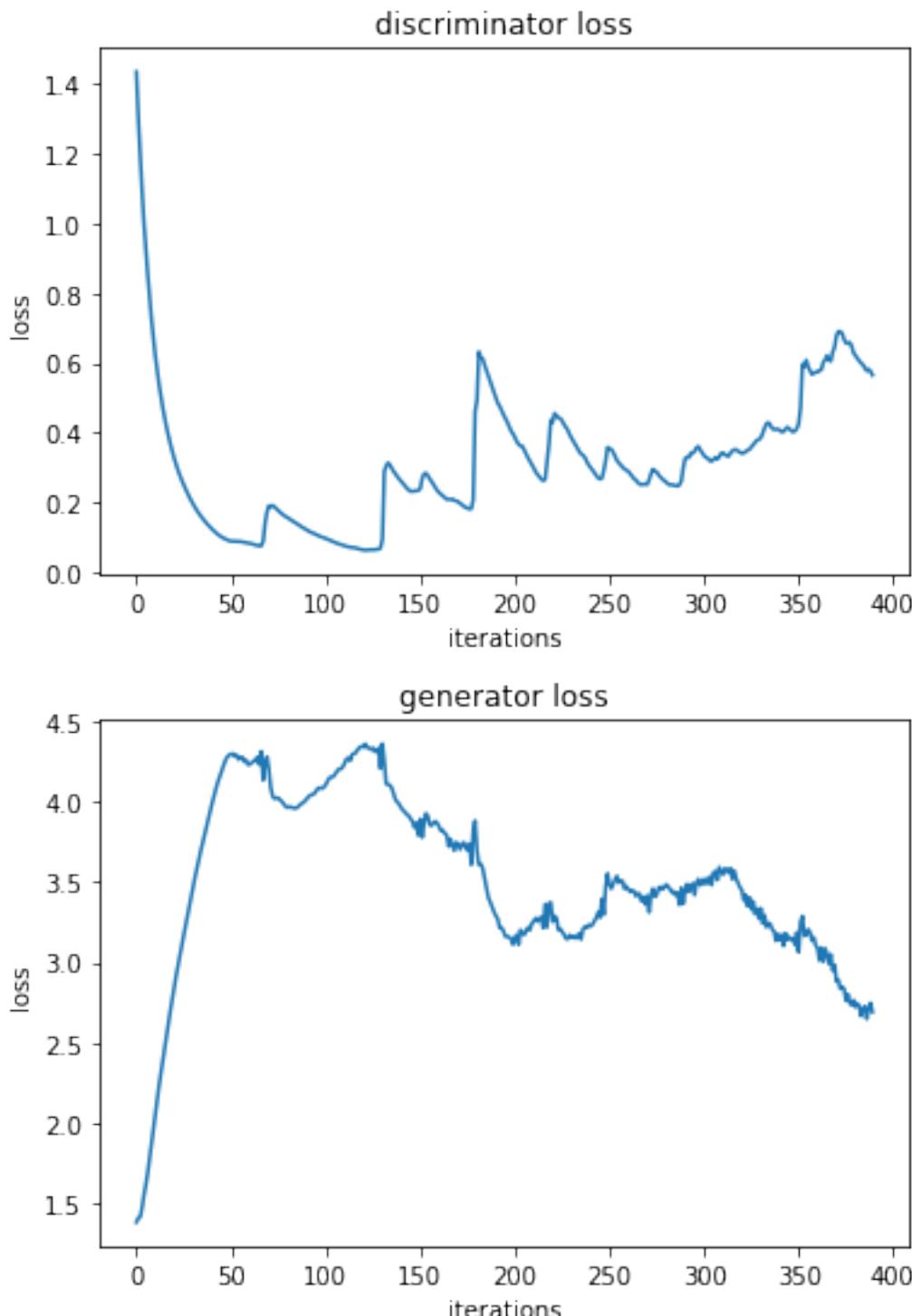


## Programming Assignment #2

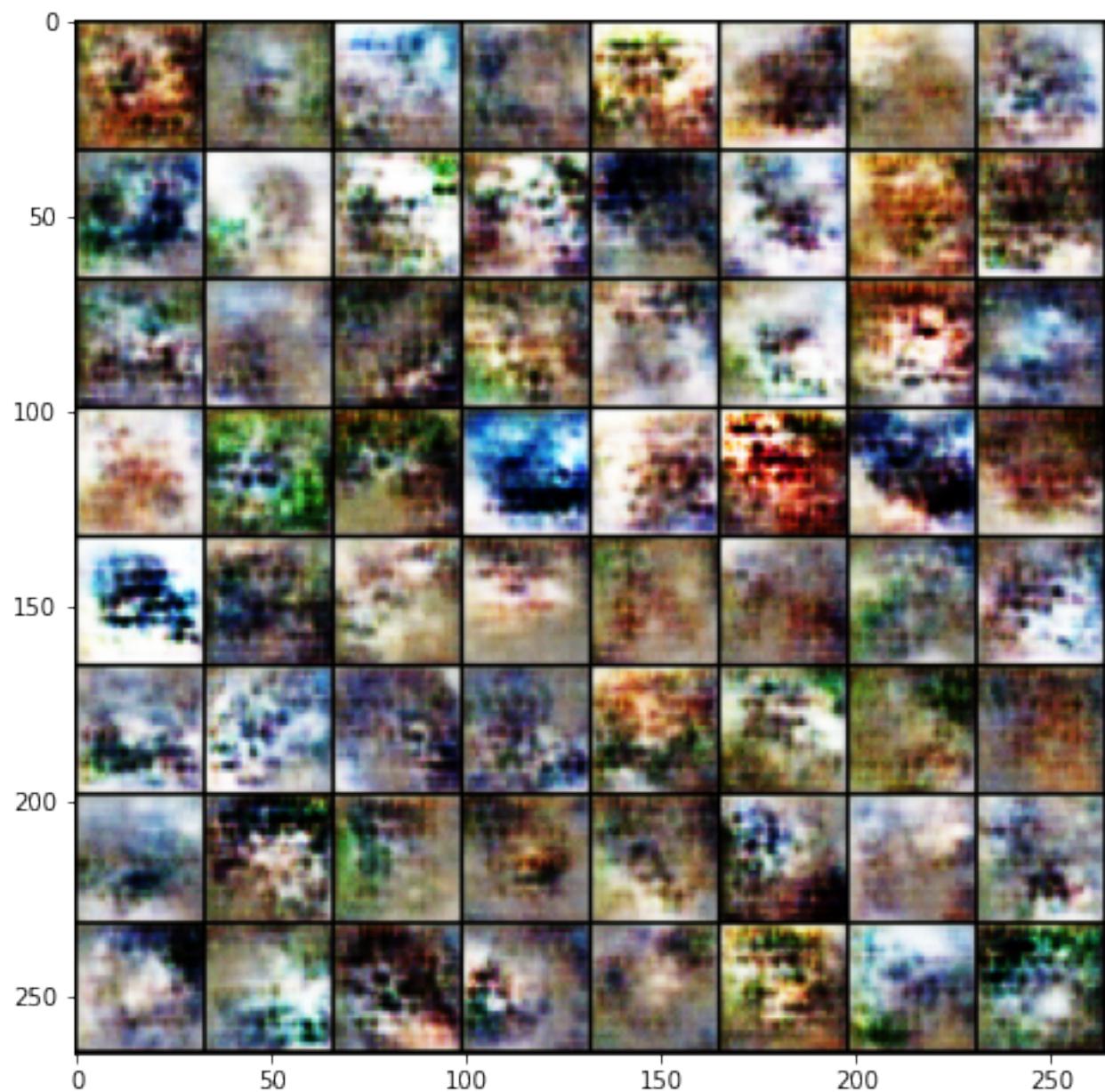
## 1. Training curves and generated images for the GAN

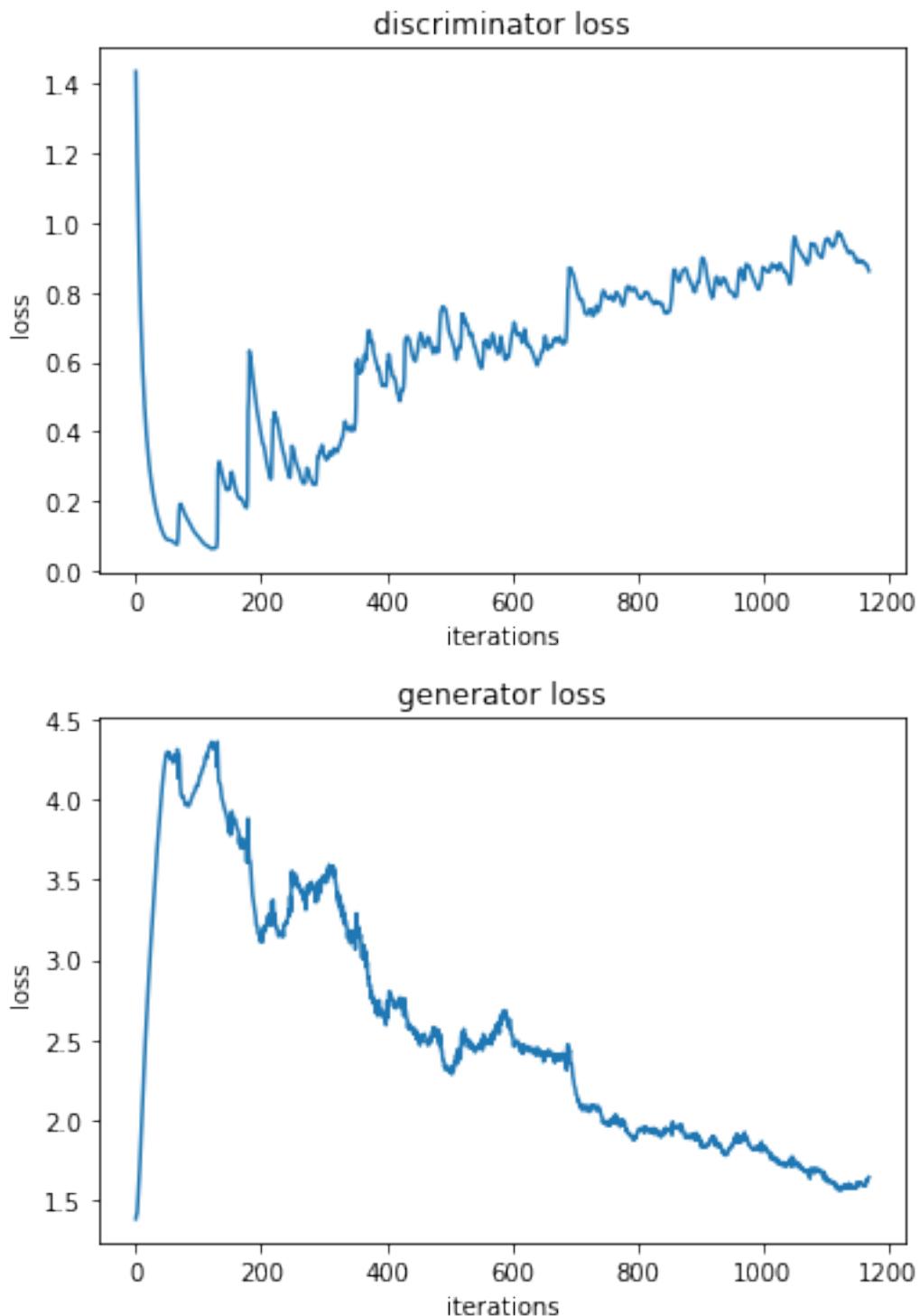
```
Start training ...
Iteration 100/9750: dis loss = 0.0629, gen loss = 4.2351
Iteration 200/9750: dis loss = 0.2497, gen loss = 2.4778
Iteration 300/9750: dis loss = 0.2129, gen loss = 3.7695
```





