dlnd_face_generation

July 6, 2018

1 Face Generation

In this project, you'll use generative adversarial networks to generate new images of faces. ### Get the Data You'll be using two datasets in this project: - MNIST - CelebA

Since the celebA dataset is complex and you're doing GANs in a project for the first time, we want you to test your neural network on MNIST before CelebA. Running the GANs on MNIST will allow you to see how well your model trains sooner.

If you're using FloydHub, set `data_dir` to "/input" and use the FloydHub data ID "R5KrjnANiKVhLWAkpXhNBe".

```
In [1]: data_dir = '/data'
        !pip install matplotlib==2.0.2
        # FloydHub - Use with data ID "R5KrjnANiKVhLWAkpXhNBe"
        #data_dir = '/input'


        """
        DON'T MODIFY ANYTHING IN THIS CELL
        """
        import helper

        helper.download_extract('mnist', data_dir)
        helper.download_extract('celeba', data_dir)
```

```
Collecting matplotlib==2.0.2
  Downloading https://files.pythonhosted.org/packages/60/d4/6b6d8a7a6bc69a1602ab372f6fc6e88ef88a
    100% || 14.6MB 46kB/s  eta 0:00:01
Requirement already satisfied: python-dateutil in /opt/conda/lib/python3.6/site-packages (from m
Requirement already satisfied: pyparsing!=2.0.0,!=2.0.4,!=2.1.2,!=2.1.6,>=1.5.6 in /opt/conda/li
Requirement already satisfied: pytz in /opt/conda/lib/python3.6/site-packages (from matplotlib==
Requirement already satisfied: numpy>=1.7.1 in /opt/conda/lib/python3.6/site-packages (from matp
Requirement already satisfied: cycler>=0.10 in /opt/conda/lib/python3.6/site-packages/cycler-0.1
Requirement already satisfied: six>=1.10 in /opt/conda/lib/python3.6/site-packages (from matplot
Installing collected packages: matplotlib
  Found existing installation: matplotlib 2.1.0
    Uninstalling matplotlib-2.1.0:
      Successfully uninstalled matplotlib-2.1.0
```

```
Successfully installed matplotlib-2.0.2
You are using pip version 9.0.1, however version 10.0.1 is available.You should consider upgradi
Found mnist Data
Found celeba Data
```

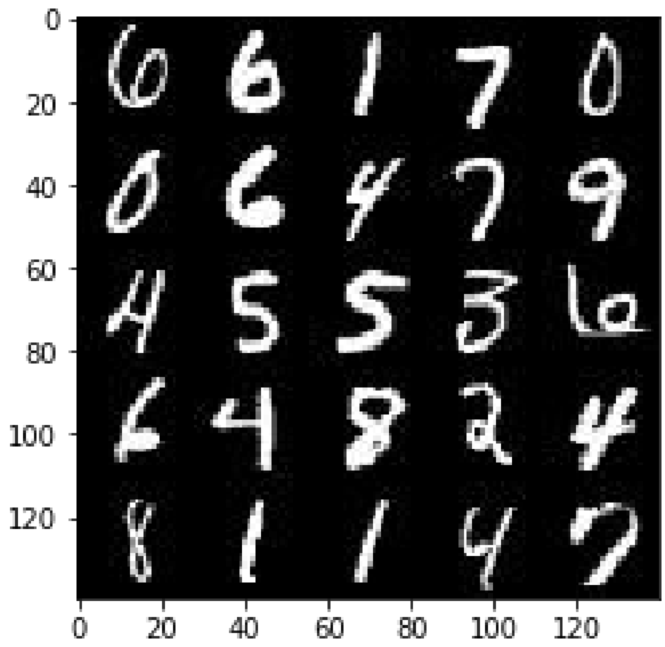
1.1 Explore the Data

1.1.1 MNIST

As you're aware, the MNIST dataset contains images of handwritten digits. You can view the first number of examples by changing `show_n_images`.

In [2]:
```
show_n_images = 25

"""
DON'T MODIFY ANYTHING IN THIS CELL
"""
%matplotlib inline
import os
from glob import glob
from matplotlib import pyplot

mnist_images = helper.get_batch(glob(os.path.join(data_dir, 'mnist/*.jpg'))[:show_n_imag
pyplot.imshow(helper.images_square_grid(mnist_images, 'L'), cmap='gray')
```

Out[2]:
```
<matplotlib.image.AxesImage at 0x7f00c29cae80>
```

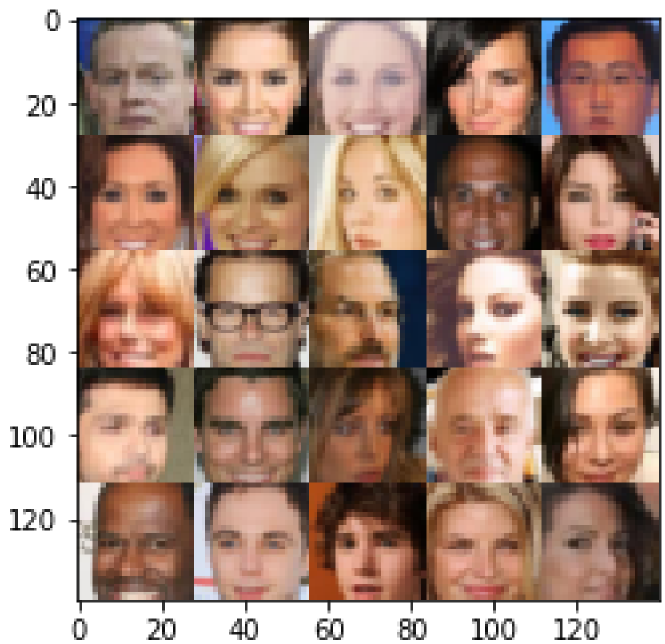


1.1.2 CelebA

The CelebFaces Attributes Dataset (CelebA) dataset contains over 200,000 celebrity images with annotations. Since you're going to be generating faces, you won't need the annotations. You can view the first number of examples by changing `show_n_images`.

In [3]:
```
show_n_images = 25

"""
DON'T MODIFY ANYTHING IN THIS CELL
"""
mnist_images = helper.get_batch(glob(os.path.join(data_dir, 'img_align_celeba/*.jpg'))[:
pyplot.imshow(helper.images_square_grid(mnist_images, 'RGB'))
```

Out[3]: <matplotlib.image.AxesImage at 0x7f00c28b4b38>



1.2 Preprocess the Data

Since the project's main focus is on building the GANs, we'll preprocess the data for you. The values of the MNIST and CelebA dataset will be in the range of -0.5 to 0.5 of 28x28 dimensional images. The CelebA images will be cropped to remove parts of the image that don't include a face, then resized down to 28x28.

The MNIST images are black and white images with a single [color channel](https://en.wikipedia.org/wiki/Channel_(digital_image%29) while the CelebA images have [3 color channels (RGB color channel)](https://en.wikipedia.org/wiki/Channel_(digital_image%29#RGB_Images). ## Build the Neural Network You'll build the components necessary to build a GANs by implementing the following functions below: - `model_inputs` - `discriminator` - `generator` - `model_loss` - `model_opt` - `train`

1.2.1 Check the Version of TensorFlow and Access to GPU

This will check to make sure you have the correct version of TensorFlow and access to a GPU

```
In [4]: """
        DON'T MODIFY ANYTHING IN THIS CELL
        """
        from distutils.version import LooseVersion
        import warnings
        import tensorflow as tf

        # Check TensorFlow Version
        assert LooseVersion(tf.__version__) >= LooseVersion('1.0'), 'Please use TensorFlow versi
        print('TensorFlow Version: {}'.format(tf.__version__))

        # Check for a GPU
        if not tf.test.gpu_device_name():
            warnings.warn('No GPU found. Please use a GPU to train your neural network.')
        else:
            print('Default GPU Device: {}'.format(tf.test.gpu_device_name()))
```

```
TensorFlow Version: 1.3.0
Default GPU Device: /gpu:0
```

1.2.2 Input

Implement the `model_inputs` function to create TF Placeholders for the Neural Network. It should create the following placeholders: - Real input images placeholder with rank 4 using `image_width`, `image_height`, and `image_channels`. - Z input placeholder with rank 2 using `z_dim`. - Learning rate placeholder with rank 0.

Return the placeholders in the following the tuple (tensor of real input images, tensor of z data)

```
In [5]: import problem_unittests as tests

        def model_inputs(image_width, image_height, image_channels, z_dim):
            """
            Create the model inputs
            :param image_width: The input image width
            :param image_height: The input image height
            :param image_channels: The number of image channels
            :param z_dim: The dimension of Z
            :return: Tuple of (tensor of real input images, tensor of z data, learning rate)
            """
```

```
    # TODO: Implement Function
    real_inputs = tf.placeholder(tf.float32, (None, image_width, image_height, image_cha
    z_inputs = tf.placeholder(tf.float32, (None, z_dim), name='z_inputs')
    learning_rate = tf.placeholder(tf.float32, name='learning_rate')
    return real_inputs, z_inputs, learning_rate


"""
DON'T MODIFY ANYTHING IN THIS CELL THAT IS BELOW THIS LINE
"""
tests.test_model_inputs(model_inputs)
```

```
ERROR:tensorflow:==================================
Object was never used (type <class 'tensorflow.python.framework.ops.Operation'>):
<tf.Operation 'assert_rank_2/Assert/Assert' type=Assert>
If you want to mark it as used call its "mark_used()" method.
It was originally created here:
['File "/opt/conda/lib/python3.6/runpy.py", line 193, in _run_module_as_main\n    "__main__", mo
==================================
Tests Passed
```

1.2.3 Discriminator

Implement `discriminator` to create a discriminator neural network that discriminates on `images`. This function should be able to reuse the variables in the neural network. Use `tf.variable_scope` with a scope name of "discriminator" to allow the variables to be reused. The function should return a tuple of (tensor output of the discriminator, tensor logits of the discriminator).

```
In [6]: def discriminator(images, reuse=False):
            """
            Create the discriminator network
            :param images: Tensor of input image(s)
            :param reuse: Boolean if the weights should be reused
            :return: Tuple of (tensor output of the discriminator, tensor logits of the discrimi
            """
            # TODO: Implement Function
            alpha = 0.2
            with tf.variable_scope('discriminator', reuse=reuse):
                # input layer is 28x28x3 (faces) or 28x28x1 (mnist)
                x1 = tf.layers.conv2d(images, 64, 5, strides=2, padding='same')
                x1 = tf.maximum(alpha * x1, x1)
                # 14x14x64

                x2 = tf.layers.conv2d(x1, 128, 5, strides=2, padding='same')
                x2 = tf.layers.batch_normalization(x2, training=True)
                x2 = tf.maximum(alpha * x2, x2)
                # 7x7x128
```

```
            x3 = tf.layers.conv2d(x2, 256, 5, strides=2, padding='same')
            x3 = tf.layers.batch_normalization(x3, training=True)
            x3 = tf.maximum(alpha * x3, x3)
            # 4x4x256

            # last layer is fully connected
            x4 = tf.reshape(x3, (-1, 4*4*256))
            logits = tf.layers.dense(x4, 1)
            out = tf.sigmoid(logits)

        return out, logits


    """
    DON'T MODIFY ANYTHING IN THIS CELL THAT IS BELOW THIS LINE
    """
    tests.test_discriminator(discriminator, tf)
```

```
Tests Passed
```

1.2.4 Generator

Implement `generator` to generate an image using `z`. This function should be able to reuse the variables in the neural network. Use `tf.variable_scope` with a scope name of "generator" to allow the variables to be reused. The function should return the generated 28 x 28 x `out_channel_dim` images.

```
In [23]: def generator(z, out_channel_dim, is_train=True):
             """
             Create the generator network
             :param z: Input z
             :param out_channel_dim: The number of channels in the output image
             :param is_train: Boolean if generator is being used for training
             :return: The tensor output of the generator
             """
             # TODO: Implement Function
             alpha = 0.2
             with tf.variable_scope('generator', reuse=(not is_train)):
                 # start with a fully connected layer
                 x1 = tf.layers.dense(z, 4*4*1024)

                 # reshape it for a convolutional stack
                 x1 = tf.reshape(x1, (-1, 4, 4, 1024))
                 x1 = tf.layers.batch_normalization(x1, training=is_train)
                 x1 = tf.maximum(alpha * x1, x1)
                 # 4x4x1024 now
```

```
            # first convolutional layer
            # formula for converting 4x4 input to 7x7 output:
            #      https://discussions.udacity.com/t/project5-discriminator-and-genarator-l
            conv1 = tf.layers.conv2d_transpose(x1, 512, 4, strides=1, padding='valid')
            conv1 = tf.layers.batch_normalization(conv1, training=is_train)
            conv1 = tf.maximum(alpha*conv1, conv1)
            # now 7x7x512

            # second convolutional layer
            x2 = tf.layers.conv2d_transpose(conv1, 256, 5, strides=2, padding='same')
            x2 = tf.layers.batch_normalization(x2, training=is_train)
            x2 = tf.maximum(alpha * x2, x2)
            # 14x14x256 now

            # final convolutional layer.
            # Don't use batch normalization.
            # Use a tanh activation function
            logits = tf.layers.conv2d_transpose(x2, out_channel_dim, 5, strides=2, padding=
            out = tf.tanh(logits)
            # 28x28xOut_channel_dim now

        return out


"""
DON'T MODIFY ANYTHING IN THIS CELL THAT IS BELOW THIS LINE
"""
tests.test_generator(generator, tf)
```

```
Tests Passed
```

1.2.5 Loss

Implement `model_loss` to build the GANs for training and calculate the loss. The function should return a tuple of (discriminator loss, generator loss). Use the following functions you implemented: - `discriminator(images, reuse=False)` - `generator(z, out_channel_dim, is_train=True)`

```
In [8]: def model_loss(input_real, input_z, out_channel_dim):
            """
            Get the loss for the discriminator and generator
            :param input_real: Images from the real dataset
            :param input_z: Z input
            :param out_channel_dim: The number of channels in the output image
            :return: A tuple of (discriminator loss, generator loss)
            """
```

```
    # TODO: Implement Function
    g_model = generator(input_z, out_channel_dim, is_train=True)
    d_model_real, d_logits_real = discriminator(input_real, reuse=False)
    d_model_fake, d_logits_fake = discriminator(g_model, reuse=True)

    d_loss_real = tf.reduce_mean(
        tf.nn.sigmoid_cross_entropy_with_logits(logits=d_logits_real, labels=tf.ones_lik
    d_loss_fake = tf.reduce_mean(
        tf.nn.sigmoid_cross_entropy_with_logits(logits=d_logits_fake, labels=tf.zeros_li
    g_loss = tf.reduce_mean(
        tf.nn.sigmoid_cross_entropy_with_logits(logits=d_logits_fake, labels=tf.ones_lik

    d_loss = d_loss_real + d_loss_fake

    return d_loss, g_loss


"""
DON'T MODIFY ANYTHING IN THIS CELL THAT IS BELOW THIS LINE
"""
tests.test_model_loss(model_loss)
```

```
Tests Passed
```

1.2.6 Optimization

Implement `model_opt` to create the optimization operations for the GANs. Use `tf.trainable_variables` to get all the trainable variables. Filter the variables with names that are in the discriminator and generator scope names. The function should return a tuple of (discriminator training operation, generator training operation).

```
In [9]: def model_opt(d_loss, g_loss, learning_rate, beta1):
    """
    Get optimization operations
    :param d_loss: Discriminator loss Tensor
    :param g_loss: Generator loss Tensor
    :param learning_rate: Learning Rate Placeholder
    :param beta1: The exponential decay rate for the 1st moment in the optimizer
    :return: A tuple of (discriminator training operation, generator training operation)
    """
    # TODO: Implement Function
    # get the discriminator and generator variables
    train_vars = tf.trainable_variables()
    d_vars = [v for v in train_vars if v.name.startswith('discriminator')]
    g_vars = [v for v in train_vars if v.name.startswith('generator')]

    with tf.control_dependencies(tf.get_collection(tf.GraphKeys.UPDATE_OPS)):
```

```
        d_train_opt = tf.train.AdamOptimizer(learning_rate=learning_rate, beta1=beta1).m
        g_train_opt = tf.train.AdamOptimizer(learning_rate=learning_rate, beta1=beta1).m

    return d_train_opt, g_train_opt


"""
DON'T MODIFY ANYTHING IN THIS CELL THAT IS BELOW THIS LINE
"""
tests.test_model_opt(model_opt, tf)
```

```
Tests Passed
```

1.3 Neural Network Training

1.3.1 Show Output

Use this function to show the current output of the generator during training. It will help you determine how well the GANs is training.