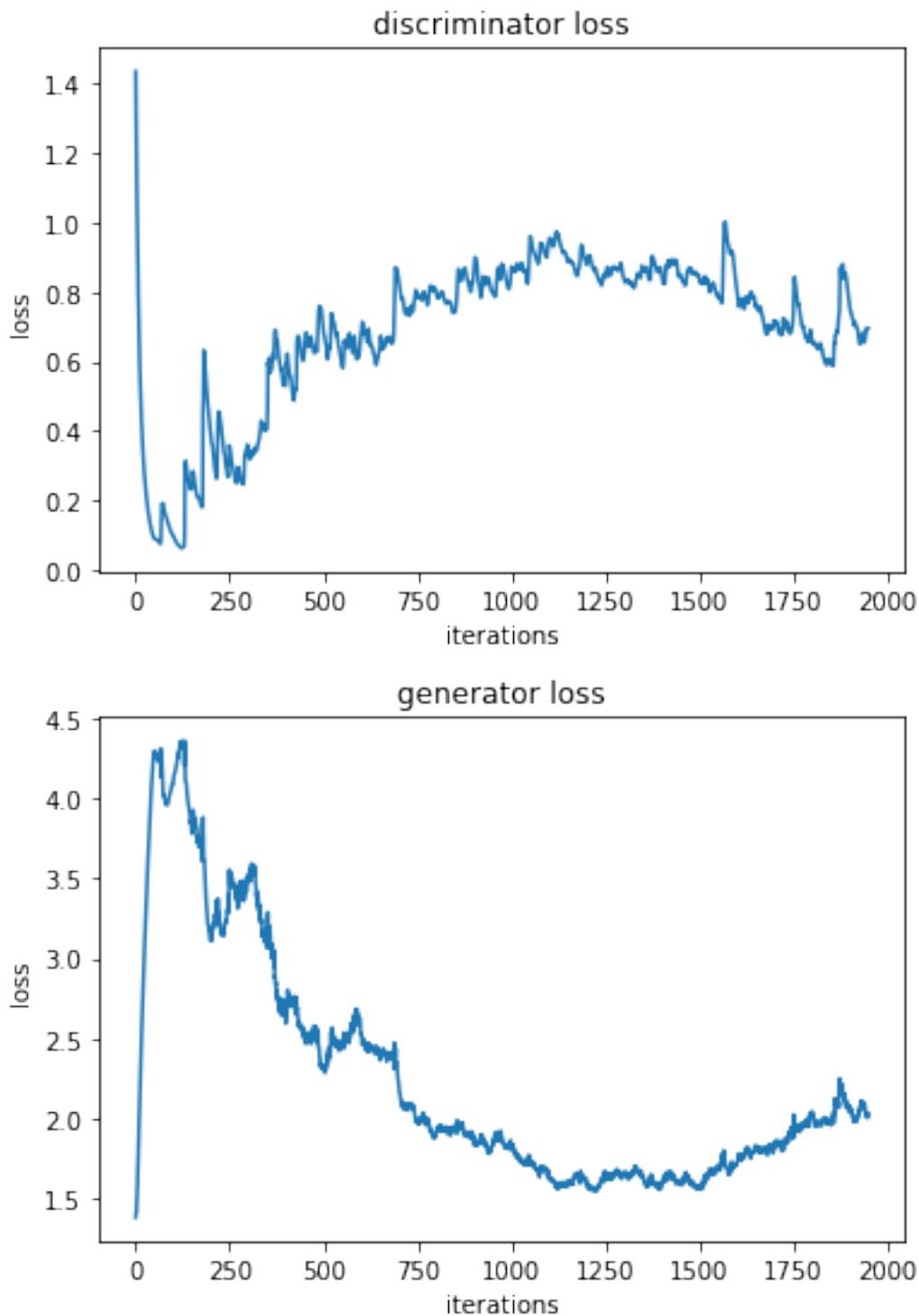
```
Iteration 400/9750: dis loss = 0.5227, gen loss = 1.2271
Iteration 500/9750: dis loss = 0.4534, gen loss = 2.5534
Iteration 600/9750: dis loss = 0.8952, gen loss = 1.7573
Iteration 700/9750: dis loss = 0.6869, gen loss = 1.6093
Iteration 800/9750: dis loss = 0.7242, gen loss = 2.3581
Iteration 900/9750: dis loss = 1.1490, gen loss = 2.1069
Iteration 1000/9750: dis loss = 1.2660, gen loss = 0.9871
Iteration 1100/9750: dis loss = 1.0671, gen loss = 2.0146
```





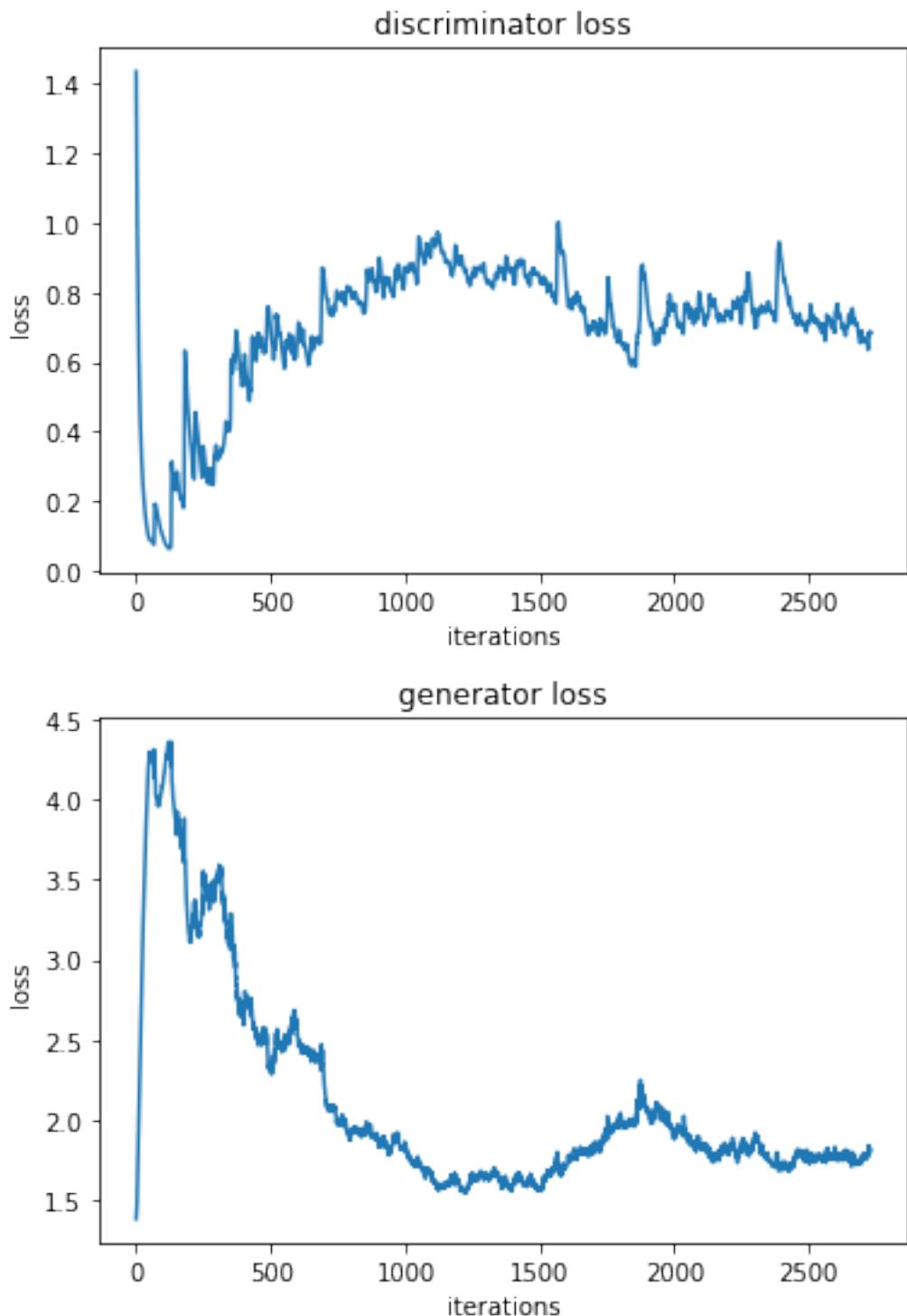
Iteration 1200/9750: dis loss = 0.7930, gen loss = 1.6598  
Iteration 1300/9750: dis loss = 0.7999, gen loss = 1.7096  
Iteration 1400/9750: dis loss = 0.7422, gen loss = 1.3521  
Iteration 1500/9750: dis loss = 0.7667, gen loss = 1.6316  
Iteration 1600/9750: dis loss = 0.6799, gen loss = 1.8167  
Iteration 1700/9750: dis loss = 0.7174, gen loss = 1.7171  
Iteration 1800/9750: dis loss = 0.5323, gen loss = 2.0609  
Iteration 1900/9750: dis loss = 0.5311, gen loss = 1.7224





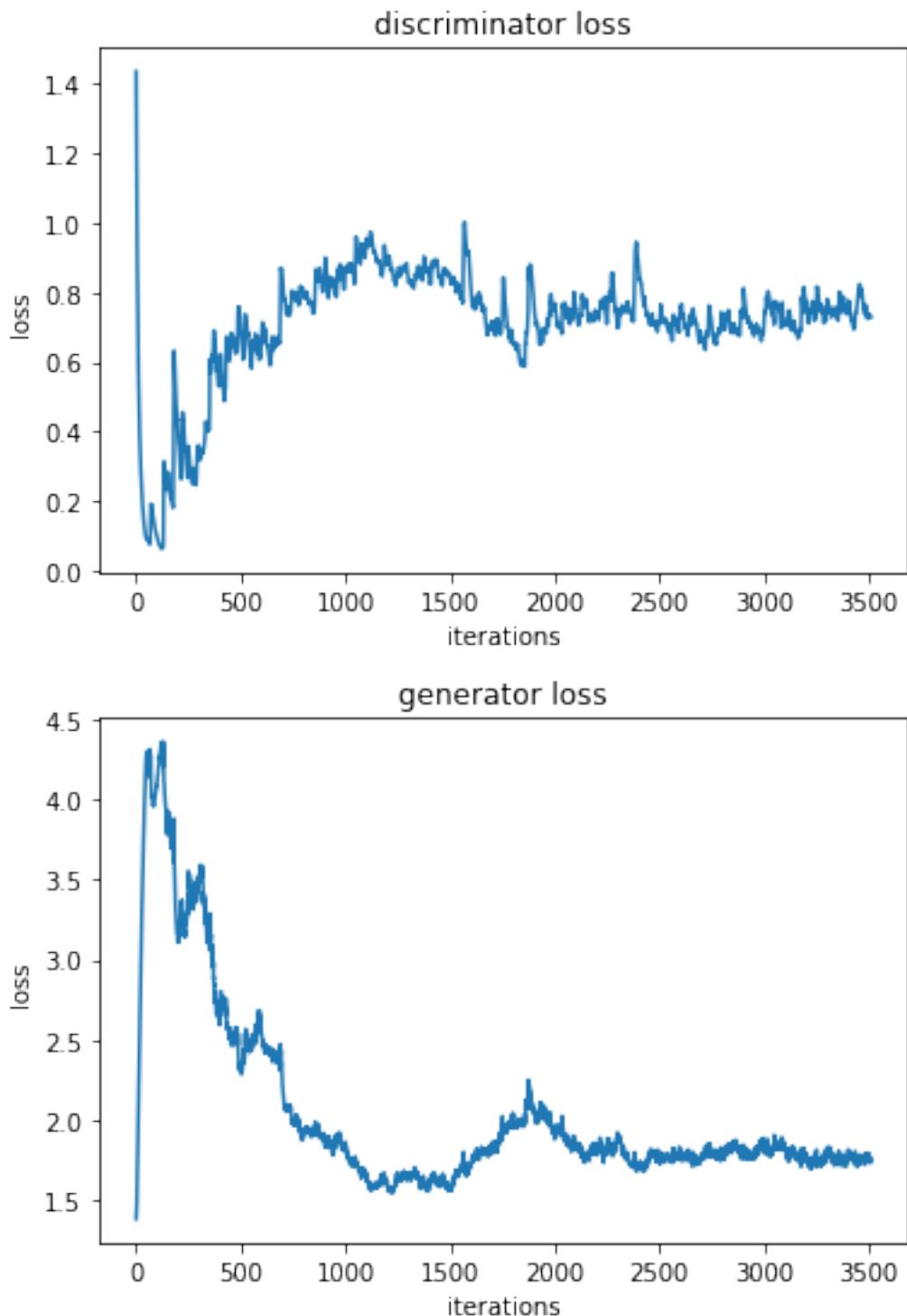
Iteration 2000/9750: dis loss = 0.8885, gen loss = 1.1243  
Iteration 2100/9750: dis loss = 0.6582, gen loss = 1.7215  
Iteration 2200/9750: dis loss = 0.6259, gen loss = 1.5566  
Iteration 2300/9750: dis loss = 0.5399, gen loss = 1.9008  
Iteration 2400/9750: dis loss = 0.8061, gen loss = 1.9047  
Iteration 2500/9750: dis loss = 0.6469, gen loss = 1.8968  
Iteration 2600/9750: dis loss = 0.7950, gen loss = 1.5524  
Iteration 2700/9750: dis loss = 0.5924, gen loss = 1.6700





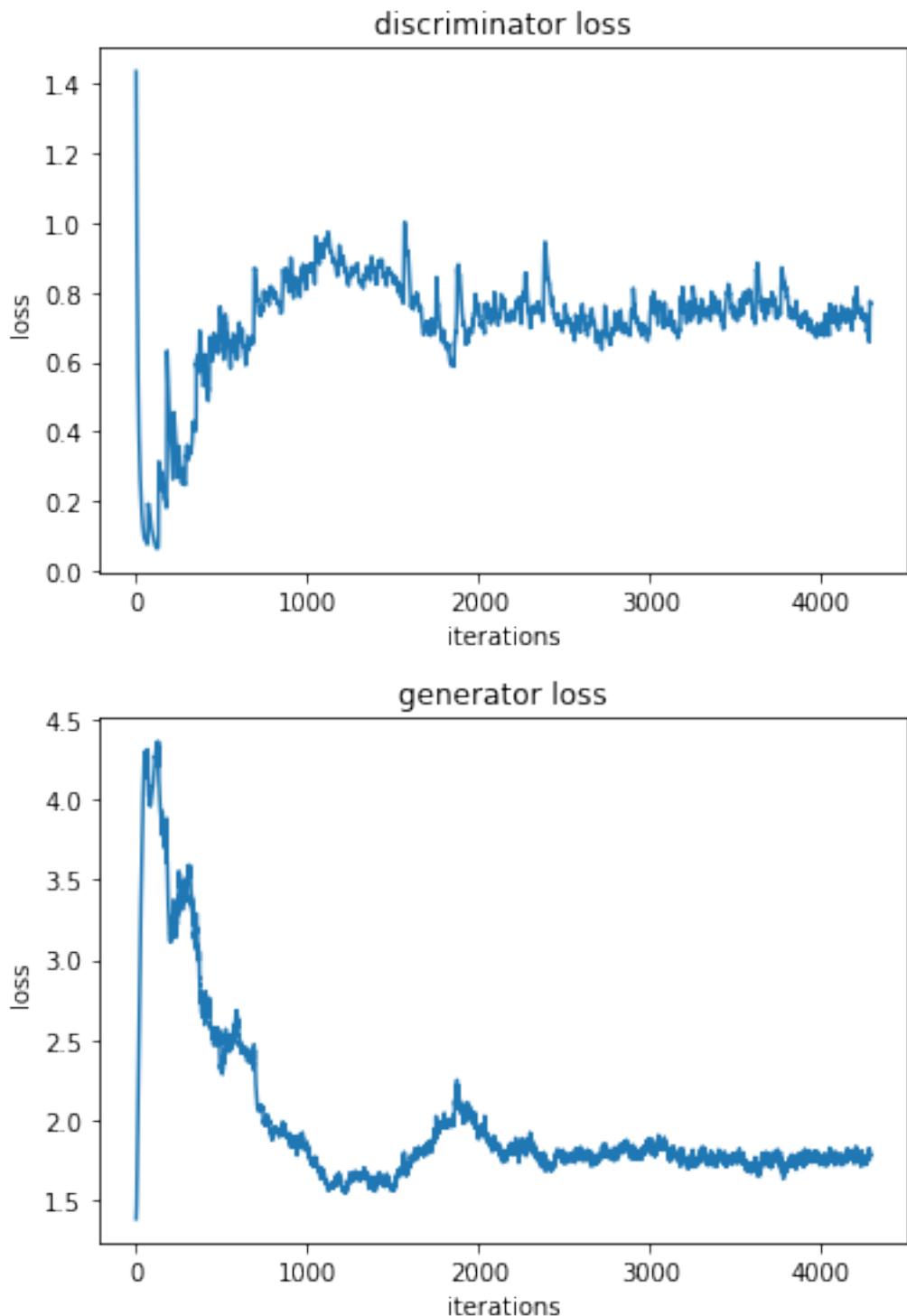
Iteration 2800/9750: dis loss = 0.6224, gen loss = 1.5939  
Iteration 2900/9750: dis loss = 0.6438, gen loss = 1.7463  
Iteration 3000/9750: dis loss = 1.1197, gen loss = 0.8040  
Iteration 3100/9750: dis loss = 0.6528, gen loss = 1.1441  
Iteration 3200/9750: dis loss = 0.7073, gen loss = 1.6726  
Iteration 3300/9750: dis loss = 0.9701, gen loss = 3.4709  
Iteration 3400/9750: dis loss = 0.8456, gen loss = 1.0558  
Iteration 3500/9750: dis loss = 0.7256, gen loss = 1.9654