In [10]:
```
"""
DON'T MODIFY ANYTHING IN THIS CELL
"""
import numpy as np

def show_generator_output(sess, n_images, input_z, out_channel_dim, image_mode):
    """
    Show example output for the generator
    :param sess: TensorFlow session
    :param n_images: Number of Images to display
    :param input_z: Input Z Tensor
    :param out_channel_dim: The number of channels in the output image
    :param image_mode: The mode to use for images ("RGB" or "L")
    """
    cmap = None if image_mode == 'RGB' else 'gray'
    z_dim = input_z.get_shape().as_list()[-1]
    example_z = np.random.uniform(-1, 1, size=[n_images, z_dim])

    samples = sess.run(
        generator(input_z, out_channel_dim, False),
        feed_dict={input_z: example_z})

    images_grid = helper.images_square_grid(samples, image_mode)
    pyplot.imshow(images_grid, cmap=cmap)
    pyplot.show()
```

In [11]:
```
%matplotlib inline
from matplotlib import pyplot as plt
```

```python
def plot_losses(d_loss, g_loss):
    """
    Plot the discriminator and generator losses on the same graph
    :param d_loss: list of loss values for the discriminator
    :param g_loss: list of loss values for the generator
    """
    fig, ax = plt.subplots()
    plt.plot(d_loss, label='Discriminator', alpha=0.5)
    plt.plot(g_loss, label='Generator', alpha=0.5)
    plt.title("Training Losses")
    plt.legend()
```

1.3.2 Train

Implement `train` to build and train the GANs. Use the following functions you implemented: - `model_inputs(image_width, image_height, image_channels, z_dim)` - `model_loss(input_real, input_z, out_channel_dim)` - `model_opt(d_loss, g_loss, learning_rate, beta1)`

Use the `show_generator_output` to show `generator` output while you train. Running `show_generator_output` for every batch will drastically increase training time and increase the size of the notebook. It's recommended to print the `generator` output every 100 batches.

```python
In [24]: def train(epoch_count, batch_size, z_dim, learning_rate, beta1, get_batches, data_shape
             """
             Train the GAN
             :param epoch_count: Number of epochs
             :param batch_size: Batch Size
             :param z_dim: Z dimension
             :param learning_rate: Learning Rate
             :param beta1: The exponential decay rate for the 1st moment in the optimizer
             :param get_batches: Function to get batches
             :param data_shape: Shape of the data
             :param data_image_mode: The image mode to use for images ("RGB" or "L")
             """
             # TODO: Build Model
             import time
             real_inputs, z_inputs, lr = model_inputs(data_shape[1], data_shape[2], data_shape[3
             d_loss, g_loss = model_loss(real_inputs, z_inputs, data_shape[-1])
             d_train_opt, g_train_opt = model_opt(d_loss, g_loss, learning_rate, beta1)

             batch_no = 0
             show_every = 100
             stats_every = 5
             n_images_to_show = 25
             n_images = data_shape[0]
             total_batches = (n_images // batch_size) * epoch_count
             start_time = time.time()
```

```
    d_losses = []
    g_losses = []

    with tf.Session() as sess:
        sess.run(tf.global_variables_initializer())
        for epoch_i in range(epoch_count):
            for batch_images in get_batches(batch_size):
                # TODO: Train Model
                # batch_start = time.time()
                batch_no += 1

                # scale batch images to [-1.0, 1.0]
                batch_images = batch_images * 2
                batch_z = np.random.uniform(-1, 1, size=(batch_size, z_dim))

                _ = sess.run(d_train_opt, feed_dict={real_inputs: batch_images, z_input
                _ = sess.run(g_train_opt, feed_dict={real_inputs: batch_images, z_input

                # compute some execution time stats for each batch
                if batch_no % stats_every == 0:
                    current_time = time.time()
                    total_time = current_time - start_time
                    # time_this_batch = current_time - batch_start
                    time_per_batch = total_time / batch_no
                    remaining_time = int(time_per_batch * (total_batches - batch_no))

                    train_loss_d = d_loss.eval({z_inputs: batch_z, real_inputs: batch_i
                    train_loss_g = g_loss.eval({z_inputs: batch_z, lr: learning_rate})
                    d_losses.append(train_loss_d)
                    g_losses.append(train_loss_g)
                    print("Epoch {}/{}: batch {}/{}: \ttime/batch: {:.2f}s\tremaining t
                         epoch_i+1, epoch_count, batch_no, total_batches, time_per_batc
                         "\td_loss: {:.4f}\tg_loss: {:.4f}".format(train_loss_d, train_

                # show generator output every show_every steps
                if batch_no % show_every == 0:
                    show_generator_output(sess, n_images_to_show, z_inputs, data_shape[

        # show the final output
        show_generator_output(sess, n_images_to_show, z_inputs, data_shape[-1], data_im
        return d_losses, g_losses
```

1.3.3 MNIST

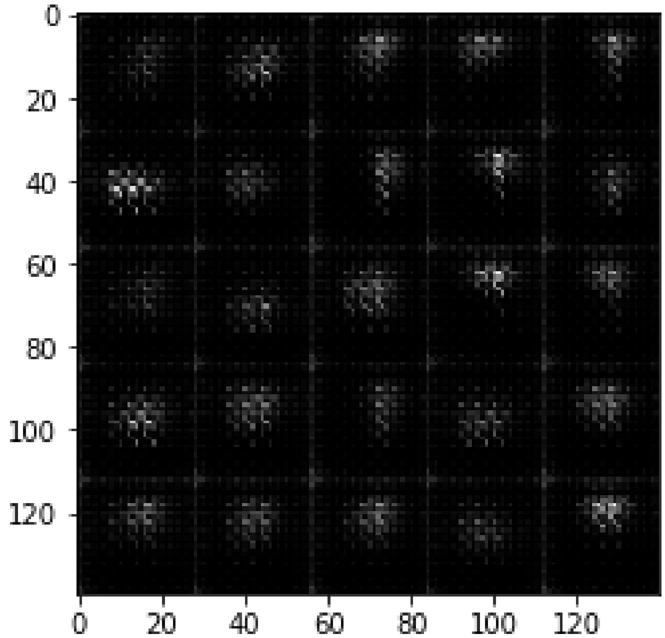
Test your GANs architecture on MNIST. After 2 epochs, the GANs should be able to generate images that look like handwritten digits. Make sure the loss of the generator is lower than the loss of the discriminator or close to 0.

1.3.4 MNIST Run 1

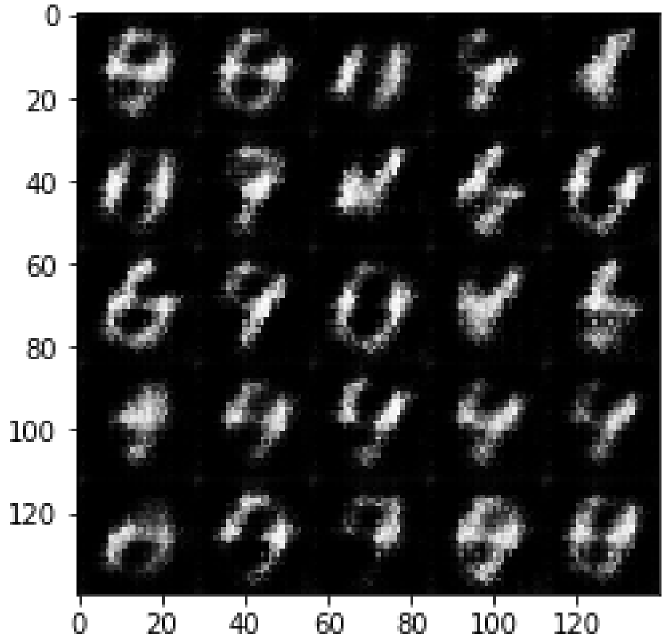
Generator shape: - layer 1: 4x4x1024 with LRELU activation - layer 2: 7x7x512 with LRELU - layer 3: 14x14x256 with LRELU - layer 4: 28x28xOutput_Channel with TANH

```
In [13]: batch_size = 128
         z_dim = 100
         learning_rate = 0.0002
         beta1 = 0.5

         d_losses = []
         g_losses = []

         """
         DON'T MODIFY ANYTHING IN THIS CELL THAT IS BELOW THIS LINE
         """
         epochs = 2

         mnist_dataset = helper.Dataset('mnist', glob(os.path.join(data_dir, 'mnist/*.jpg')))
         with tf.Graph().as_default():
             # jcc: added lists for plotting discriminator and generator losses
             d_losses, g_losses = train(epochs, batch_size, z_dim, learning_rate, beta1, mnist_d
                   mnist_dataset.shape, mnist_dataset.image_mode)
```

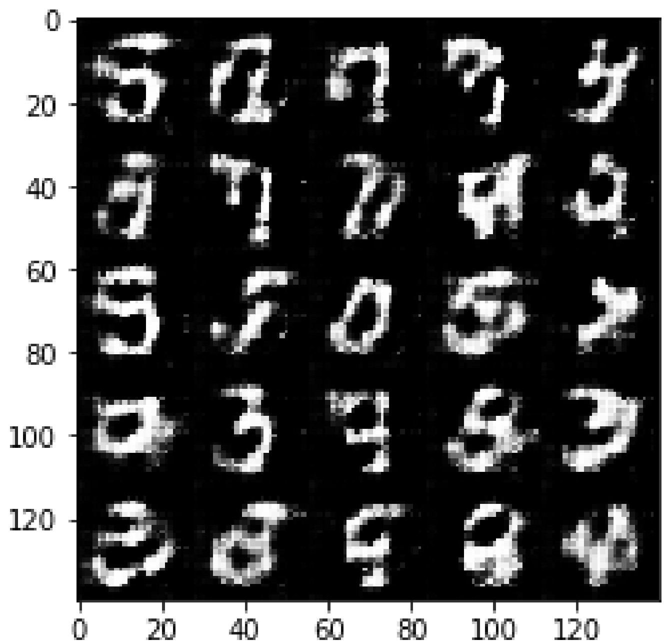
```
Epoch 1/2: batch 5/936:         time/batch: 1.68s       remaining time: 1565s         d_loss: 1
Epoch 1/2: batch 10/936:         time/batch: 1.12s       remaining time: 1036s         d_loss:
Epoch 1/2: batch 15/936:         time/batch: 0.93s       remaining time: 855s         d_loss: 0
Epoch 1/2: batch 20/936:         time/batch: 0.83s       remaining time: 764s         d_loss: 0
Epoch 1/2: batch 25/936:         time/batch: 0.78s       remaining time: 708s         d_loss: 0
Epoch 1/2: batch 30/936:         time/batch: 0.74s       remaining time: 669s         d_loss: 0
Epoch 1/2: batch 35/936:         time/batch: 0.71s       remaining time: 642s         d_loss: 0
Epoch 1/2: batch 40/936:         time/batch: 0.69s       remaining time: 619s         d_loss: 0
Epoch 1/2: batch 45/936:         time/batch: 0.68s       remaining time: 602s         d_loss: 0
Epoch 1/2: batch 50/936:         time/batch: 0.66s       remaining time: 588s         d_loss: 0
Epoch 1/2: batch 55/936:         time/batch: 0.65s       remaining time: 575s         d_loss: 0
Epoch 1/2: batch 60/936:         time/batch: 0.64s       remaining time: 564s         d_loss: 0
Epoch 1/2: batch 65/936:         time/batch: 0.64s       remaining time: 554s         d_loss: 4
Epoch 1/2: batch 70/936:         time/batch: 0.63s       remaining time: 546s         d_loss: 0
Epoch 1/2: batch 75/936:         time/batch: 0.63s       remaining time: 538s         d_loss: 0
Epoch 1/2: batch 80/936:         time/batch: 0.62s       remaining time: 531s         d_loss: 0
Epoch 1/2: batch 85/936:         time/batch: 0.62s       remaining time: 525s         d_loss: 0
Epoch 1/2: batch 90/936:         time/batch: 0.61s       remaining time: 518s         d_loss: 0
Epoch 1/2: batch 95/936:         time/batch: 0.61s       remaining time: 512s         d_loss: 0
Epoch 1/2: batch 100/936:         time/batch: 0.61s       remaining time: 507s         d_loss:
```



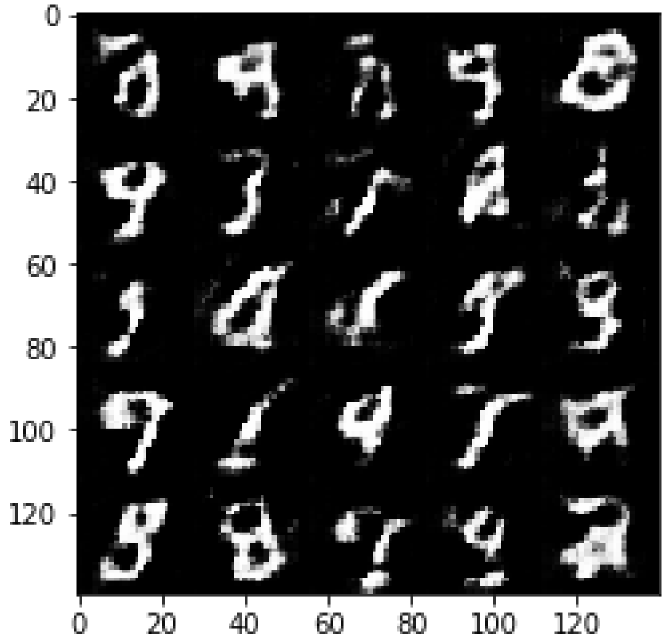
```
Epoch 1/2: batch 105/936:         time/batch: 0.61s         remaining time: 506s         d_loss:
Epoch 1/2: batch 110/936:         time/batch: 0.61s         remaining time: 500s         d_loss:
Epoch 1/2: batch 115/936:         time/batch: 0.60s         remaining time: 495s         d_loss:
Epoch 1/2: batch 120/936:         time/batch: 0.60s         remaining time: 491s         d_loss:
Epoch 1/2: batch 125/936:         time/batch: 0.60s         remaining time: 486s         d_loss:
Epoch 1/2: batch 130/936:         time/batch: 0.60s         remaining time: 482s         d_loss:
Epoch 1/2: batch 135/936:         time/batch: 0.60s         remaining time: 477s         d_loss:
Epoch 1/2: batch 140/936:         time/batch: 0.60s         remaining time: 473s         d_loss:
Epoch 1/2: batch 145/936:         time/batch: 0.59s         remaining time: 469s         d_loss:
Epoch 1/2: batch 150/936:         time/batch: 0.59s         remaining time: 465s         d_loss:
Epoch 1/2: batch 155/936:         time/batch: 0.59s         remaining time: 461s         d_loss:
Epoch 1/2: batch 160/936:         time/batch: 0.59s         remaining time: 457s         d_loss:
Epoch 1/2: batch 165/936:         time/batch: 0.59s         remaining time: 453s         d_loss:
Epoch 1/2: batch 170/936:         time/batch: 0.59s         remaining time: 449s         d_loss:
Epoch 1/2: batch 175/936:         time/batch: 0.59s         remaining time: 446s         d_loss:
Epoch 1/2: batch 180/936:         time/batch: 0.59s         remaining time: 442s         d_loss:
Epoch 1/2: batch 185/936:         time/batch: 0.58s         remaining time: 438s         d_loss:
Epoch 1/2: batch 190/936:         time/batch: 0.58s         remaining time: 435s         d_loss:
Epoch 1/2: batch 195/936:         time/batch: 0.58s         remaining time: 431s         d_loss:
Epoch 1/2: batch 200/936:         time/batch: 0.58s         remaining time: 428s         d_loss:
```



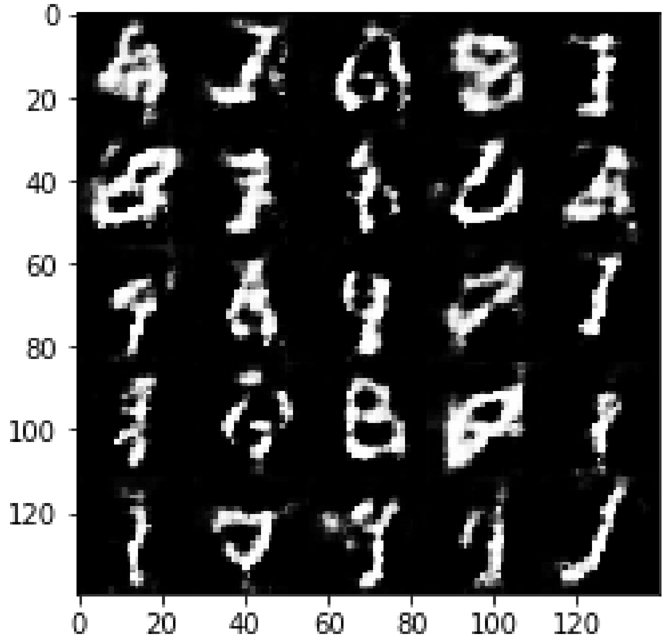

```
Epoch 1/2: batch 205/936:        time/batch: 0.58s        remaining time: 425s        d_loss:
Epoch 1/2: batch 210/936:        time/batch: 0.58s        remaining time: 422s        d_loss:
Epoch 1/2: batch 215/936:        time/batch: 0.58s        remaining time: 419s        d_loss:
Epoch 1/2: batch 220/936:        time/batch: 0.58s        remaining time: 415s        d_loss:
Epoch 1/2: batch 225/936:        time/batch: 0.58s        remaining time: 412s        d_loss:
Epoch 1/2: batch 230/936:        time/batch: 0.58s        remaining time: 408s        d_loss:
Epoch 1/2: batch 235/936:        time/batch: 0.58s        remaining time: 405s        d_loss:
Epoch 1/2: batch 240/936:        time/batch: 0.58s        remaining time: 402s        d_loss:
Epoch 1/2: batch 245/936:        time/batch: 0.58s        remaining time: 399s        d_loss:
Epoch 1/2: batch 250/936:        time/batch: 0.58s        remaining time: 395s        d_loss:
Epoch 1/2: batch 255/936:        time/batch: 0.58s        remaining time: 392s        d_loss:
Epoch 1/2: batch 260/936:        time/batch: 0.58s        remaining time: 389s        d_loss:
Epoch 1/2: batch 265/936:        time/batch: 0.58s        remaining time: 386s        d_loss:
Epoch 1/2: batch 270/936:        time/batch: 0.58s        remaining time: 383s        d_loss:
Epoch 1/2: batch 275/936:        time/batch: 0.57s        remaining time: 379s        d_loss:
Epoch 1/2: batch 280/936:        time/batch: 0.57s        remaining time: 376s        d_loss:
Epoch 1/2: batch 285/936:        time/batch: 0.57s        remaining time: 373s        d_loss:
Epoch 1/2: batch 290/936:        time/batch: 0.57s        remaining time: 370s        d_loss:
Epoch 1/2: batch 295/936:        time/batch: 0.57s        remaining time: 367s        d_loss:
Epoch 1/2: batch 300/936:        time/batch: 0.57s        remaining time: 364s        d_loss:
```



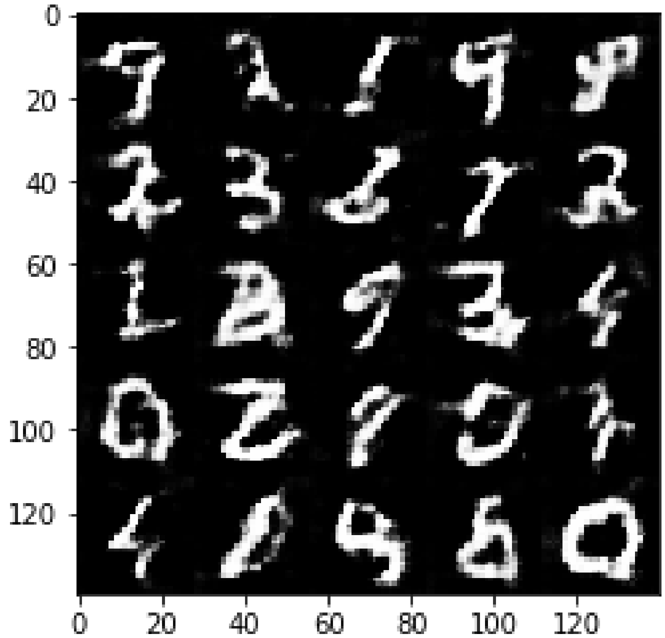
```
Epoch 1/2: batch 305/936:        time/batch: 0.57s        remaining time: 361s        d_loss:
Epoch 1/2: batch 310/936:        time/batch: 0.57s        remaining time: 358s        d_loss:
Epoch 1/2: batch 315/936:        time/batch: 0.57s        remaining time: 355s        d_loss:
Epoch 1/2: batch 320/936:        time/batch: 0.57s        remaining time: 352s        d_loss:
Epoch 1/2: batch 325/936:        time/batch: 0.57s        remaining time: 349s        d_loss:
Epoch 1/2: batch 330/936:        time/batch: 0.57s        remaining time: 346s        d_loss:
Epoch 1/2: batch 335/936:        time/batch: 0.57s        remaining time: 343s        d_loss:
Epoch 1/2: batch 340/936:        time/batch: 0.57s        remaining time: 340s        d_loss:
Epoch 1/2: batch 345/936:        time/batch: 0.57s        remaining time: 337s        d_loss:
Epoch 1/2: batch 350/936:        time/batch: 0.57s        remaining time: 334s        d_loss:
Epoch 1/2: batch 355/936:        time/batch: 0.57s        remaining time: 331s        d_loss:
Epoch 1/2: batch 360/936:        time/batch: 0.57s        remaining time: 328s        d_loss:
Epoch 1/2: batch 365/936:        time/batch: 0.57s        remaining time: 325s        d_loss:
Epoch 1/2: batch 370/936:        time/batch: 0.57s        remaining time: 322s        d_loss:
Epoch 1/2: batch 375/936:        time/batch: 0.57s        remaining time: 319s        d_loss:
Epoch 1/2: batch 380/936:        time/batch: 0.57s        remaining time: 316s        d_loss:
Epoch 1/2: batch 385/936:        time/batch: 0.57s        remaining time: 313s        d_loss:
Epoch 1/2: batch 390/936:        time/batch: 0.57s        remaining time: 310s        d_loss:
Epoch 1/2: batch 395/936:        time/batch: 0.57s        remaining time: 307s        d_loss:
Epoch 1/2: batch 400/936:        time/batch: 0.57s        remaining time: 304s        d_loss:
```



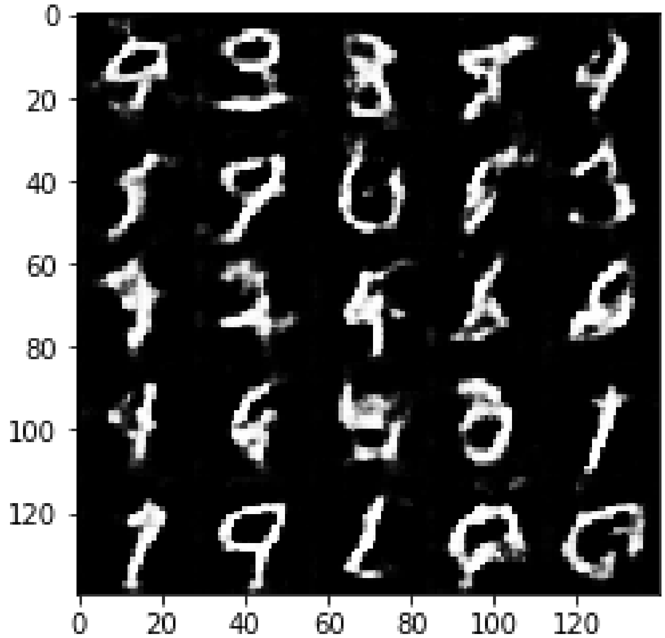
```
Epoch 1/2: batch 405/936:        time/batch: 0.57s        remaining time: 301s        d_loss:
Epoch 1/2: batch 410/936:        time/batch: 0.57s        remaining time: 298s        d_loss:
Epoch 1/2: batch 415/936:        time/batch: 0.57s        remaining time: 296s        d_loss:
Epoch 1/2: batch 420/936:        time/batch: 0.57s        remaining time: 293s        d_loss:
Epoch 1/2: batch 425/936:        time/batch: 0.57s        remaining time: 290s        d_loss:
Epoch 1/2: batch 430/936:        time/batch: 0.57s        remaining time: 287s        d_loss:
Epoch 1/2: batch 435/936:        time/batch: 0.57s        remaining time: 284s        d_loss:
Epoch 1/2: batch 440/936:        time/batch: 0.57s        remaining time: 281s        d_loss:
Epoch 1/2: batch 445/936:        time/batch: 0.57s        remaining time: 278s        d_loss:
Epoch 1/2: batch 450/936:        time/batch: 0.57s        remaining time: 275s        d_loss:
Epoch 1/2: batch 455/936:        time/batch: 0.57s        remaining time: 272s        d_loss:
Epoch 1/2: batch 460/936:        time/batch: 0.57s        remaining time: 269s        d_loss:
Epoch 1/2: batch 465/936:        time/batch: 0.57s        remaining time: 266s        d_loss:
Epoch 2/2: batch 470/936:        time/batch: 0.57s        remaining time: 263s        d_loss:
Epoch 2/2: batch 475/936:        time/batch: 0.56s        remaining time: 260s        d_loss:
Epoch 2/2: batch 480/936:        time/batch: 0.56s        remaining time: 257s        d_loss:
Epoch 2/2: batch 485/936:        time/batch: 0.56s        remaining time: 253s        d_loss:
Epoch 2/2: batch 490/936:        time/batch: 0.56s        remaining time: 250s        d_loss:
Epoch 2/2: batch 495/936:        time/batch: 0.56s        remaining time: 247s        d_loss:
Epoch 2/2: batch 500/936:        time/batch: 0.56s        remaining time: 243s        d_loss:
```



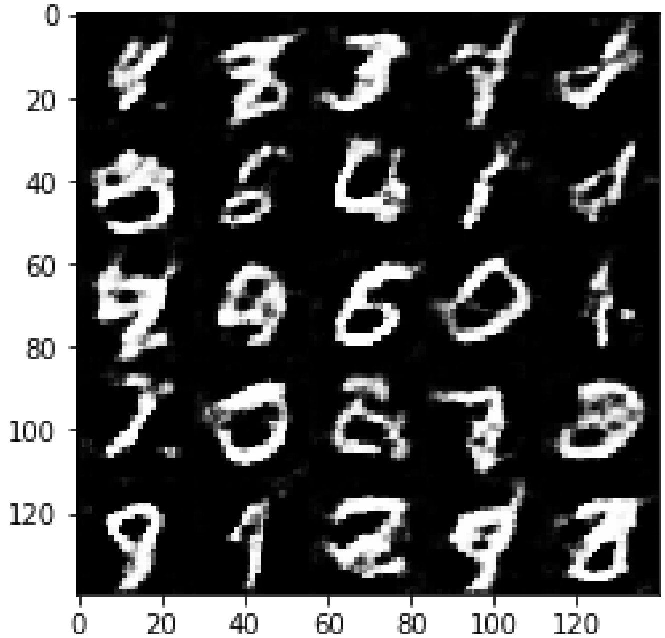

```
Epoch 2/2: batch 505/936:        time/batch: 0.56s        remaining time: 241s        d_loss:
Epoch 2/2: batch 510/936:        time/batch: 0.56s        remaining time: 237s        d_loss:
Epoch 2/2: batch 515/936:        time/batch: 0.56s        remaining time: 234s        d_loss:
Epoch 2/2: batch 520/936:        time/batch: 0.56s        remaining time: 231s        d_loss:
Epoch 2/2: batch 525/936:        time/batch: 0.56s        remaining time: 228s        d_loss:
Epoch 2/2: batch 530/936:        time/batch: 0.55s        remaining time: 225s        d_loss:
Epoch 2/2: batch 535/936:        time/batch: 0.55s        remaining time: 222s        d_loss:
Epoch 2/2: batch 540/936:        time/batch: 0.55s        remaining time: 218s        d_loss:
Epoch 2/2: batch 545/936:        time/batch: 0.55s        remaining time: 215s        d_loss:
Epoch 2/2: batch 550/936:        time/batch: 0.55s        remaining time: 212s        d_loss:
Epoch 2/2: batch 555/936:        time/batch: 0.55s        remaining time: 209s        d_loss:
Epoch 2/2: batch 560/936:        time/batch: 0.55s        remaining time: 206s        d_loss:
Epoch 2/2: batch 565/936:        time/batch: 0.55s        remaining time: 203s        d_loss:
Epoch 2/2: batch 570/936:        time/batch: 0.55s        remaining time: 200s        d_loss:
Epoch 2/2: batch 575/936:        time/batch: 0.55s        remaining time: 197s        d_loss:
Epoch 2/2: batch 580/936:        time/batch: 0.55s        remaining time: 194s        d_loss:
Epoch 2/2: batch 585/936:        time/batch: 0.55s        remaining time: 191s        d_loss:
Epoch 2/2: batch 590/936:        time/batch: 0.54s        remaining time: 188s        d_loss:
Epoch 2/2: batch 595/936:        time/batch: 0.54s        remaining time: 185s        d_loss:
Epoch 2/2: batch 600/936:        time/batch: 0.54s        remaining time: 182s        d_loss:
```



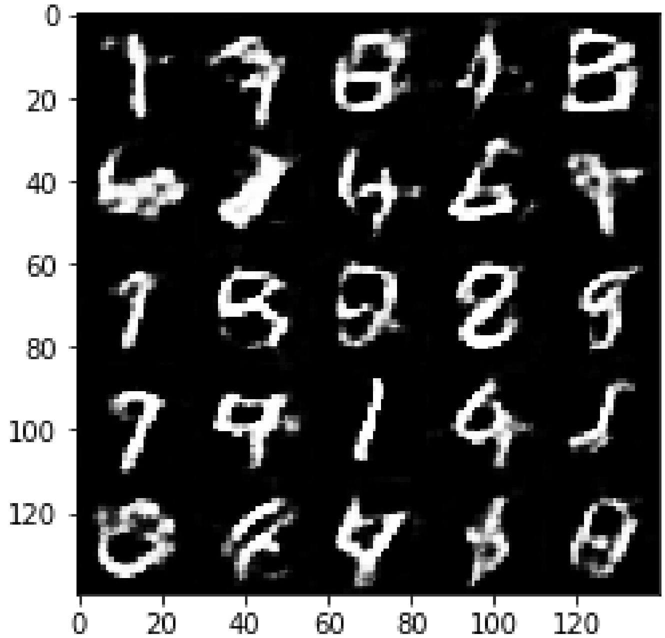

```
Epoch 2/2: batch 605/936:        time/batch: 0.54s        remaining time: 179s        d_loss:
Epoch 2/2: batch 610/936:        time/batch: 0.54s        remaining time: 176s        d_loss:
Epoch 2/2: batch 615/936:        time/batch: 0.54s        remaining time: 173s        d_loss:
Epoch 2/2: batch 620/936:        time/batch: 0.54s        remaining time: 171s        d_loss:
Epoch 2/2: batch 625/936:        time/batch: 0.54s        remaining time: 168s        d_loss:
Epoch 2/2: batch 630/936:        time/batch: 0.54s        remaining time: 165s        d_loss:
Epoch 2/2: batch 635/936:        time/batch: 0.54s        remaining time: 162s        d_loss:
Epoch 2/2: batch 640/936:        time/batch: 0.54s        remaining time: 159s        d_loss:
Epoch 2/2: batch 645/936:        time/batch: 0.54s        remaining time: 156s        d_loss:
Epoch 2/2: batch 650/936:        time/batch: 0.54s        remaining time: 153s        d_loss:
Epoch 2/2: batch 655/936:        time/batch: 0.54s        remaining time: 150s        d_loss:
Epoch 2/2: batch 660/936:        time/batch: 0.54s        remaining time: 148s        d_loss:
Epoch 2/2: batch 665/936:        time/batch: 0.54s        remaining time: 145s        d_loss:
Epoch 2/2: batch 670/936:        time/batch: 0.54s        remaining time: 142s        d_loss:
Epoch 2/2: batch 675/936:        time/batch: 0.53s        remaining time: 139s        d_loss:
Epoch 2/2: batch 680/936:        time/batch: 0.53s        remaining time: 136s        d_loss:
Epoch 2/2: batch 685/936:        time/batch: 0.53s        remaining time: 133s        d_loss:
Epoch 2/2: batch 690/936:        time/batch: 0.53s        remaining time: 131s        d_loss:
Epoch 2/2: batch 695/936:        time/batch: 0.53s        remaining time: 128s        d_loss:
Epoch 2/2: batch 700/936:        time/batch: 0.53s        remaining time: 125s        d_loss:
```