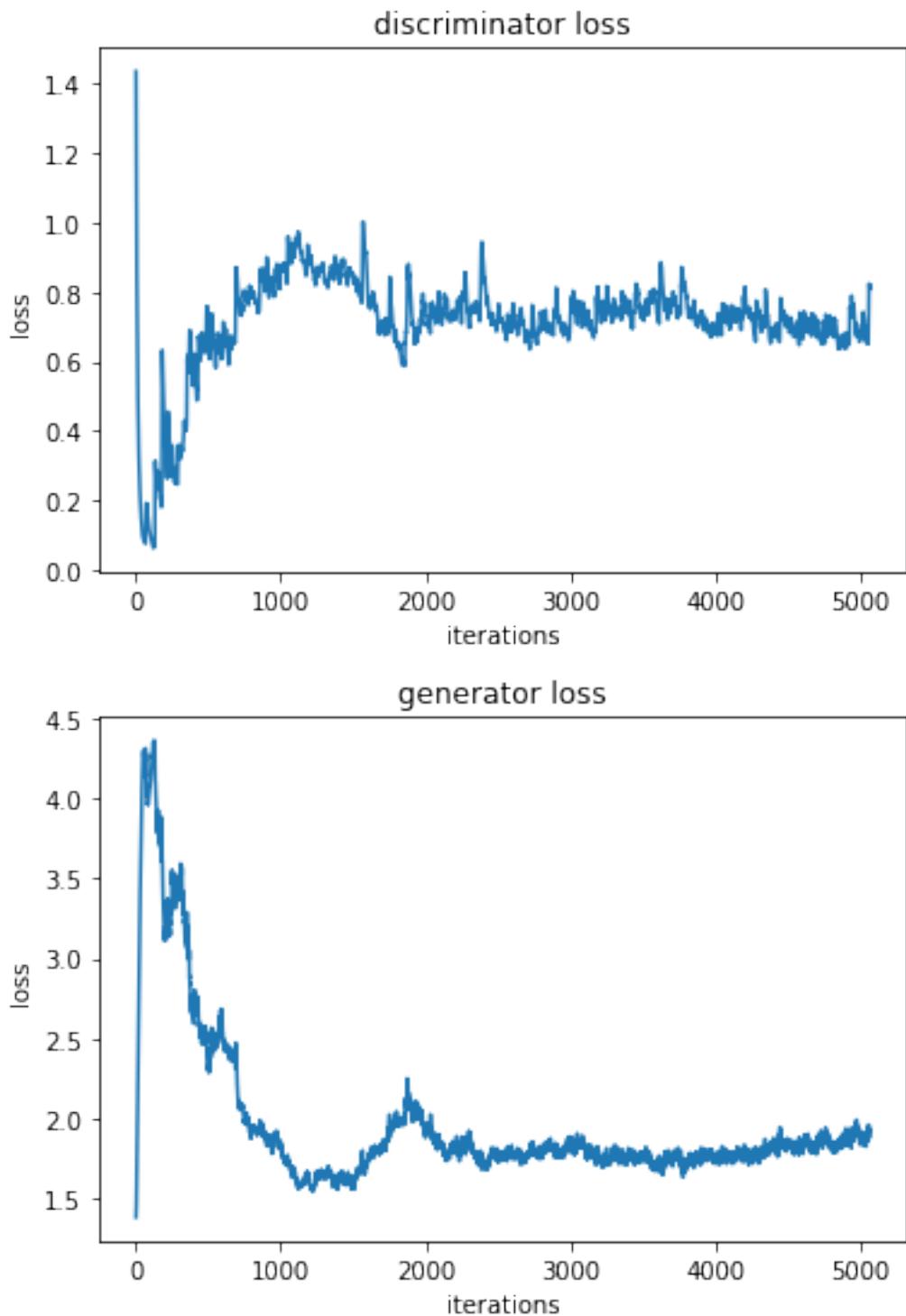
```
Iteration 3600/9750: dis loss = 0.6327, gen loss = 2.2531
Iteration 3700/9750: dis loss = 0.7037, gen loss = 1.8068
Iteration 3800/9750: dis loss = 0.6513, gen loss = 1.9482
Iteration 3900/9750: dis loss = 0.6686, gen loss = 1.1710
Iteration 4000/9750: dis loss = 0.7287, gen loss = 1.5105
Iteration 4100/9750: dis loss = 0.6815, gen loss = 1.5150
Iteration 4200/9750: dis loss = 0.6161, gen loss = 1.8334
```





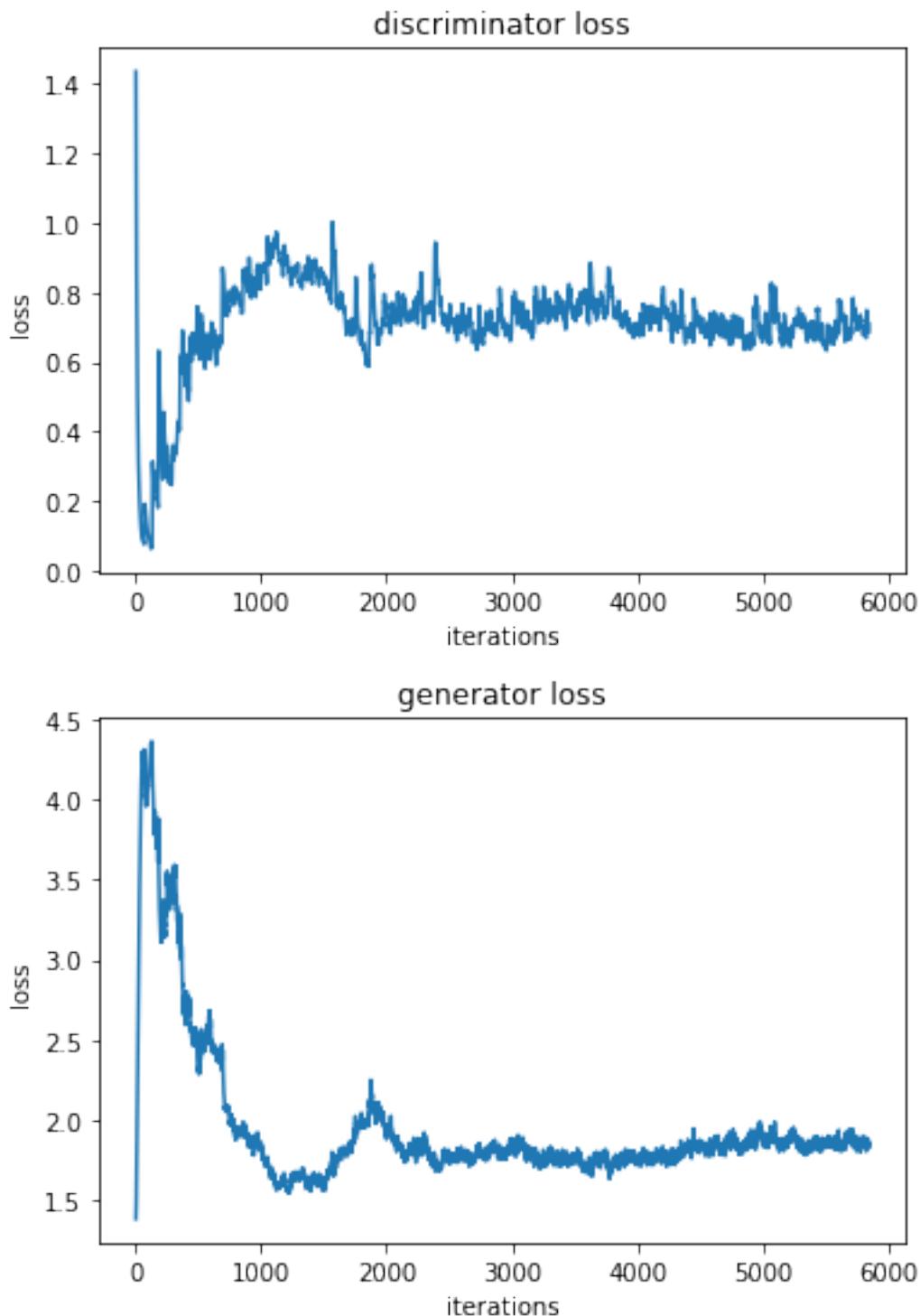
```
Iteration 4300/9750: dis loss = 0.7251, gen loss = 1.6929
Iteration 4400/9750: dis loss = 0.7480, gen loss = 1.3721
Iteration 4500/9750: dis loss = 0.6748, gen loss = 1.4612
Iteration 4600/9750: dis loss = 0.5124, gen loss = 1.9875
Iteration 4700/9750: dis loss = 0.5620, gen loss = 1.5020
Iteration 4800/9750: dis loss = 0.6041, gen loss = 1.6057
Iteration 4900/9750: dis loss = 0.5939, gen loss = 1.8536
Iteration 5000/9750: dis loss = 0.5602, gen loss = 2.3359
```