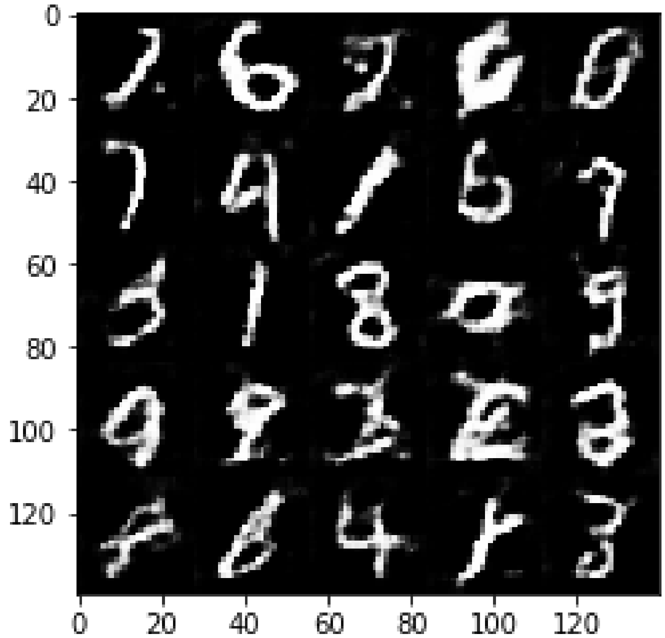
```
Epoch 2/2: batch 705/936:        time/batch: 0.53s        remaining time: 122s        d_loss:
Epoch 2/2: batch 710/936:        time/batch: 0.53s        remaining time: 120s        d_loss:
Epoch 2/2: batch 715/936:        time/batch: 0.53s        remaining time: 117s        d_loss:
Epoch 2/2: batch 720/936:        time/batch: 0.53s        remaining time: 114s        d_loss:
Epoch 2/2: batch 725/936:        time/batch: 0.53s        remaining time: 111s        d_loss:
Epoch 2/2: batch 730/936:        time/batch: 0.53s        remaining time: 109s        d_loss:
Epoch 2/2: batch 735/936:        time/batch: 0.53s        remaining time: 106s        d_loss:
Epoch 2/2: batch 740/936:        time/batch: 0.53s        remaining time: 103s        d_loss:
Epoch 2/2: batch 745/936:        time/batch: 0.53s        remaining time: 100s        d_loss:
Epoch 2/2: batch 750/936:        time/batch: 0.53s        remaining time: 98s        d_loss: 1
Epoch 2/2: batch 755/936:        time/batch: 0.53s        remaining time: 95s        d_loss: 1
Epoch 2/2: batch 760/936:        time/batch: 0.53s        remaining time: 92s        d_loss: 1
Epoch 2/2: batch 765/936:        time/batch: 0.53s        remaining time: 90s        d_loss: 1
Epoch 2/2: batch 770/936:        time/batch: 0.53s        remaining time: 87s        d_loss: 0
Epoch 2/2: batch 775/936:        time/batch: 0.53s        remaining time: 84s        d_loss: 0
Epoch 2/2: batch 780/936:        time/batch: 0.53s        remaining time: 81s        d_loss: 1
Epoch 2/2: batch 785/936:        time/batch: 0.52s        remaining time: 79s        d_loss: 0
Epoch 2/2: batch 790/936:        time/batch: 0.52s        remaining time: 76s        d_loss: 1
Epoch 2/2: batch 795/936:        time/batch: 0.52s        remaining time: 73s        d_loss: 0
Epoch 2/2: batch 800/936:        time/batch: 0.52s        remaining time: 71s        d_loss: 1
```



```
Epoch 2/2: batch 805/936:        time/batch: 0.52s       remaining time: 68s        d_loss: 1
Epoch 2/2: batch 810/936:        time/batch: 0.52s       remaining time: 65s        d_loss: 1
Epoch 2/2: batch 815/936:        time/batch: 0.52s       remaining time: 63s        d_loss: 0
Epoch 2/2: batch 820/936:        time/batch: 0.52s       remaining time: 60s        d_loss: 1
Epoch 2/2: batch 825/936:        time/batch: 0.52s       remaining time: 57s        d_loss: 0
Epoch 2/2: batch 830/936:        time/batch: 0.52s       remaining time: 55s        d_loss: 0
Epoch 2/2: batch 835/936:        time/batch: 0.52s       remaining time: 52s        d_loss: 1
Epoch 2/2: batch 840/936:        time/batch: 0.52s       remaining time: 50s        d_loss: 1
Epoch 2/2: batch 845/936:        time/batch: 0.52s       remaining time: 47s        d_loss: 0
Epoch 2/2: batch 850/936:        time/batch: 0.52s       remaining time: 44s        d_loss: 1
Epoch 2/2: batch 855/936:        time/batch: 0.52s       remaining time: 42s        d_loss: 1
Epoch 2/2: batch 860/936:        time/batch: 0.52s       remaining time: 39s        d_loss: 1
Epoch 2/2: batch 865/936:        time/batch: 0.52s       remaining time: 36s        d_loss: 1
Epoch 2/2: batch 870/936:        time/batch: 0.52s       remaining time: 34s        d_loss: 0
Epoch 2/2: batch 875/936:        time/batch: 0.52s       remaining time: 31s        d_loss: 0
Epoch 2/2: batch 880/936:        time/batch: 0.52s       remaining time: 29s        d_loss: 1
Epoch 2/2: batch 885/936:        time/batch: 0.52s       remaining time: 26s        d_loss: 0
Epoch 2/2: batch 890/936:        time/batch: 0.52s       remaining time: 23s        d_loss: 0
Epoch 2/2: batch 895/936:        time/batch: 0.52s       remaining time: 21s        d_loss: 1
Epoch 2/2: batch 900/936:        time/batch: 0.52s       remaining time: 18s        d_loss: 0
```




```
Epoch 2/2: batch 905/936:        time/batch: 0.52s        remaining time: 16s         d_loss: 0
Epoch 2/2: batch 910/936:        time/batch: 0.52s        remaining time: 13s         d_loss: 0
Epoch 2/2: batch 915/936:        time/batch: 0.52s        remaining time: 10s         d_loss: 0
Epoch 2/2: batch 920/936:        time/batch: 0.52s        remaining time: 8s         d_loss: 1.
Epoch 2/2: batch 925/936:        time/batch: 0.52s        remaining time: 5s         d_loss: 0.
Epoch 2/2: batch 930/936:        time/batch: 0.52s        remaining time: 3s         d_loss: 0.
Epoch 2/2: batch 935/936:        time/batch: 0.52s        remaining time: 0s         d_loss: 1.
```



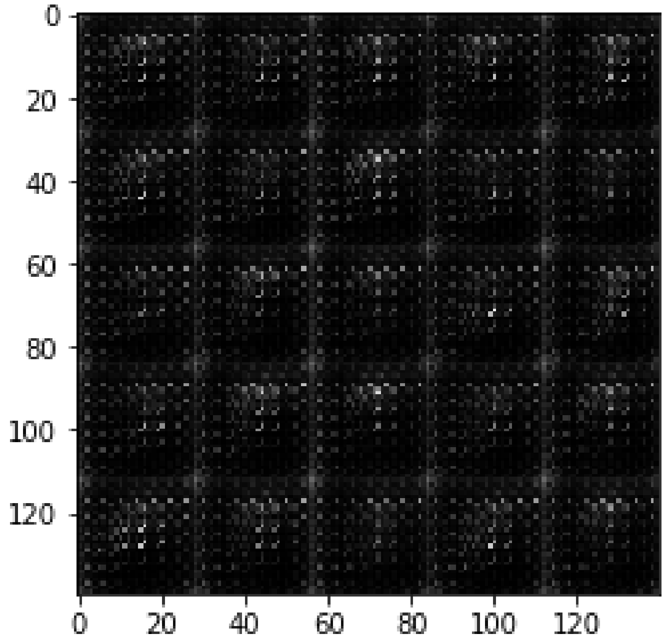

```
In [14]: plot_losses(d_losses, g_losses)
```

1.3.5 MNIST Run 2

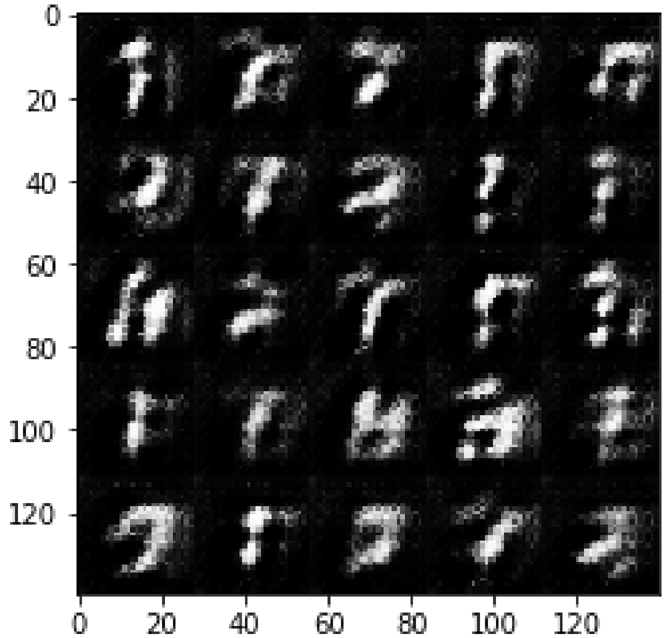
Generator shape: - layer 1: 4x4x512 with LRELU activation - layer 2: 7x7x256 with LRELU - layer 3: 14x14x128 with LRELU - layer 4: 28x28xOutput_Channel with TANH

```
In [17]: batch_size = 128
         z_dim = 100
         learning_rate = 0.0002
         beta1 = 0.5

         d_losses = []
         g_losses = []

         """
         DON'T MODIFY ANYTHING IN THIS CELL THAT IS BELOW THIS LINE
         """
         epochs = 2

         mnist_dataset = helper.Dataset('mnist', glob(os.path.join(data_dir, 'mnist/*.jpg')))
         with tf.Graph().as_default():
             # jcc: added lists for plotting discriminator and generator losses
             d_losses, g_losses = train(epochs, batch_size, z_dim, learning_rate, beta1, mnist_d
                   mnist_dataset.shape, mnist_dataset.image_mode)
```

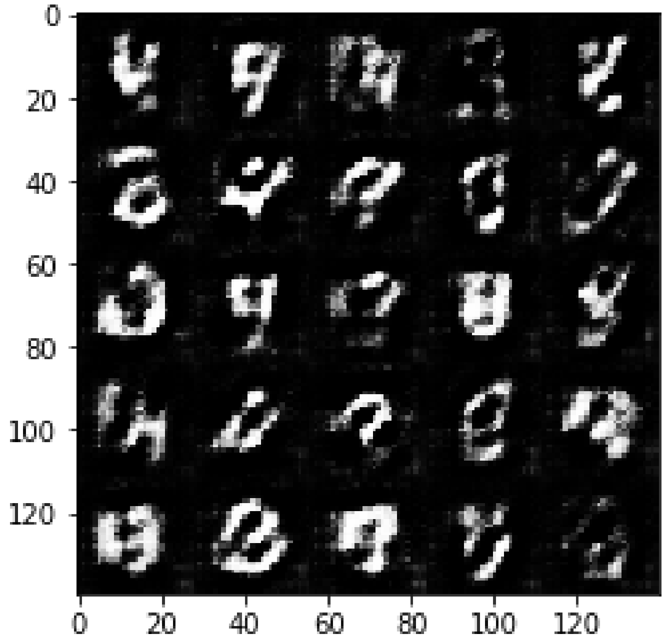
```
Epoch 1/2: batch 5/936:         time/batch: 0.40s        remaining time: 369s         d_loss: 0.
Epoch 1/2: batch 10/936:         time/batch: 0.31s        remaining time: 291s         d_loss: 0
Epoch 1/2: batch 15/936:         time/batch: 0.28s        remaining time: 262s         d_loss: 0
Epoch 1/2: batch 20/936:         time/batch: 0.27s        remaining time: 246s         d_loss: 0
Epoch 1/2: batch 25/936:         time/batch: 0.26s        remaining time: 236s         d_loss: 0
Epoch 1/2: batch 30/936:         time/batch: 0.25s        remaining time: 230s         d_loss: 0
Epoch 1/2: batch 35/936:         time/batch: 0.25s        remaining time: 224s         d_loss: 2
Epoch 1/2: batch 40/936:         time/batch: 0.25s        remaining time: 220s         d_loss: 0
Epoch 1/2: batch 45/936:         time/batch: 0.24s        remaining time: 217s         d_loss: 0
Epoch 1/2: batch 50/936:         time/batch: 0.24s        remaining time: 214s         d_loss: 2
Epoch 1/2: batch 55/936:         time/batch: 0.24s        remaining time: 211s         d_loss: 0
Epoch 1/2: batch 60/936:         time/batch: 0.24s        remaining time: 209s         d_loss: 0
Epoch 1/2: batch 65/936:         time/batch: 0.24s        remaining time: 206s         d_loss: 0
Epoch 1/2: batch 70/936:         time/batch: 0.24s        remaining time: 204s         d_loss: 0
Epoch 1/2: batch 75/936:         time/batch: 0.24s        remaining time: 202s         d_loss: 0
Epoch 1/2: batch 80/936:         time/batch: 0.24s        remaining time: 201s         d_loss: 0
Epoch 1/2: batch 85/936:         time/batch: 0.23s        remaining time: 199s         d_loss: 1
Epoch 1/2: batch 90/936:         time/batch: 0.23s        remaining time: 197s         d_loss: 0
Epoch 1/2: batch 95/936:         time/batch: 0.23s        remaining time: 196s         d_loss: 0
Epoch 1/2: batch 100/936:         time/batch: 0.23s        remaining time: 194s         d_loss:
```



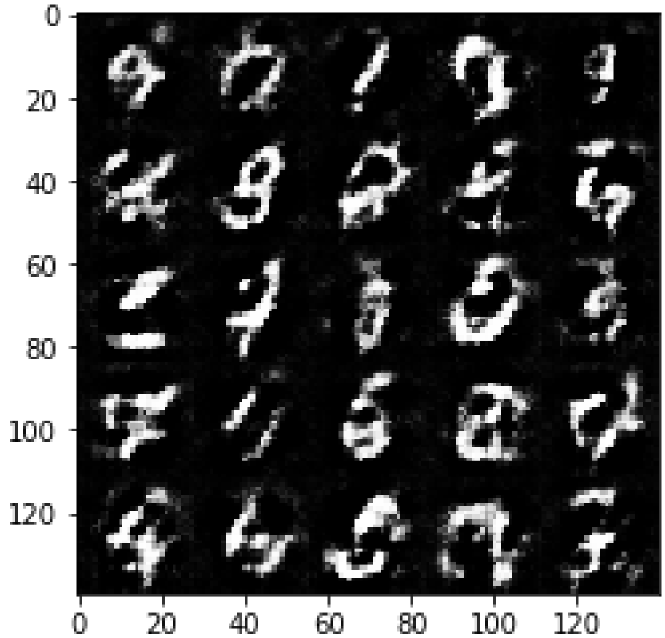

```
Epoch 1/2: batch 105/936:        time/batch: 0.24s        remaining time: 196s        d_loss:
Epoch 1/2: batch 110/936:        time/batch: 0.24s        remaining time: 194s        d_loss:
Epoch 1/2: batch 115/936:        time/batch: 0.23s        remaining time: 192s        d_loss:
Epoch 1/2: batch 120/936:        time/batch: 0.23s        remaining time: 191s        d_loss:
Epoch 1/2: batch 125/936:        time/batch: 0.23s        remaining time: 189s        d_loss:
Epoch 1/2: batch 130/936:        time/batch: 0.23s        remaining time: 188s        d_loss:
Epoch 1/2: batch 135/936:        time/batch: 0.23s        remaining time: 186s        d_loss:
Epoch 1/2: batch 140/936:        time/batch: 0.23s        remaining time: 185s        d_loss:
Epoch 1/2: batch 145/936:        time/batch: 0.23s        remaining time: 184s        d_loss:
Epoch 1/2: batch 150/936:        time/batch: 0.23s        remaining time: 182s        d_loss:
Epoch 1/2: batch 155/936:        time/batch: 0.23s        remaining time: 181s        d_loss:
Epoch 1/2: batch 160/936:        time/batch: 0.23s        remaining time: 179s        d_loss:
Epoch 1/2: batch 165/936:        time/batch: 0.23s        remaining time: 178s        d_loss:
Epoch 1/2: batch 170/936:        time/batch: 0.23s        remaining time: 177s        d_loss:
Epoch 1/2: batch 175/936:        time/batch: 0.23s        remaining time: 175s        d_loss:
Epoch 1/2: batch 180/936:        time/batch: 0.23s        remaining time: 174s        d_loss:
Epoch 1/2: batch 185/936:        time/batch: 0.23s        remaining time: 173s        d_loss:
Epoch 1/2: batch 190/936:        time/batch: 0.23s        remaining time: 172s        d_loss:
Epoch 1/2: batch 195/936:        time/batch: 0.23s        remaining time: 170s        d_loss:
Epoch 1/2: batch 200/936:        time/batch: 0.23s        remaining time: 169s        d_loss:
```



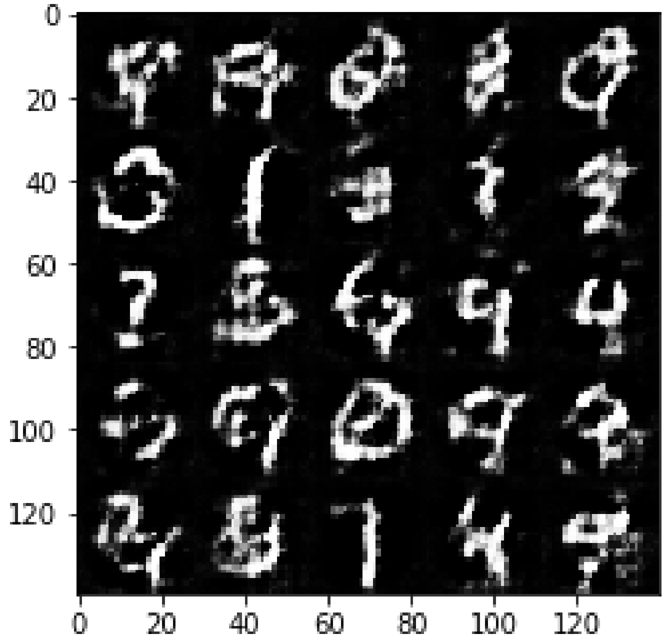

```
Epoch 1/2: batch 205/936:        time/batch: 0.23s        remaining time: 169s        d_loss:
Epoch 1/2: batch 210/936:        time/batch: 0.23s        remaining time: 168s        d_loss:
Epoch 1/2: batch 215/936:        time/batch: 0.23s        remaining time: 166s        d_loss:
Epoch 1/2: batch 220/936:        time/batch: 0.23s        remaining time: 165s        d_loss:
Epoch 1/2: batch 225/936:        time/batch: 0.23s        remaining time: 164s        d_loss:
Epoch 1/2: batch 230/936:        time/batch: 0.23s        remaining time: 163s        d_loss:
Epoch 1/2: batch 235/936:        time/batch: 0.23s        remaining time: 161s        d_loss:
Epoch 1/2: batch 240/936:        time/batch: 0.23s        remaining time: 160s        d_loss:
Epoch 1/2: batch 245/936:        time/batch: 0.23s        remaining time: 159s        d_loss:
Epoch 1/2: batch 250/936:        time/batch: 0.23s        remaining time: 158s        d_loss:
Epoch 1/2: batch 255/936:        time/batch: 0.23s        remaining time: 156s        d_loss:
Epoch 1/2: batch 260/936:        time/batch: 0.23s        remaining time: 155s        d_loss:
Epoch 1/2: batch 265/936:        time/batch: 0.23s        remaining time: 154s        d_loss:
Epoch 1/2: batch 270/936:        time/batch: 0.23s        remaining time: 153s        d_loss:
Epoch 1/2: batch 275/936:        time/batch: 0.23s        remaining time: 152s        d_loss:
Epoch 1/2: batch 280/936:        time/batch: 0.23s        remaining time: 150s        d_loss:
Epoch 1/2: batch 285/936:        time/batch: 0.23s        remaining time: 149s        d_loss:
Epoch 1/2: batch 290/936:        time/batch: 0.23s        remaining time: 148s        d_loss:
Epoch 1/2: batch 295/936:        time/batch: 0.23s        remaining time: 147s        d_loss:
Epoch 1/2: batch 300/936:        time/batch: 0.23s        remaining time: 146s        d_loss:
```



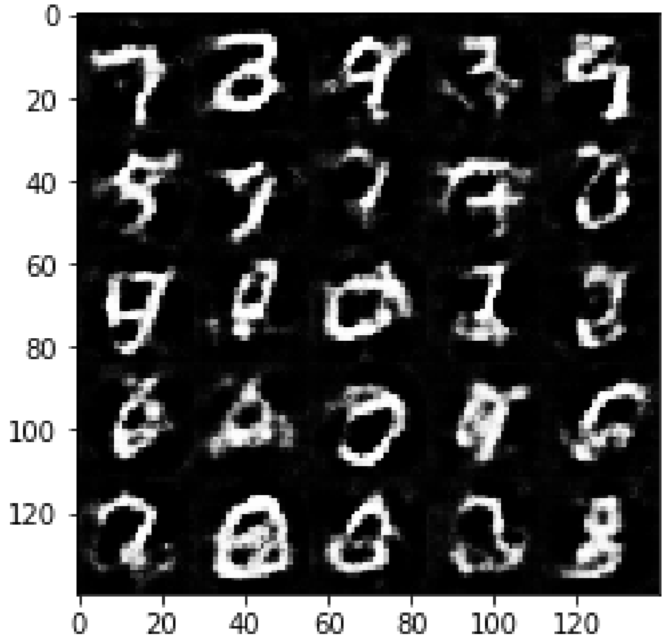

```
Epoch 1/2: batch 305/936:        time/batch: 0.23s        remaining time: 145s        d_loss:
Epoch 1/2: batch 310/936:        time/batch: 0.23s        remaining time: 144s        d_loss:
Epoch 1/2: batch 315/936:        time/batch: 0.23s        remaining time: 143s        d_loss:
Epoch 1/2: batch 320/936:        time/batch: 0.23s        remaining time: 142s        d_loss:
Epoch 1/2: batch 325/936:        time/batch: 0.23s        remaining time: 140s        d_loss:
Epoch 1/2: batch 330/936:        time/batch: 0.23s        remaining time: 139s        d_loss:
Epoch 1/2: batch 335/936:        time/batch: 0.23s        remaining time: 138s        d_loss:
Epoch 1/2: batch 340/936:        time/batch: 0.23s        remaining time: 137s        d_loss:
Epoch 1/2: batch 345/936:        time/batch: 0.23s        remaining time: 136s        d_loss:
Epoch 1/2: batch 350/936:        time/batch: 0.23s        remaining time: 134s        d_loss:
Epoch 1/2: batch 355/936:        time/batch: 0.23s        remaining time: 133s        d_loss:
Epoch 1/2: batch 360/936:        time/batch: 0.23s        remaining time: 132s        d_loss:
Epoch 1/2: batch 365/936:        time/batch: 0.23s        remaining time: 131s        d_loss:
Epoch 1/2: batch 370/936:        time/batch: 0.23s        remaining time: 130s        d_loss:
Epoch 1/2: batch 375/936:        time/batch: 0.23s        remaining time: 128s        d_loss:
Epoch 1/2: batch 380/936:        time/batch: 0.23s        remaining time: 127s        d_loss:
Epoch 1/2: batch 385/936:        time/batch: 0.23s        remaining time: 126s        d_loss:
Epoch 1/2: batch 390/936:        time/batch: 0.23s        remaining time: 125s        d_loss:
Epoch 1/2: batch 395/936:        time/batch: 0.23s        remaining time: 124s        d_loss:
Epoch 1/2: batch 400/936:        time/batch: 0.23s        remaining time: 123s        d_loss:
```



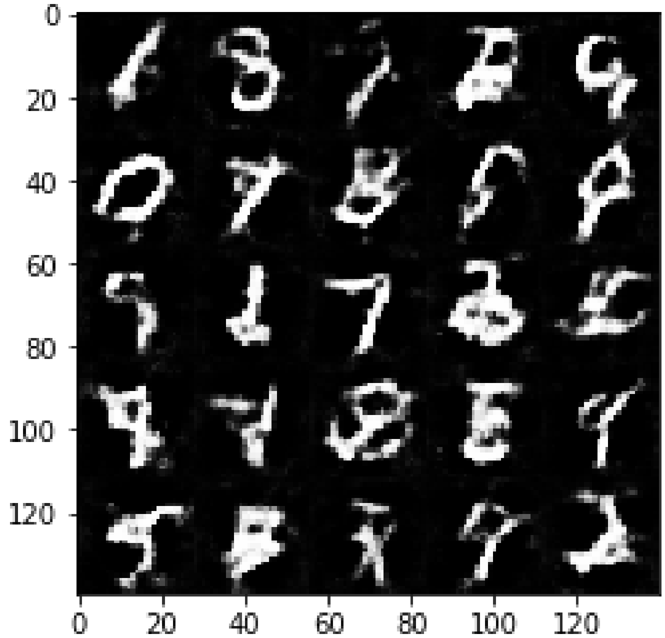

```
Epoch 1/2: batch 405/936:        time/batch: 0.23s        remaining time: 122s        d_loss:
Epoch 1/2: batch 410/936:        time/batch: 0.23s        remaining time: 121s        d_loss:
Epoch 1/2: batch 415/936:        time/batch: 0.23s        remaining time: 119s        d_loss:
Epoch 1/2: batch 420/936:        time/batch: 0.23s        remaining time: 118s        d_loss:
Epoch 1/2: batch 425/936:        time/batch: 0.23s        remaining time: 117s        d_loss:
Epoch 1/2: batch 430/936:        time/batch: 0.23s        remaining time: 116s        d_loss:
Epoch 1/2: batch 435/936:        time/batch: 0.23s        remaining time: 115s        d_loss:
Epoch 1/2: batch 440/936:        time/batch: 0.23s        remaining time: 114s        d_loss:
Epoch 1/2: batch 445/936:        time/batch: 0.23s        remaining time: 112s        d_loss:
Epoch 1/2: batch 450/936:        time/batch: 0.23s        remaining time: 111s        d_loss:
Epoch 1/2: batch 455/936:        time/batch: 0.23s        remaining time: 110s        d_loss:
Epoch 1/2: batch 460/936:        time/batch: 0.23s        remaining time: 109s        d_loss:
Epoch 1/2: batch 465/936:        time/batch: 0.23s        remaining time: 108s        d_loss:
Epoch 2/2: batch 470/936:        time/batch: 0.23s        remaining time: 106s        d_loss:
Epoch 2/2: batch 475/936:        time/batch: 0.23s        remaining time: 105s        d_loss:
Epoch 2/2: batch 480/936:        time/batch: 0.23s        remaining time: 104s        d_loss:
Epoch 2/2: batch 485/936:        time/batch: 0.23s        remaining time: 103s        d_loss:
Epoch 2/2: batch 490/936:        time/batch: 0.23s        remaining time: 102s        d_loss:
Epoch 2/2: batch 495/936:        time/batch: 0.23s        remaining time: 101s        d_loss:
Epoch 2/2: batch 500/936:        time/batch: 0.23s        remaining time: 99s        d_loss: 0
```



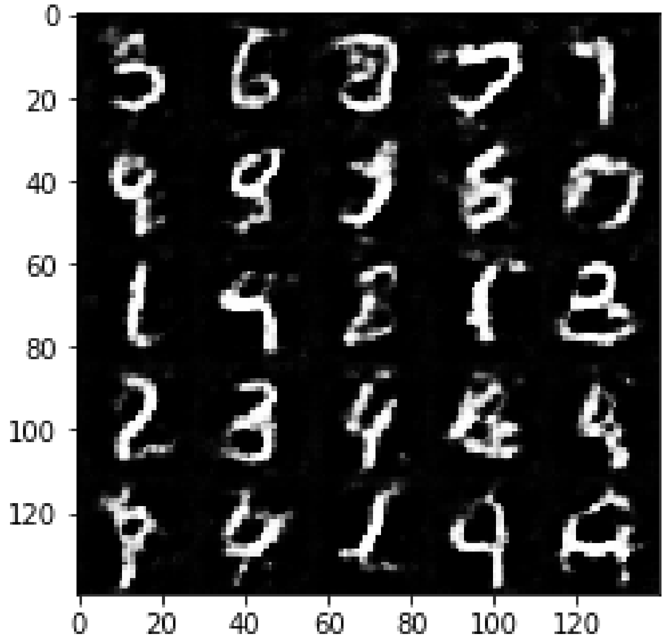
```
Epoch 2/2: batch 505/936:      time/batch: 0.23s      remaining time: 99s      d_loss: 0
Epoch 2/2: batch 510/936:      time/batch: 0.23s      remaining time: 97s      d_loss: 1
Epoch 2/2: batch 515/936:      time/batch: 0.23s      remaining time: 96s      d_loss: 0
Epoch 2/2: batch 520/936:      time/batch: 0.23s      remaining time: 95s      d_loss: 0
Epoch 2/2: batch 525/936:      time/batch: 0.23s      remaining time: 94s      d_loss: 0
Epoch 2/2: batch 530/936:      time/batch: 0.23s      remaining time: 93s      d_loss: 1
Epoch 2/2: batch 535/936:      time/batch: 0.23s      remaining time: 92s      d_loss: 0
Epoch 2/2: batch 540/936:      time/batch: 0.23s      remaining time: 90s      d_loss: 0
Epoch 2/2: batch 545/936:      time/batch: 0.23s      remaining time: 89s      d_loss: 0
Epoch 2/2: batch 550/936:      time/batch: 0.23s      remaining time: 88s      d_loss: 1
Epoch 2/2: batch 555/936:      time/batch: 0.23s      remaining time: 87s      d_loss: 0
Epoch 2/2: batch 560/936:      time/batch: 0.23s      remaining time: 86s      d_loss: 0
Epoch 2/2: batch 565/936:      time/batch: 0.23s      remaining time: 85s      d_loss: 0
Epoch 2/2: batch 570/936:      time/batch: 0.23s      remaining time: 83s      d_loss: 0
Epoch 2/2: batch 575/936:      time/batch: 0.23s      remaining time: 82s      d_loss: 0
Epoch 2/2: batch 580/936:      time/batch: 0.23s      remaining time: 81s      d_loss: 0
Epoch 2/2: batch 585/936:      time/batch: 0.23s      remaining time: 80s      d_loss: 1
Epoch 2/2: batch 590/936:      time/batch: 0.23s      remaining time: 79s      d_loss: 0
Epoch 2/2: batch 595/936:      time/batch: 0.23s      remaining time: 78s      d_loss: 1
Epoch 2/2: batch 600/936:      time/batch: 0.23s      remaining time: 76s      d_loss: 0
```