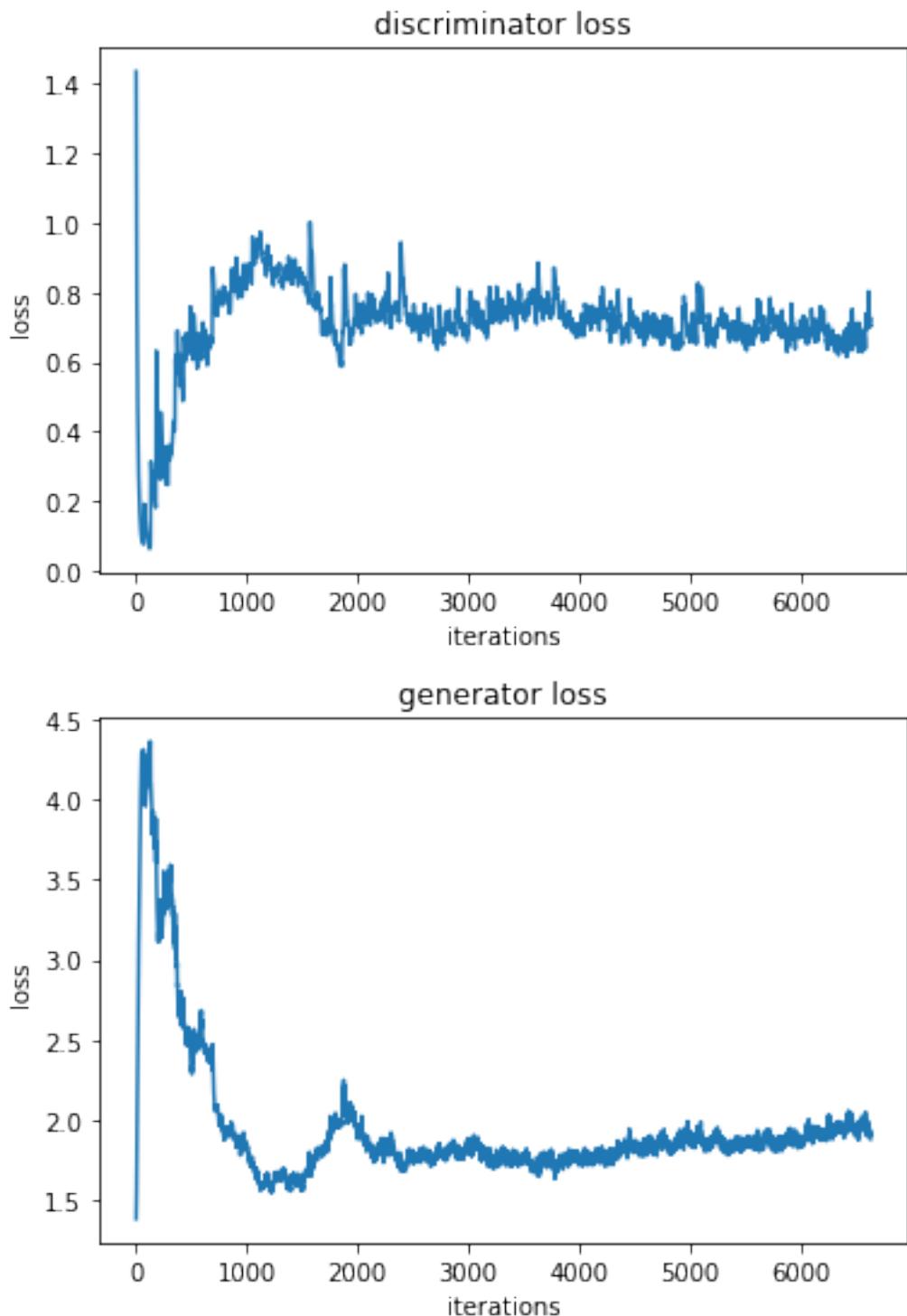
```
Iteration 5100/9750: dis loss = 0.8755, gen loss = 1.6082
Iteration 5200/9750: dis loss = 0.5713, gen loss = 1.3494
Iteration 5300/9750: dis loss = 0.6811, gen loss = 2.3659
Iteration 5400/9750: dis loss = 0.6290, gen loss = 2.3640
Iteration 5500/9750: dis loss = 0.5427, gen loss = 1.6380
Iteration 5600/9750: dis loss = 0.8667, gen loss = 1.4200
Iteration 5700/9750: dis loss = 0.6736, gen loss = 2.6629
Iteration 5800/9750: dis loss = 0.5832, gen loss = 1.6845
```





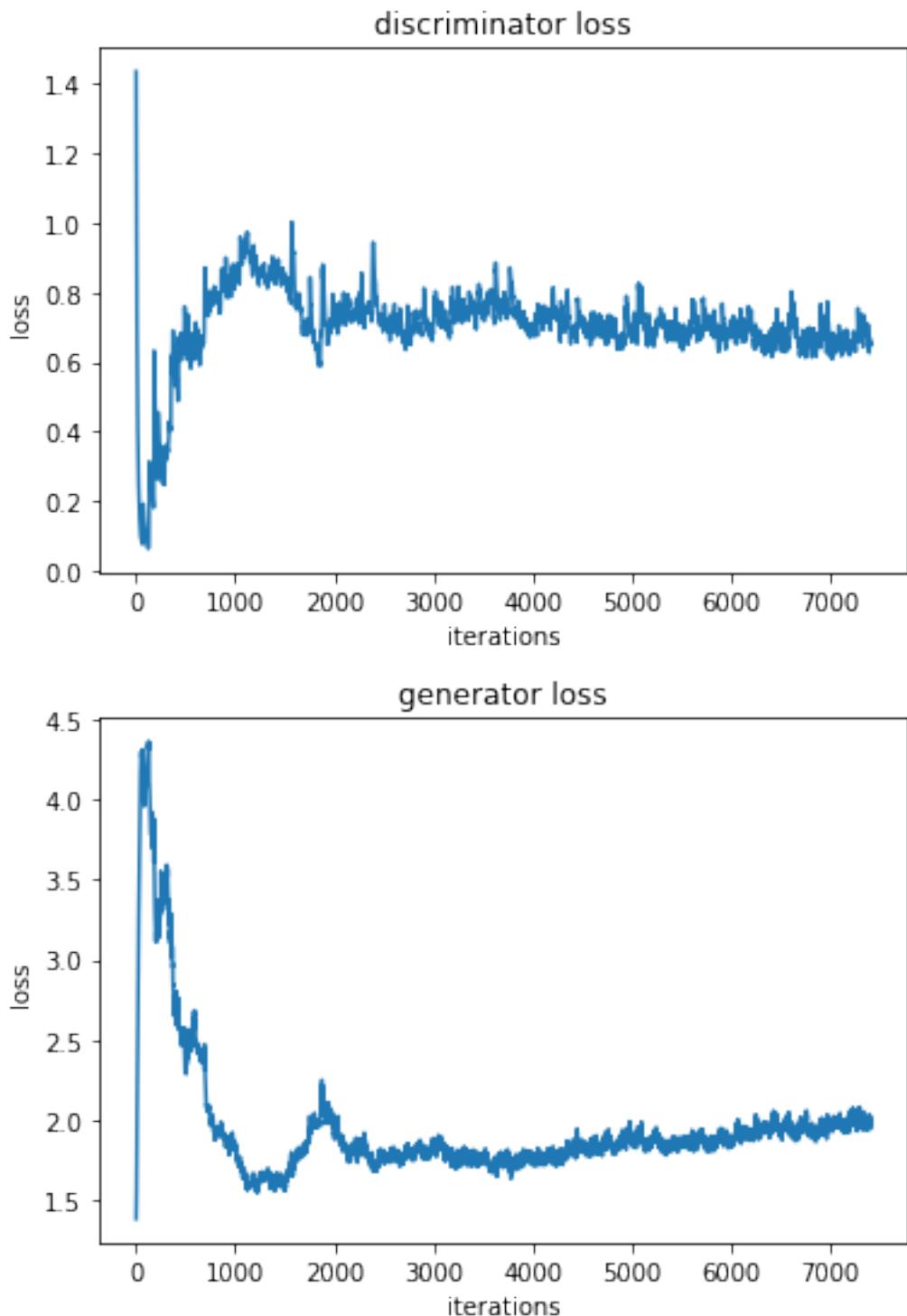
```
Iteration 5900/9750: dis loss = 0.7379, gen loss = 1.3723
Iteration 6000/9750: dis loss = 0.6272, gen loss = 2.3189
Iteration 6100/9750: dis loss = 0.7428, gen loss = 1.3738
Iteration 6200/9750: dis loss = 1.0995, gen loss = 2.9812
Iteration 6300/9750: dis loss = 0.7271, gen loss = 3.0213
Iteration 6400/9750: dis loss = 0.6095, gen loss = 1.3125
Iteration 6500/9750: dis loss = 0.7458, gen loss = 1.0691
Iteration 6600/9750: dis loss = 0.7886, gen loss = 1.4806
```