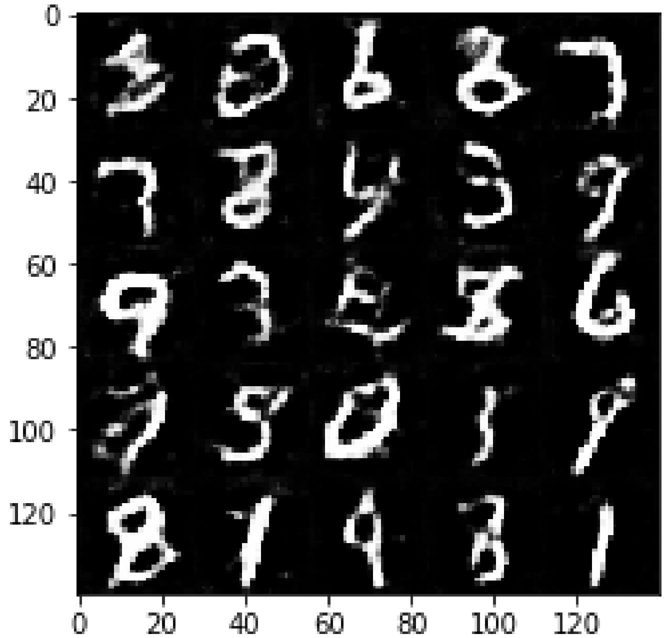

```
Epoch 2/2: batch 605/936:        time/batch: 0.23s        remaining time: 75s        d_loss: 0
Epoch 2/2: batch 610/936:        time/batch: 0.23s        remaining time: 74s        d_loss: 0
Epoch 2/2: batch 615/936:        time/batch: 0.23s        remaining time: 73s        d_loss: 1
Epoch 2/2: batch 620/936:        time/batch: 0.23s        remaining time: 72s        d_loss: 0
Epoch 2/2: batch 625/936:        time/batch: 0.23s        remaining time: 71s        d_loss: 1
Epoch 2/2: batch 630/936:        time/batch: 0.23s        remaining time: 70s        d_loss: 0
Epoch 2/2: batch 635/936:        time/batch: 0.23s        remaining time: 68s        d_loss: 0
Epoch 2/2: batch 640/936:        time/batch: 0.23s        remaining time: 67s        d_loss: 0
Epoch 2/2: batch 645/936:        time/batch: 0.23s        remaining time: 66s        d_loss: 0
Epoch 2/2: batch 650/936:        time/batch: 0.23s        remaining time: 65s        d_loss: 1
Epoch 2/2: batch 655/936:        time/batch: 0.23s        remaining time: 64s        d_loss: 0
Epoch 2/2: batch 660/936:        time/batch: 0.23s        remaining time: 63s        d_loss: 0
Epoch 2/2: batch 665/936:        time/batch: 0.23s        remaining time: 62s        d_loss: 1
Epoch 2/2: batch 670/936:        time/batch: 0.23s        remaining time: 60s        d_loss: 0
Epoch 2/2: batch 675/936:        time/batch: 0.23s        remaining time: 59s        d_loss: 0
Epoch 2/2: batch 680/936:        time/batch: 0.23s        remaining time: 58s        d_loss: 0
Epoch 2/2: batch 685/936:        time/batch: 0.23s        remaining time: 57s        d_loss: 0
Epoch 2/2: batch 690/936:        time/batch: 0.23s        remaining time: 56s        d_loss: 1
Epoch 2/2: batch 695/936:        time/batch: 0.23s        remaining time: 55s        d_loss: 0
Epoch 2/2: batch 700/936:        time/batch: 0.23s        remaining time: 53s        d_loss: 0
```



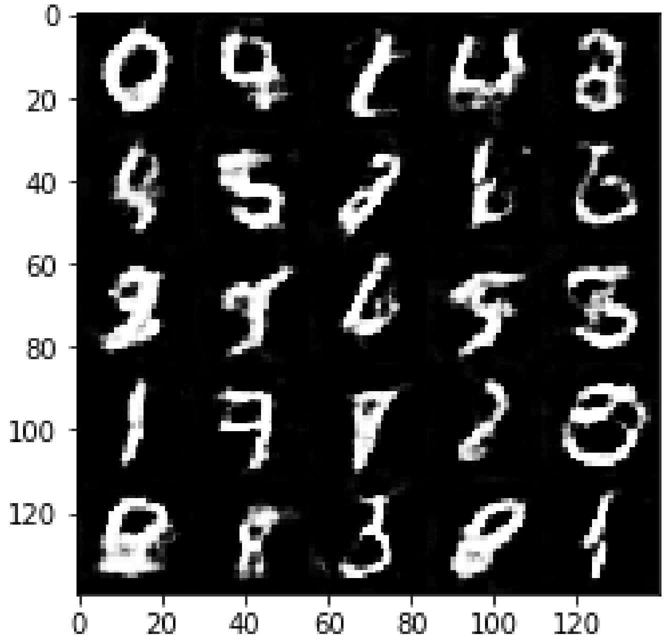

```
Epoch 2/2: batch 705/936:        time/batch: 0.23s        remaining time: 52s        d_loss: 0
Epoch 2/2: batch 710/936:        time/batch: 0.23s        remaining time: 51s        d_loss: 0
Epoch 2/2: batch 715/936:        time/batch: 0.23s        remaining time: 50s        d_loss: 1
Epoch 2/2: batch 720/936:        time/batch: 0.23s        remaining time: 49s        d_loss: 0
Epoch 2/2: batch 725/936:        time/batch: 0.23s        remaining time: 48s        d_loss: 0
Epoch 2/2: batch 730/936:        time/batch: 0.23s        remaining time: 47s        d_loss: 0
Epoch 2/2: batch 735/936:        time/batch: 0.23s        remaining time: 46s        d_loss: 0
Epoch 2/2: batch 740/936:        time/batch: 0.23s        remaining time: 44s        d_loss: 0
Epoch 2/2: batch 745/936:        time/batch: 0.23s        remaining time: 43s        d_loss: 0
Epoch 2/2: batch 750/936:        time/batch: 0.23s        remaining time: 42s        d_loss: 0
Epoch 2/2: batch 755/936:        time/batch: 0.23s        remaining time: 41s        d_loss: 0
Epoch 2/2: batch 760/936:        time/batch: 0.23s        remaining time: 40s        d_loss: 1
Epoch 2/2: batch 765/936:        time/batch: 0.23s        remaining time: 39s        d_loss: 0
Epoch 2/2: batch 770/936:        time/batch: 0.23s        remaining time: 37s        d_loss: 0
Epoch 2/2: batch 775/936:        time/batch: 0.23s        remaining time: 36s        d_loss: 0
Epoch 2/2: batch 780/936:        time/batch: 0.23s        remaining time: 35s        d_loss: 0
Epoch 2/2: batch 785/936:        time/batch: 0.23s        remaining time: 34s        d_loss: 0
Epoch 2/2: batch 790/936:        time/batch: 0.23s        remaining time: 33s        d_loss: 0
Epoch 2/2: batch 795/936:        time/batch: 0.23s        remaining time: 32s        d_loss: 0
Epoch 2/2: batch 800/936:        time/batch: 0.23s        remaining time: 31s        d_loss: 1
```



```
Epoch 2/2: batch 805/936:        time/batch: 0.23s        remaining time: 29s        d_loss: 0
Epoch 2/2: batch 810/936:        time/batch: 0.23s        remaining time: 28s        d_loss: 0
Epoch 2/2: batch 815/936:        time/batch: 0.23s        remaining time: 27s        d_loss: 1
Epoch 2/2: batch 820/936:        time/batch: 0.23s        remaining time: 26s        d_loss: 0
Epoch 2/2: batch 825/936:        time/batch: 0.23s        remaining time: 25s        d_loss: 0
Epoch 2/2: batch 830/936:        time/batch: 0.23s        remaining time: 24s        d_loss: 0
Epoch 2/2: batch 835/936:        time/batch: 0.23s        remaining time: 23s        d_loss: 1
Epoch 2/2: batch 840/936:        time/batch: 0.23s        remaining time: 21s        d_loss: 0
Epoch 2/2: batch 845/936:        time/batch: 0.23s        remaining time: 20s        d_loss: 0
Epoch 2/2: batch 850/936:        time/batch: 0.23s        remaining time: 19s        d_loss: 0
Epoch 2/2: batch 855/936:        time/batch: 0.23s        remaining time: 18s        d_loss: 1
Epoch 2/2: batch 860/936:        time/batch: 0.23s        remaining time: 17s        d_loss: 0
Epoch 2/2: batch 865/936:        time/batch: 0.23s        remaining time: 16s        d_loss: 0
Epoch 2/2: batch 870/936:        time/batch: 0.23s        remaining time: 15s        d_loss: 0
Epoch 2/2: batch 875/936:        time/batch: 0.23s        remaining time: 13s        d_loss: 0
Epoch 2/2: batch 880/936:        time/batch: 0.23s        remaining time: 12s        d_loss: 0
Epoch 2/2: batch 885/936:        time/batch: 0.23s        remaining time: 11s        d_loss: 0
Epoch 2/2: batch 890/936:        time/batch: 0.23s        remaining time: 10s        d_loss: 0
Epoch 2/2: batch 895/936:        time/batch: 0.23s        remaining time: 9s        d_loss: 0.
Epoch 2/2: batch 900/936:        time/batch: 0.23s        remaining time: 8s        d_loss: 1.
```




```
Epoch 2/2: batch 905/936:        time/batch: 0.23s        remaining time: 7s        d_loss: 0.
Epoch 2/2: batch 910/936:        time/batch: 0.23s        remaining time: 5s        d_loss: 0.
Epoch 2/2: batch 915/936:        time/batch: 0.23s        remaining time: 4s        d_loss: 0.
Epoch 2/2: batch 920/936:        time/batch: 0.23s        remaining time: 3s        d_loss: 0.
Epoch 2/2: batch 925/936:        time/batch: 0.23s        remaining time: 2s        d_loss: 0.
Epoch 2/2: batch 930/936:        time/batch: 0.23s        remaining time: 1s        d_loss: 0.
Epoch 2/2: batch 935/936:        time/batch: 0.23s        remaining time: 0s        d_loss: 0.
```



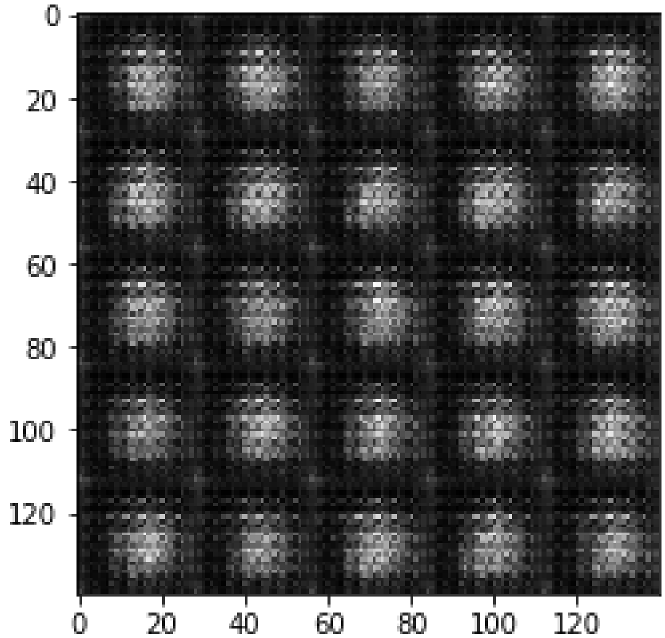

```
In [18]: plot_losses(d_losses, g_losses)
```

1.3.6 MNIST Run 3: decrease learning rate

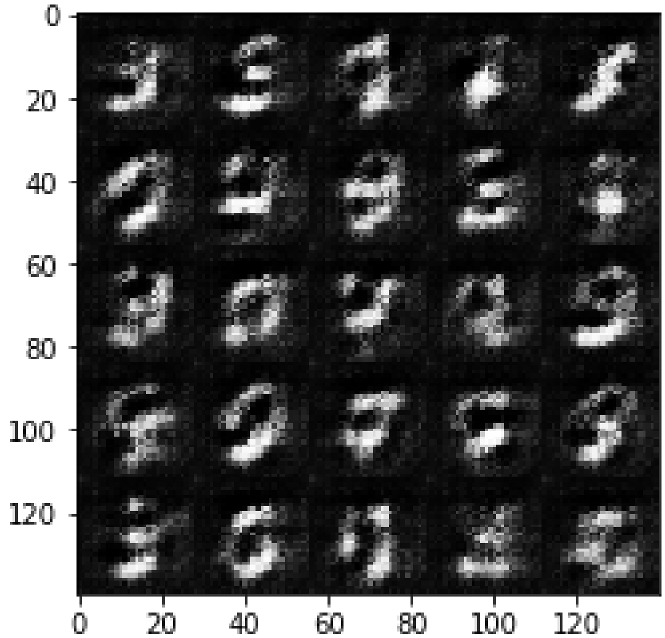
Generator - layer 1: 4x4x512 with LRELU - layer 2: 7x7x256 with LRELU - layer 3: 14x14x128 with LRELU - layer 4: 28x28xOutput_Channel with TANH

In [21]:
```
batch_size = 128
z_dim = 100
learning_rate = 0.0001
beta1 = 0.5

d_losses = []
g_losses = []

"""
DON'T MODIFY ANYTHING IN THIS CELL THAT IS BELOW THIS LINE
"""
epochs = 2

mnist_dataset = helper.Dataset('mnist', glob(os.path.join(data_dir, 'mnist/*.jpg')))
with tf.Graph().as_default():
    # jcc: added lists for plotting discriminator and generator losses
    d_losses, g_losses = train(epochs, batch_size, z_dim, learning_rate, beta1, mnist_d
          mnist_dataset.shape, mnist_dataset.image_mode)
```

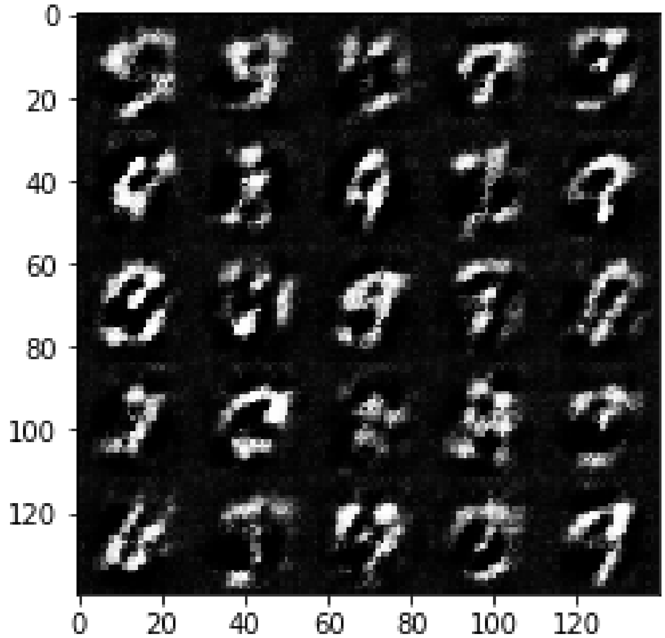
```
Epoch 1/2: batch 5/936:        time/batch: 0.32s       remaining time: 294s        d_loss: 1.
Epoch 1/2: batch 10/936:        time/batch: 0.27s       remaining time: 253s        d_loss: 0
Epoch 1/2: batch 15/936:        time/batch: 0.26s       remaining time: 236s        d_loss: 0
Epoch 1/2: batch 20/936:        time/batch: 0.25s       remaining time: 228s        d_loss: 0
Epoch 1/2: batch 25/936:        time/batch: 0.24s       remaining time: 222s        d_loss: 0
Epoch 1/2: batch 30/936:        time/batch: 0.24s       remaining time: 217s        d_loss: 0
Epoch 1/2: batch 35/936:        time/batch: 0.24s       remaining time: 214s        d_loss: 1
Epoch 1/2: batch 40/936:        time/batch: 0.24s       remaining time: 211s        d_loss: 0
Epoch 1/2: batch 45/936:        time/batch: 0.23s       remaining time: 209s        d_loss: 0
Epoch 1/2: batch 50/936:        time/batch: 0.23s       remaining time: 207s        d_loss: 1
Epoch 1/2: batch 55/936:        time/batch: 0.23s       remaining time: 205s        d_loss: 0
Epoch 1/2: batch 60/936:        time/batch: 0.23s       remaining time: 203s        d_loss: 0
Epoch 1/2: batch 65/936:        time/batch: 0.23s       remaining time: 201s        d_loss: 0
Epoch 1/2: batch 70/936:        time/batch: 0.23s       remaining time: 200s        d_loss: 0
Epoch 1/2: batch 75/936:        time/batch: 0.23s       remaining time: 198s        d_loss: 0
Epoch 1/2: batch 80/936:        time/batch: 0.23s       remaining time: 197s        d_loss: 0
Epoch 1/2: batch 85/936:        time/batch: 0.23s       remaining time: 195s        d_loss: 0
Epoch 1/2: batch 90/936:        time/batch: 0.23s       remaining time: 194s        d_loss: 0
Epoch 1/2: batch 95/936:        time/batch: 0.23s       remaining time: 192s        d_loss: 0
Epoch 1/2: batch 100/936:        time/batch: 0.23s       remaining time: 191s        d_loss:
```