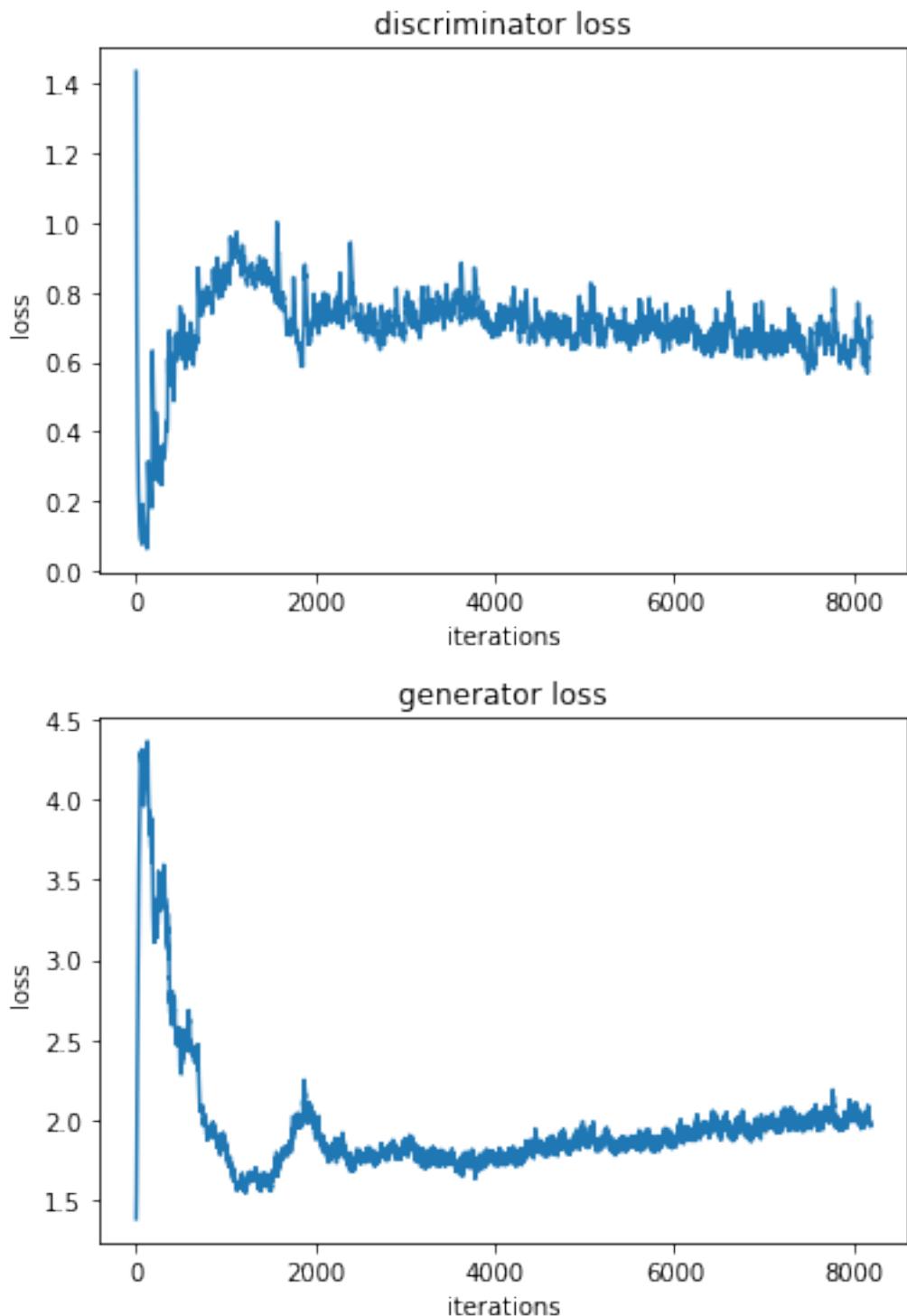
```
Iteration 6700/9750: dis loss = 0.6063, gen loss = 1.8489
Iteration 6800/9750: dis loss = 0.6195, gen loss = 1.5746
Iteration 6900/9750: dis loss = 0.5387, gen loss = 2.2534
Iteration 7000/9750: dis loss = 0.6296, gen loss = 1.6314
Iteration 7100/9750: dis loss = 0.7221, gen loss = 2.9368
Iteration 7200/9750: dis loss = 0.7985, gen loss = 3.8387
Iteration 7300/9750: dis loss = 0.7649, gen loss = 3.7216
Iteration 7400/9750: dis loss = 1.0168, gen loss = 2.7074
```



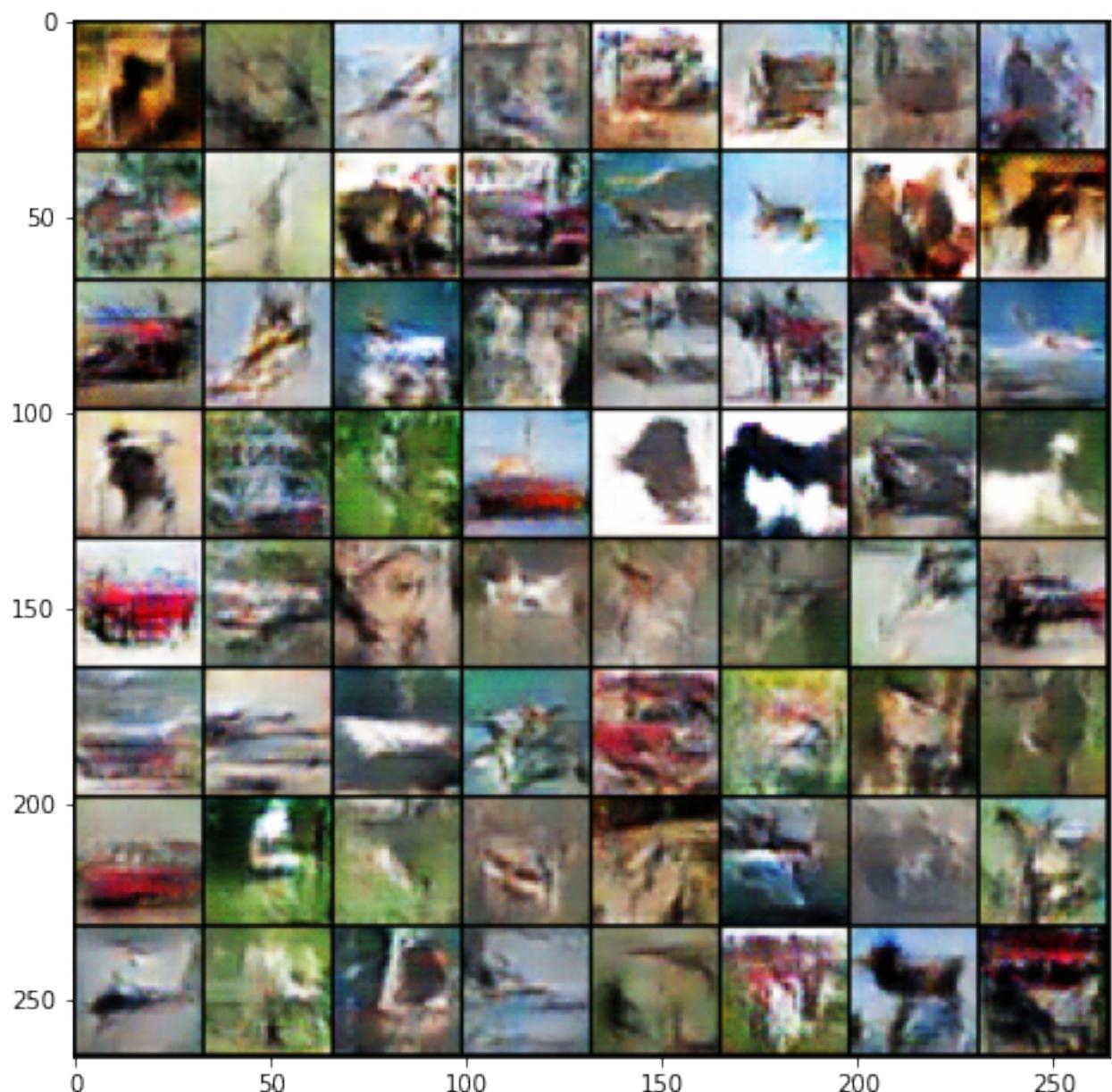


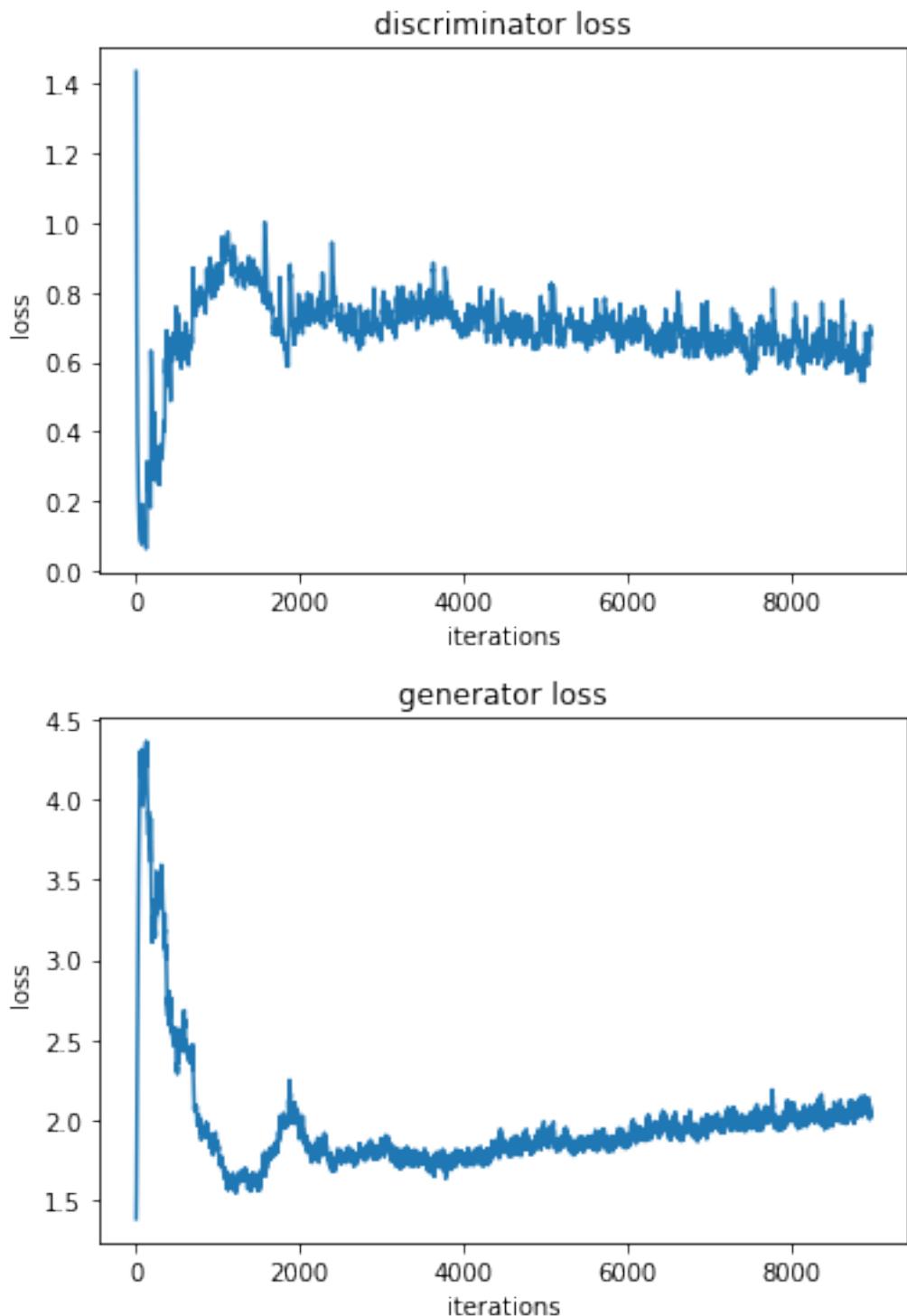
Iteration 7500/9750: dis loss = 0.8890, gen loss = 0.7619  
Iteration 7600/9750: dis loss = 0.6753, gen loss = 1.4397  
Iteration 7700/9750: dis loss = 0.6914, gen loss = 1.5707  
Iteration 7800/9750: dis loss = 0.5734, gen loss = 1.6726  
Iteration 7900/9750: dis loss = 0.5336, gen loss = 1.5273  
Iteration 8000/9750: dis loss = 0.6100, gen loss = 2.2719  
Iteration 8100/9750: dis loss = 0.4573, gen loss = 2.4093