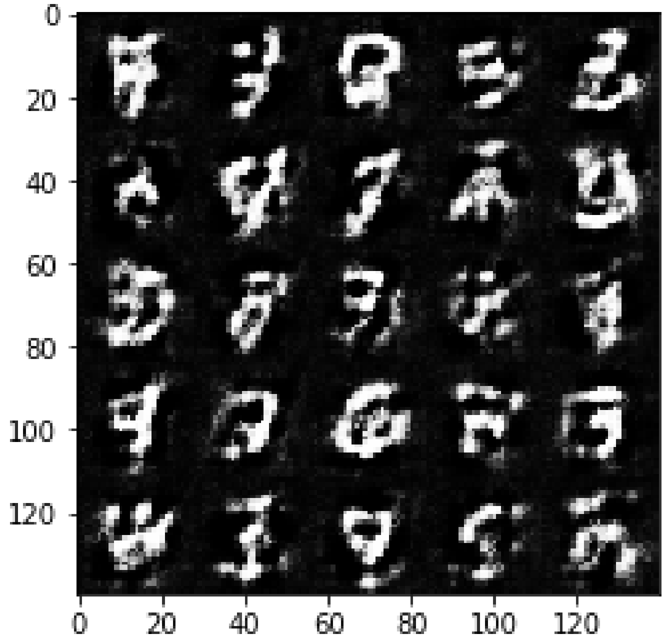

```
Epoch 1/2: batch 105/936:        time/batch: 0.23s        remaining time: 192s        d_loss:
Epoch 1/2: batch 110/936:        time/batch: 0.23s        remaining time: 191s        d_loss:
Epoch 1/2: batch 115/936:        time/batch: 0.23s        remaining time: 189s        d_loss:
Epoch 1/2: batch 120/936:        time/batch: 0.23s        remaining time: 188s        d_loss:
Epoch 1/2: batch 125/936:        time/batch: 0.23s        remaining time: 186s        d_loss:
Epoch 1/2: batch 130/936:        time/batch: 0.23s        remaining time: 185s        d_loss:
Epoch 1/2: batch 135/936:        time/batch: 0.23s        remaining time: 184s        d_loss:
Epoch 1/2: batch 140/936:        time/batch: 0.23s        remaining time: 182s        d_loss:
Epoch 1/2: batch 145/936:        time/batch: 0.23s        remaining time: 181s        d_loss:
Epoch 1/2: batch 150/936:        time/batch: 0.23s        remaining time: 180s        d_loss:
Epoch 1/2: batch 155/936:        time/batch: 0.23s        remaining time: 179s        d_loss:
Epoch 1/2: batch 160/936:        time/batch: 0.23s        remaining time: 177s        d_loss:
Epoch 1/2: batch 165/936:        time/batch: 0.23s        remaining time: 176s        d_loss:
Epoch 1/2: batch 170/936:        time/batch: 0.23s        remaining time: 175s        d_loss:
Epoch 1/2: batch 175/936:        time/batch: 0.23s        remaining time: 174s        d_loss:
Epoch 1/2: batch 180/936:        time/batch: 0.23s        remaining time: 172s        d_loss:
Epoch 1/2: batch 185/936:        time/batch: 0.23s        remaining time: 171s        d_loss:
Epoch 1/2: batch 190/936:        time/batch: 0.23s        remaining time: 170s        d_loss:
Epoch 1/2: batch 195/936:        time/batch: 0.23s        remaining time: 169s        d_loss:
Epoch 1/2: batch 200/936:        time/batch: 0.23s        remaining time: 168s        d_loss:
```



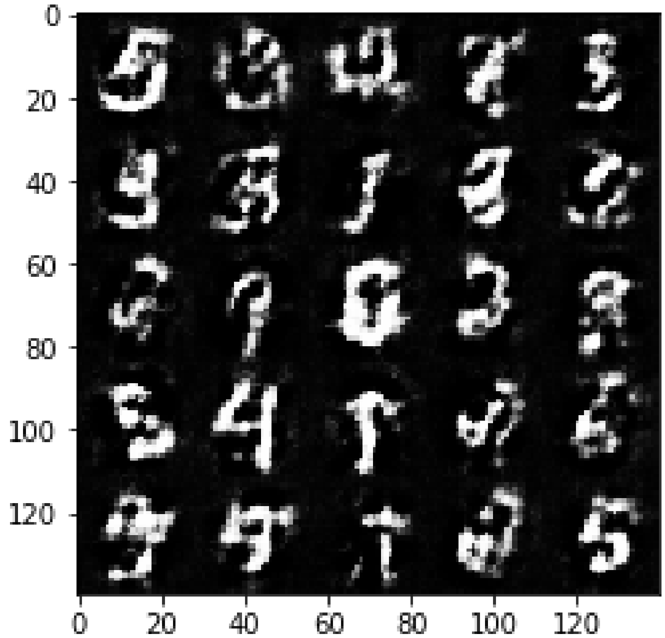

```
Epoch 1/2: batch 205/936:         time/batch: 0.23s        remaining time: 167s         d_loss:
Epoch 1/2: batch 210/936:         time/batch: 0.23s        remaining time: 166s         d_loss:
Epoch 1/2: batch 215/936:         time/batch: 0.23s        remaining time: 165s         d_loss:
Epoch 1/2: batch 220/936:         time/batch: 0.23s        remaining time: 164s         d_loss:
Epoch 1/2: batch 225/936:         time/batch: 0.23s        remaining time: 162s         d_loss:
Epoch 1/2: batch 230/936:         time/batch: 0.23s        remaining time: 161s         d_loss:
Epoch 1/2: batch 235/936:         time/batch: 0.23s        remaining time: 160s         d_loss:
Epoch 1/2: batch 240/936:         time/batch: 0.23s        remaining time: 159s         d_loss:
Epoch 1/2: batch 245/936:         time/batch: 0.23s        remaining time: 158s         d_loss:
Epoch 1/2: batch 250/936:         time/batch: 0.23s        remaining time: 156s         d_loss:
Epoch 1/2: batch 255/936:         time/batch: 0.23s        remaining time: 155s         d_loss:
Epoch 1/2: batch 260/936:         time/batch: 0.23s        remaining time: 154s         d_loss:
Epoch 1/2: batch 265/936:         time/batch: 0.23s        remaining time: 153s         d_loss:
Epoch 1/2: batch 270/936:         time/batch: 0.23s        remaining time: 152s         d_loss:
Epoch 1/2: batch 275/936:         time/batch: 0.23s        remaining time: 150s         d_loss:
Epoch 1/2: batch 280/936:         time/batch: 0.23s        remaining time: 149s         d_loss:
Epoch 1/2: batch 285/936:         time/batch: 0.23s        remaining time: 148s         d_loss:
Epoch 1/2: batch 290/936:         time/batch: 0.23s        remaining time: 147s         d_loss:
Epoch 1/2: batch 295/936:         time/batch: 0.23s        remaining time: 146s         d_loss:
Epoch 1/2: batch 300/936:         time/batch: 0.23s        remaining time: 145s         d_loss:
```



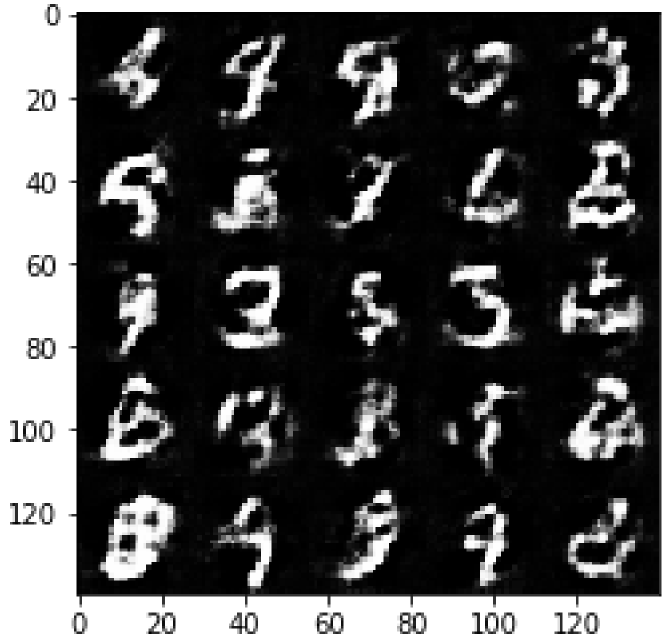

```
Epoch 1/2: batch 305/936:        time/batch: 0.23s        remaining time: 144s        d_loss:
Epoch 1/2: batch 310/936:        time/batch: 0.23s        remaining time: 143s        d_loss:
Epoch 1/2: batch 315/936:        time/batch: 0.23s        remaining time: 142s        d_loss:
Epoch 1/2: batch 320/936:        time/batch: 0.23s        remaining time: 141s        d_loss:
Epoch 1/2: batch 325/936:        time/batch: 0.23s        remaining time: 140s        d_loss:
Epoch 1/2: batch 330/936:        time/batch: 0.23s        remaining time: 138s        d_loss:
Epoch 1/2: batch 335/936:        time/batch: 0.23s        remaining time: 137s        d_loss:
Epoch 1/2: batch 340/936:        time/batch: 0.23s        remaining time: 136s        d_loss:
Epoch 1/2: batch 345/936:        time/batch: 0.23s        remaining time: 135s        d_loss:
Epoch 1/2: batch 350/936:        time/batch: 0.23s        remaining time: 134s        d_loss:
Epoch 1/2: batch 355/936:        time/batch: 0.23s        remaining time: 132s        d_loss:
Epoch 1/2: batch 360/936:        time/batch: 0.23s        remaining time: 131s        d_loss:
Epoch 1/2: batch 365/936:        time/batch: 0.23s        remaining time: 130s        d_loss:
Epoch 1/2: batch 370/936:        time/batch: 0.23s        remaining time: 129s        d_loss:
Epoch 1/2: batch 375/936:        time/batch: 0.23s        remaining time: 128s        d_loss:
Epoch 1/2: batch 380/936:        time/batch: 0.23s        remaining time: 127s        d_loss:
Epoch 1/2: batch 385/936:        time/batch: 0.23s        remaining time: 125s        d_loss:
Epoch 1/2: batch 390/936:        time/batch: 0.23s        remaining time: 124s        d_loss:
Epoch 1/2: batch 395/936:        time/batch: 0.23s        remaining time: 123s        d_loss:
Epoch 1/2: batch 400/936:        time/batch: 0.23s        remaining time: 122s        d_loss:
```



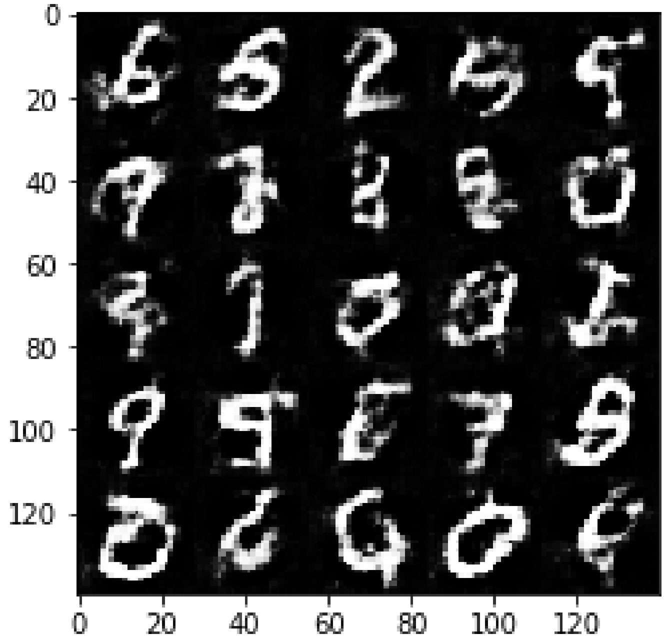

```
Epoch 1/2: batch 405/936:        time/batch: 0.23s        remaining time: 121s        d_loss:
Epoch 1/2: batch 410/936:        time/batch: 0.23s        remaining time: 120s        d_loss:
Epoch 1/2: batch 415/936:        time/batch: 0.23s        remaining time: 119s        d_loss:
Epoch 1/2: batch 420/936:        time/batch: 0.23s        remaining time: 118s        d_loss:
Epoch 1/2: batch 425/936:        time/batch: 0.23s        remaining time: 116s        d_loss:
Epoch 1/2: batch 430/936:        time/batch: 0.23s        remaining time: 115s        d_loss:
Epoch 1/2: batch 435/936:        time/batch: 0.23s        remaining time: 114s        d_loss:
Epoch 1/2: batch 440/936:        time/batch: 0.23s        remaining time: 113s        d_loss:
Epoch 1/2: batch 445/936:        time/batch: 0.23s        remaining time: 112s        d_loss:
Epoch 1/2: batch 450/936:        time/batch: 0.23s        remaining time: 111s        d_loss:
Epoch 1/2: batch 455/936:        time/batch: 0.23s        remaining time: 109s        d_loss:
Epoch 1/2: batch 460/936:        time/batch: 0.23s        remaining time: 108s        d_loss:
Epoch 1/2: batch 465/936:        time/batch: 0.23s        remaining time: 107s        d_loss:
Epoch 2/2: batch 470/936:        time/batch: 0.23s        remaining time: 106s        d_loss:
Epoch 2/2: batch 475/936:        time/batch: 0.23s        remaining time: 105s        d_loss:
Epoch 2/2: batch 480/936:        time/batch: 0.23s        remaining time: 104s        d_loss:
Epoch 2/2: batch 485/936:        time/batch: 0.23s        remaining time: 102s        d_loss:
Epoch 2/2: batch 490/936:        time/batch: 0.23s        remaining time: 101s        d_loss:
Epoch 2/2: batch 495/936:        time/batch: 0.23s        remaining time: 100s        d_loss:
Epoch 2/2: batch 500/936:        time/batch: 0.23s        remaining time: 99s        d_loss: 0
```



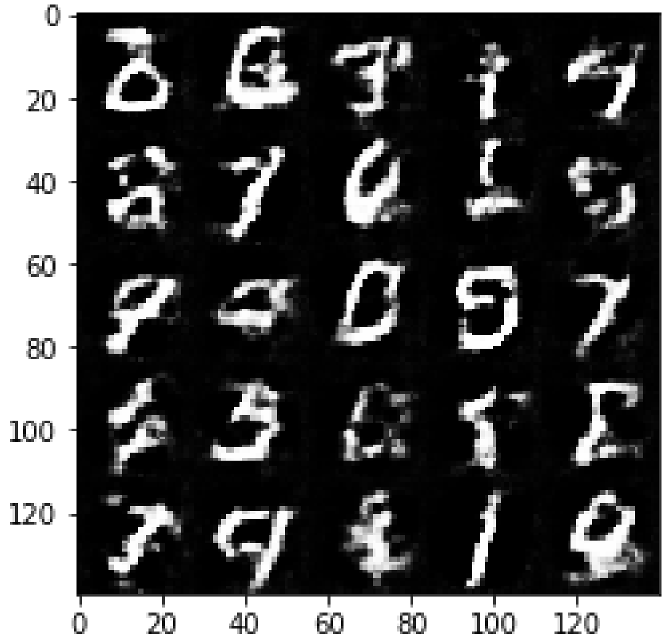
```
Epoch 2/2: batch 505/936:        time/batch: 0.23s        remaining time: 98s        d_loss: 0
Epoch 2/2: batch 510/936:        time/batch: 0.23s        remaining time: 97s        d_loss: 0
Epoch 2/2: batch 515/936:        time/batch: 0.23s        remaining time: 96s        d_loss: 0
Epoch 2/2: batch 520/936:        time/batch: 0.23s        remaining time: 95s        d_loss: 0
Epoch 2/2: batch 525/936:        time/batch: 0.23s        remaining time: 94s        d_loss: 0
Epoch 2/2: batch 530/936:        time/batch: 0.23s        remaining time: 92s        d_loss: 0
Epoch 2/2: batch 535/936:        time/batch: 0.23s        remaining time: 91s        d_loss: 0
Epoch 2/2: batch 540/936:        time/batch: 0.23s        remaining time: 90s        d_loss: 0
Epoch 2/2: batch 545/936:        time/batch: 0.23s        remaining time: 89s        d_loss: 0
Epoch 2/2: batch 550/936:        time/batch: 0.23s        remaining time: 88s        d_loss: 0
Epoch 2/2: batch 555/936:        time/batch: 0.23s        remaining time: 87s        d_loss: 0
Epoch 2/2: batch 560/936:        time/batch: 0.23s        remaining time: 85s        d_loss: 0
Epoch 2/2: batch 565/936:        time/batch: 0.23s        remaining time: 84s        d_loss: 0
Epoch 2/2: batch 570/936:        time/batch: 0.23s        remaining time: 83s        d_loss: 0
Epoch 2/2: batch 575/936:        time/batch: 0.23s        remaining time: 82s        d_loss: 0
Epoch 2/2: batch 580/936:        time/batch: 0.23s        remaining time: 81s        d_loss: 0
Epoch 2/2: batch 585/936:        time/batch: 0.23s        remaining time: 80s        d_loss: 0
Epoch 2/2: batch 590/936:        time/batch: 0.23s        remaining time: 78s        d_loss: 0
Epoch 2/2: batch 595/936:        time/batch: 0.23s        remaining time: 77s        d_loss: 0
Epoch 2/2: batch 600/936:        time/batch: 0.23s        remaining time: 76s        d_loss: 0
```