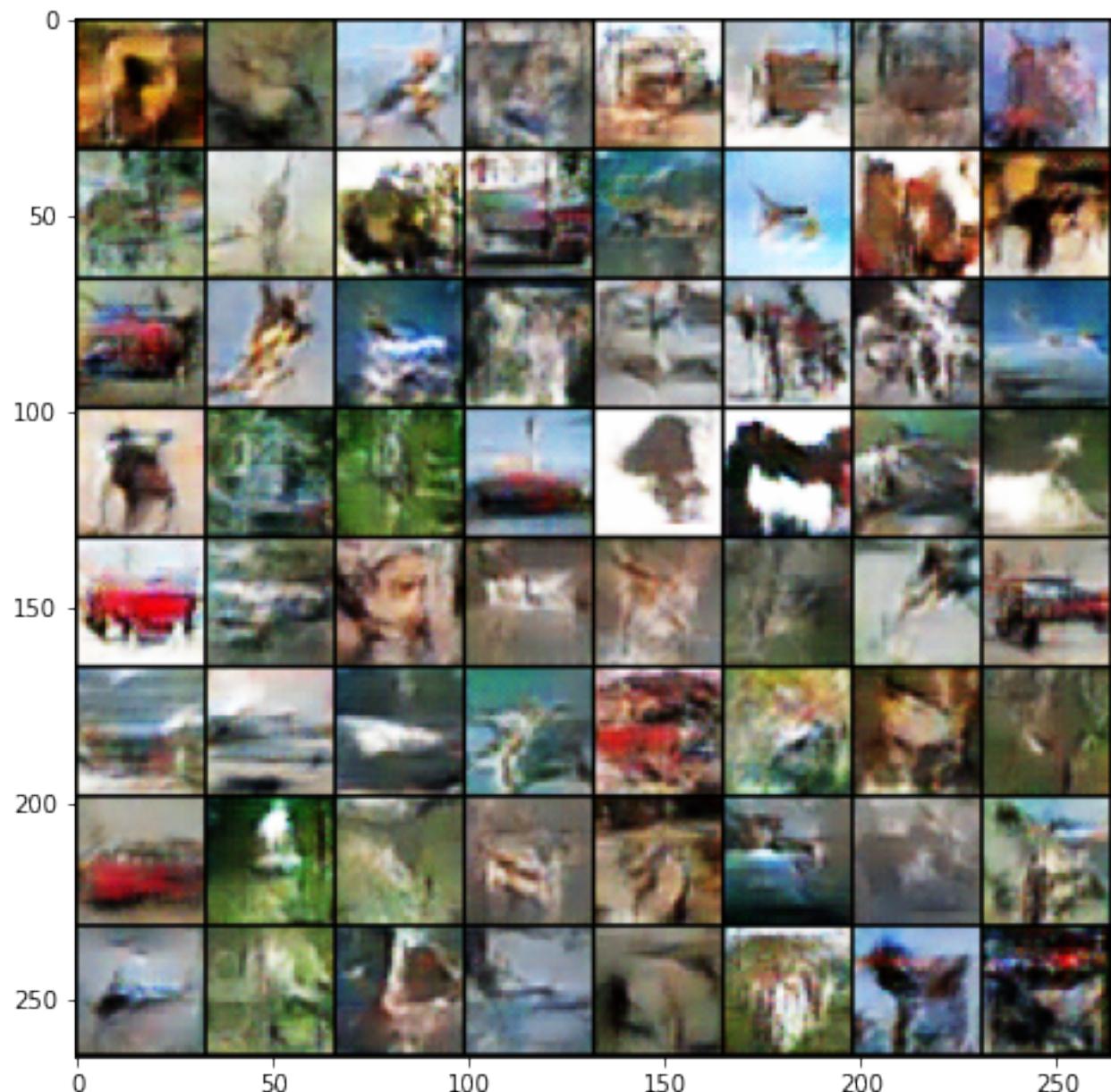


```
Iteration 8200/9750: dis loss = 0.7967, gen loss = 0.7368
Iteration 8300/9750: dis loss = 0.5399, gen loss = 1.6004
Iteration 8400/9750: dis loss = 0.4747, gen loss = 2.0732
Iteration 8500/9750: dis loss = 0.6471, gen loss = 1.8064
Iteration 8600/9750: dis loss = 0.5223, gen loss = 1.8212
Iteration 8700/9750: dis loss = 0.6199, gen loss = 2.2180
Iteration 8800/9750: dis loss = 0.5333, gen loss = 2.0680
Iteration 8900/9750: dis loss = 0.6682, gen loss = 1.3884
```



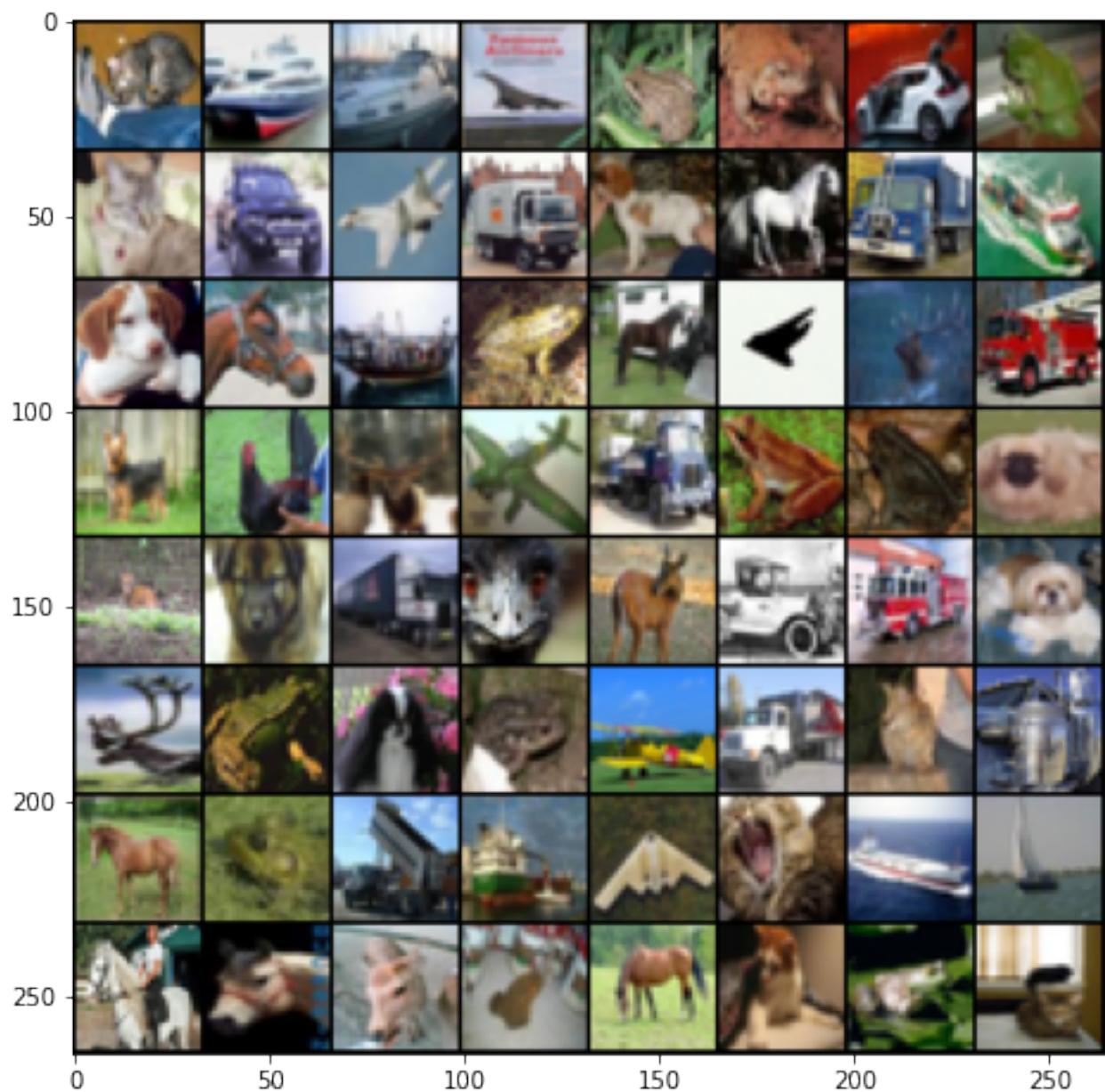


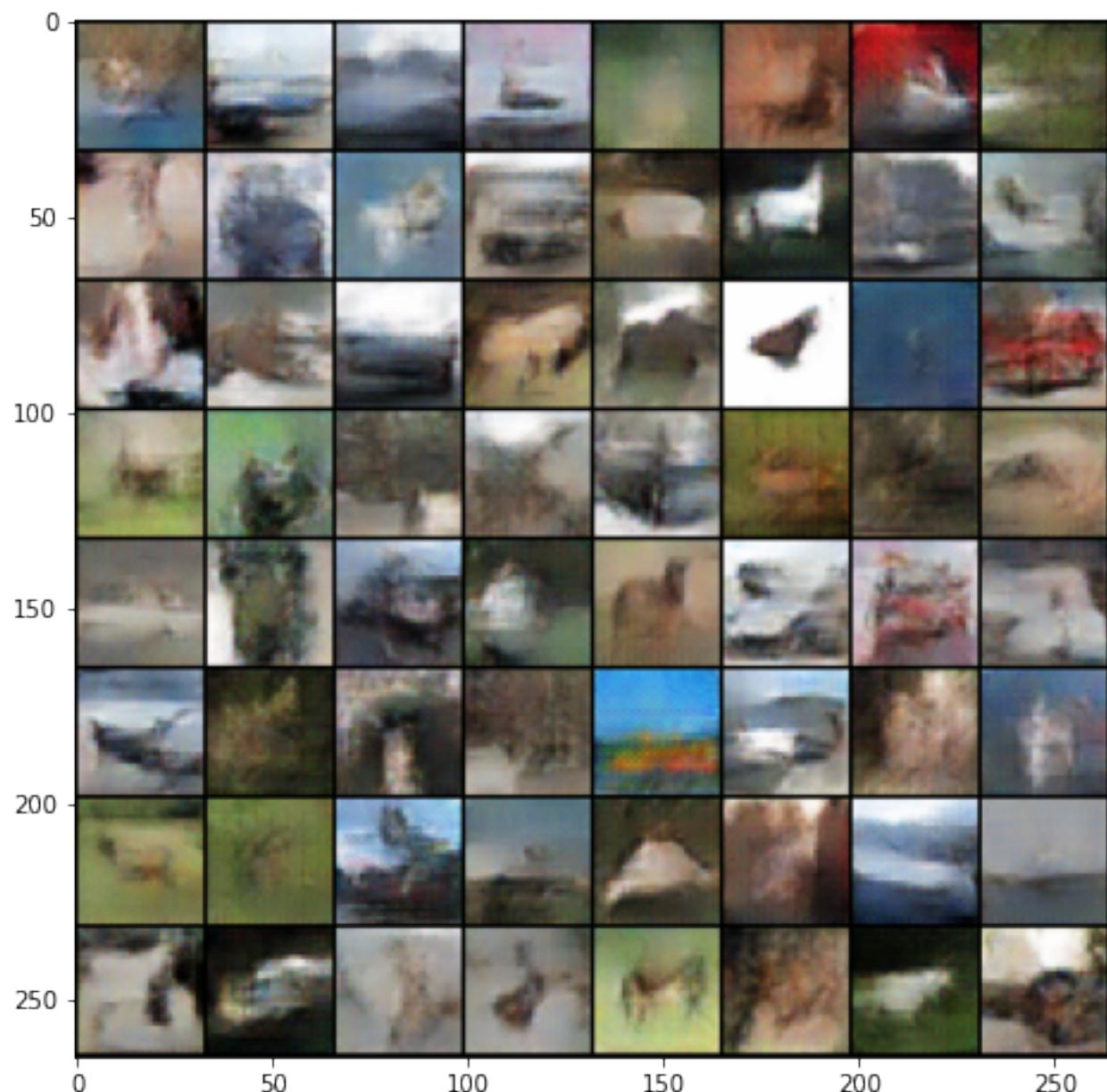
Iteration 9000/9750: dis loss = 0.4420, gen loss = 2.0664  
Iteration 9100/9750: dis loss = 0.6949, gen loss = 2.1892  
Iteration 9200/9750: dis loss = 0.6362, gen loss = 1.2211  
Iteration 9300/9750: dis loss = 0.9027, gen loss = 1.0774  
Iteration 9400/9750: dis loss = 0.6350, gen loss = 1.8629  
Iteration 9500/9750: dis loss = 0.4719, gen loss = 2.3268  
Iteration 9600/9750: dis loss = 0.5210, gen loss = 1.7452  
Iteration 9700/9750: dis loss = 0.5104, gen loss = 1.7783



Problem 2-4: Activation Maximization images

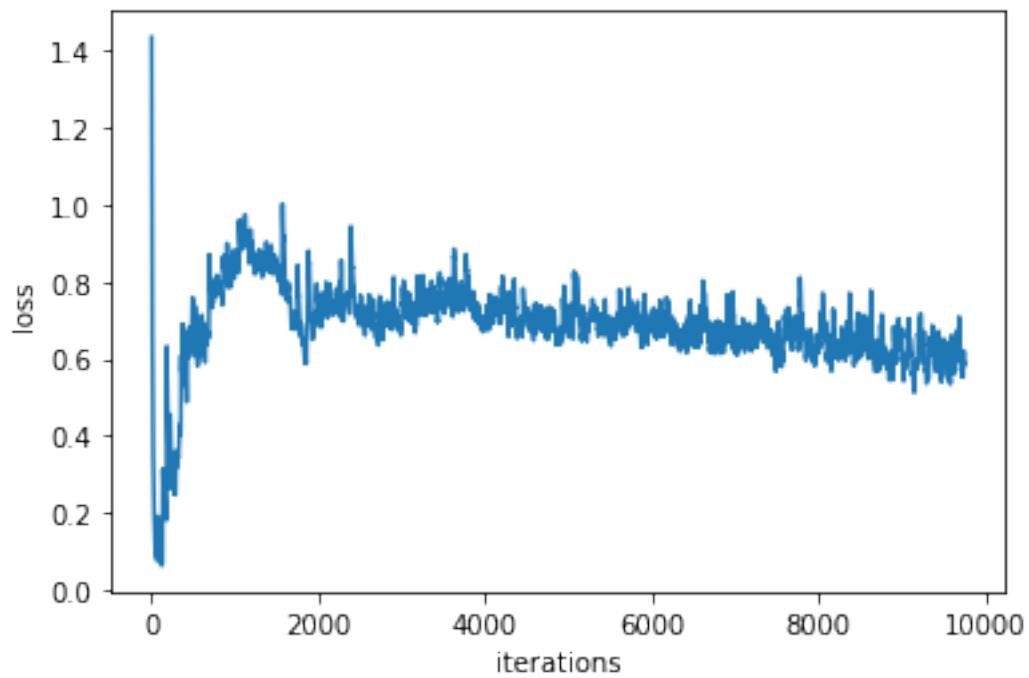
average reconstruction loss = 0.0135



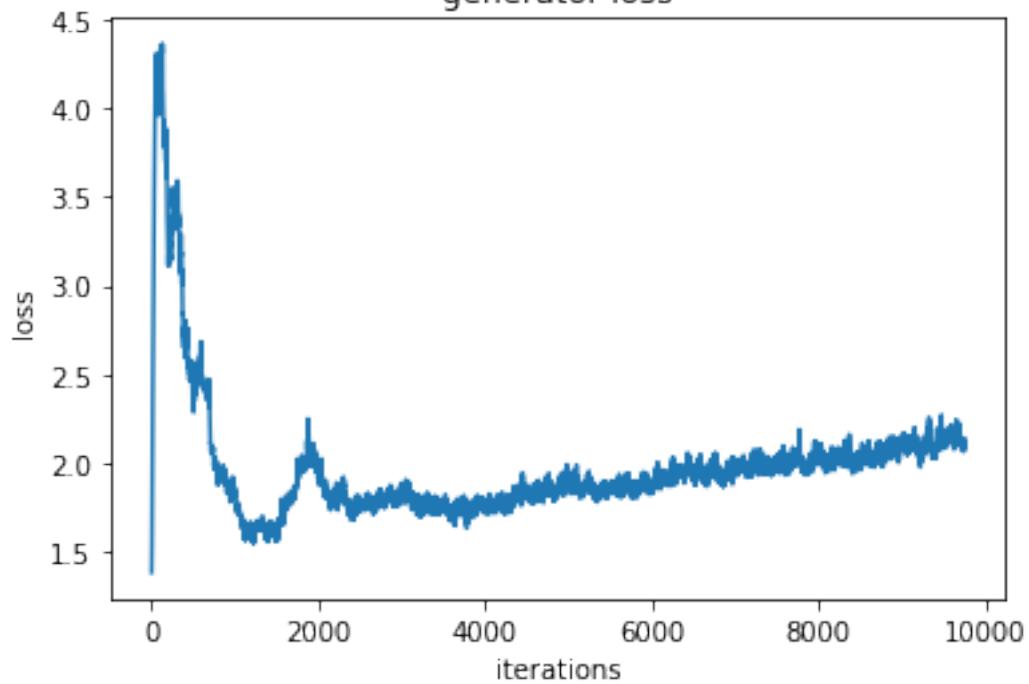




discriminator loss



generator loss



... Done!

## 2. Answers to inline questions about GANs

**Problem 2-2 Question:** In the forger versus police story, we made part of it hand-wavy to hide a flaw that makes the story improbable to actually happen and makes it a bad analogy of how the training works in a GAN. Now that you have implemented a GAN, can you spot the flaw?

Specifically, when we consider one of the two parties, the other is treated as a black box. They know their opponent's result but not how they work. What is wrong here?

**Your answer:** The discriminator actually uses the generator as a black box, but not the other way around. The discriminator does not learn from generator internal parameters where the generator does learn from the discriminator.

**Problem 2-3 Question:** By removing the first batch normalization layer, for two different distributions to get confused with each other they must produce two distributions after dis\_lrelu1 such that one can be obtained by applying an isotropic scaling and a translation to the other. Such a case is still possible but extremely unlikely to happen.

Propose a different way of feeding the samples to solve the problem in the second question without omitting any batch normalization layers or changing their mode of operation.

**Your answer:**

The propose will be to merge the real batches with the fake batches, then we can train both discriminator and generator using this merged batch. This will allow the real batch and the fake batch to be normalized in the discriminator and generator optimization process. The discriminator now will be able to distinguish between real batch and fake batches more effectively.