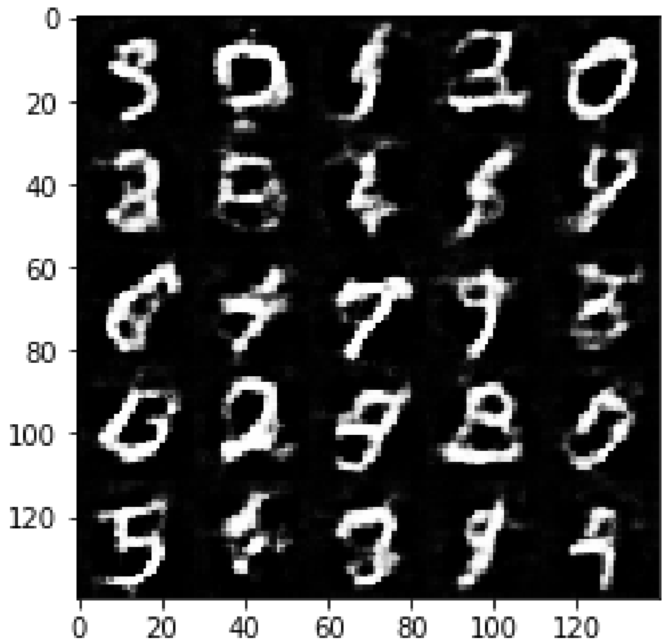

```
Epoch 2/2: batch 605/936:        time/batch: 0.23s        remaining time: 75s        d_loss: 0
Epoch 2/2: batch 610/936:        time/batch: 0.23s        remaining time: 74s        d_loss: 0
Epoch 2/2: batch 615/936:        time/batch: 0.23s        remaining time: 73s        d_loss: 0
Epoch 2/2: batch 620/936:        time/batch: 0.23s        remaining time: 72s        d_loss: 0
Epoch 2/2: batch 625/936:        time/batch: 0.23s        remaining time: 71s        d_loss: 0
Epoch 2/2: batch 630/936:        time/batch: 0.23s        remaining time: 69s        d_loss: 0
Epoch 2/2: batch 635/936:        time/batch: 0.23s        remaining time: 68s        d_loss: 0
Epoch 2/2: batch 640/936:        time/batch: 0.23s        remaining time: 67s        d_loss: 0
Epoch 2/2: batch 645/936:        time/batch: 0.23s        remaining time: 66s        d_loss: 1
Epoch 2/2: batch 650/936:        time/batch: 0.23s        remaining time: 65s        d_loss: 0
Epoch 2/2: batch 655/936:        time/batch: 0.23s        remaining time: 64s        d_loss: 0
Epoch 2/2: batch 660/936:        time/batch: 0.23s        remaining time: 63s        d_loss: 0
Epoch 2/2: batch 665/936:        time/batch: 0.23s        remaining time: 61s        d_loss: 0
Epoch 2/2: batch 670/936:        time/batch: 0.23s        remaining time: 60s        d_loss: 0
Epoch 2/2: batch 675/936:        time/batch: 0.23s        remaining time: 59s        d_loss: 0
Epoch 2/2: batch 680/936:        time/batch: 0.23s        remaining time: 58s        d_loss: 0
Epoch 2/2: batch 685/936:        time/batch: 0.23s        remaining time: 57s        d_loss: 0
Epoch 2/2: batch 690/936:        time/batch: 0.23s        remaining time: 56s        d_loss: 0
Epoch 2/2: batch 695/936:        time/batch: 0.23s        remaining time: 55s        d_loss: 0
Epoch 2/2: batch 700/936:        time/batch: 0.23s        remaining time: 53s        d_loss: 0
```



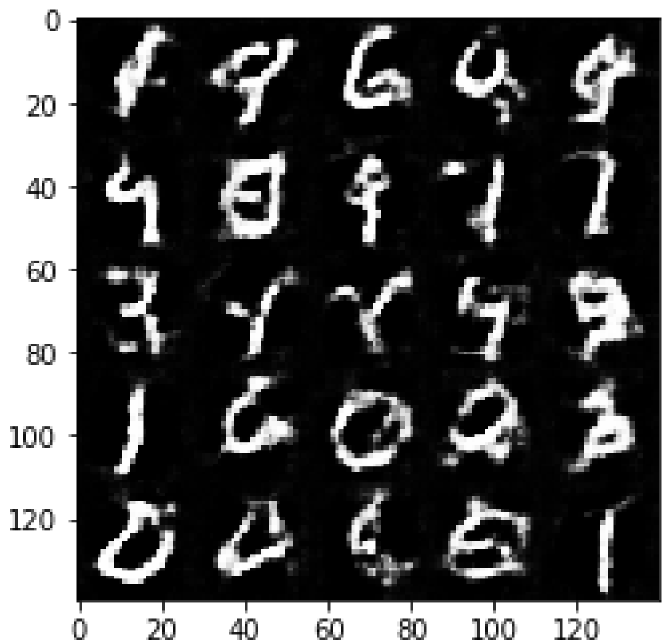

```
Epoch 2/2: batch 705/936:        time/batch: 0.23s        remaining time: 52s        d_loss: 0
Epoch 2/2: batch 710/936:        time/batch: 0.23s        remaining time: 51s        d_loss: 0
Epoch 2/2: batch 715/936:        time/batch: 0.23s        remaining time: 50s        d_loss: 0
Epoch 2/2: batch 720/936:        time/batch: 0.23s        remaining time: 49s        d_loss: 0
Epoch 2/2: batch 725/936:        time/batch: 0.23s        remaining time: 48s        d_loss: 0
Epoch 2/2: batch 730/936:        time/batch: 0.23s        remaining time: 47s        d_loss: 0
Epoch 2/2: batch 735/936:        time/batch: 0.23s        remaining time: 45s        d_loss: 0
Epoch 2/2: batch 740/936:        time/batch: 0.23s        remaining time: 44s        d_loss: 0
Epoch 2/2: batch 745/936:        time/batch: 0.23s        remaining time: 43s        d_loss: 0
Epoch 2/2: batch 750/936:        time/batch: 0.23s        remaining time: 42s        d_loss: 0
Epoch 2/2: batch 755/936:        time/batch: 0.23s        remaining time: 41s        d_loss: 0
Epoch 2/2: batch 760/936:        time/batch: 0.23s        remaining time: 40s        d_loss: 1
Epoch 2/2: batch 765/936:        time/batch: 0.23s        remaining time: 39s        d_loss: 1
Epoch 2/2: batch 770/936:        time/batch: 0.23s        remaining time: 37s        d_loss: 0
Epoch 2/2: batch 775/936:        time/batch: 0.23s        remaining time: 36s        d_loss: 0
Epoch 2/2: batch 780/936:        time/batch: 0.23s        remaining time: 35s        d_loss: 0
Epoch 2/2: batch 785/936:        time/batch: 0.23s        remaining time: 34s        d_loss: 0
Epoch 2/2: batch 790/936:        time/batch: 0.23s        remaining time: 33s        d_loss: 0
Epoch 2/2: batch 795/936:        time/batch: 0.23s        remaining time: 32s        d_loss: 0
Epoch 2/2: batch 800/936:        time/batch: 0.23s        remaining time: 31s        d_loss: 0
```



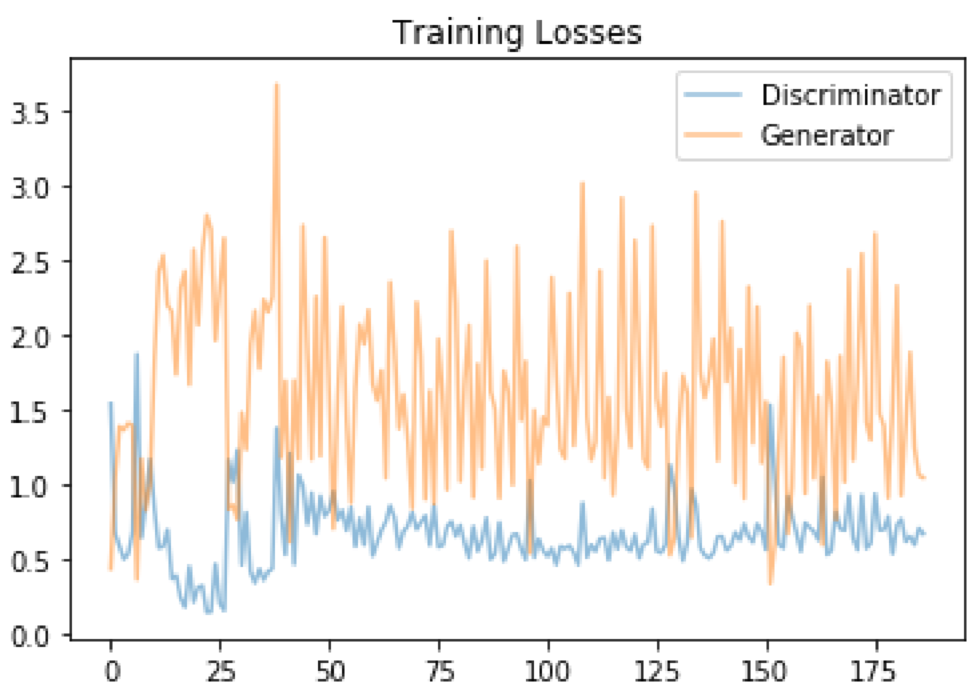

```
Epoch 2/2: batch 805/936:        time/batch: 0.23s       remaining time: 29s        d_loss: 0
Epoch 2/2: batch 810/936:        time/batch: 0.23s       remaining time: 28s        d_loss: 0
Epoch 2/2: batch 815/936:        time/batch: 0.23s       remaining time: 27s        d_loss: 0
Epoch 2/2: batch 820/936:        time/batch: 0.23s       remaining time: 26s        d_loss: 1
Epoch 2/2: batch 825/936:        time/batch: 0.23s       remaining time: 25s        d_loss: 0
Epoch 2/2: batch 830/936:        time/batch: 0.23s       remaining time: 24s        d_loss: 0
Epoch 2/2: batch 835/936:        time/batch: 0.23s       remaining time: 23s        d_loss: 0
Epoch 2/2: batch 840/936:        time/batch: 0.23s       remaining time: 21s        d_loss: 0
Epoch 2/2: batch 845/936:        time/batch: 0.23s       remaining time: 20s        d_loss: 0
Epoch 2/2: batch 850/936:        time/batch: 0.23s       remaining time: 19s        d_loss: 0
Epoch 2/2: batch 855/936:        time/batch: 0.23s       remaining time: 18s        d_loss: 0
Epoch 2/2: batch 860/936:        time/batch: 0.23s       remaining time: 17s        d_loss: 0
Epoch 2/2: batch 865/936:        time/batch: 0.23s       remaining time: 16s        d_loss: 0
Epoch 2/2: batch 870/936:        time/batch: 0.23s       remaining time: 15s        d_loss: 0
Epoch 2/2: batch 875/936:        time/batch: 0.23s       remaining time: 13s        d_loss: 0
Epoch 2/2: batch 880/936:        time/batch: 0.23s       remaining time: 12s        d_loss: 0
Epoch 2/2: batch 885/936:        time/batch: 0.23s       remaining time: 11s        d_loss: 0
Epoch 2/2: batch 890/936:        time/batch: 0.23s       remaining time: 10s        d_loss: 0
Epoch 2/2: batch 895/936:        time/batch: 0.23s       remaining time: 9s        d_loss: 0.
Epoch 2/2: batch 900/936:        time/batch: 0.23s       remaining time: 8s        d_loss: 0.
```




```
Epoch 2/2: batch 905/936:         time/batch: 0.23s        remaining time: 7s          d_loss: 0.
Epoch 2/2: batch 910/936:         time/batch: 0.23s        remaining time: 5s          d_loss: 0.
Epoch 2/2: batch 915/936:         time/batch: 0.23s        remaining time: 4s          d_loss: 0.
Epoch 2/2: batch 920/936:         time/batch: 0.23s        remaining time: 3s          d_loss: 0.
Epoch 2/2: batch 925/936:         time/batch: 0.23s        remaining time: 2s          d_loss: 0.
Epoch 2/2: batch 930/936:         time/batch: 0.23s        remaining time: 1s          d_loss: 0.
Epoch 2/2: batch 935/936:         time/batch: 0.23s        remaining time: 0s          d_loss: 0.
```



In [22]: plot_losses(d_losses, g_losses)



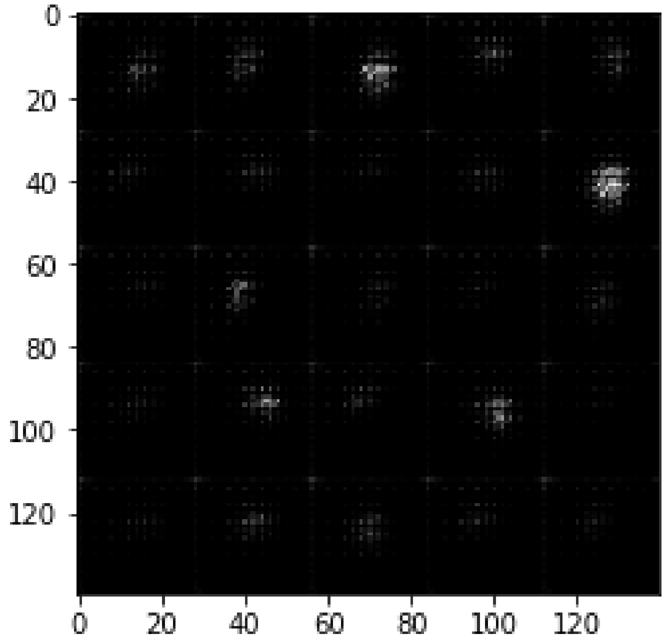
1.3.7 MNIST Run 4

The Generator defined in Run 1 seems to give the best results so far. We return to it and experiment with some of the other hyperparameters.

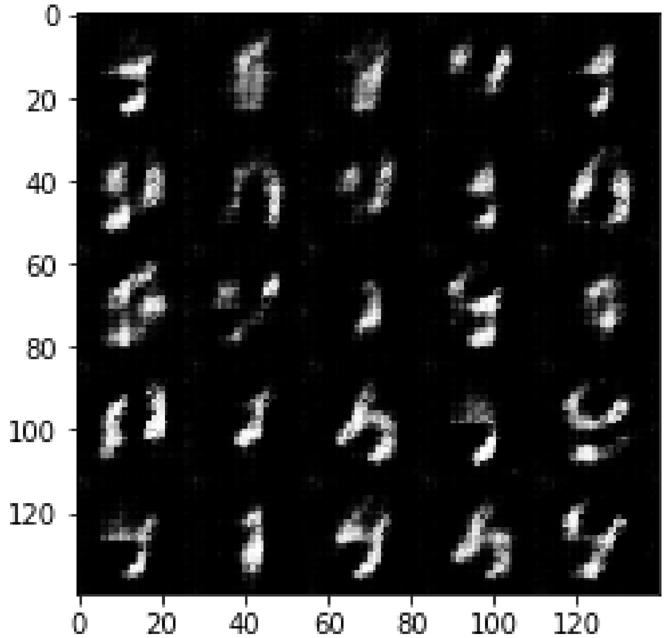
Generator shape: - layer 1: 4x4x1024 with LRELU activation - layer 2: 7x7x512 with LRELU - layer 3: 14x14x256 with LRELU - layer 4: 28x28xOutput_Channel with TANH

```
In [25]: batch_size = 256
         z_dim = 100
         learning_rate = 0.0002
         beta1 = 0.5

         d_losses = []
         g_losses = []

         """
         DON'T MODIFY ANYTHING IN THIS CELL THAT IS BELOW THIS LINE
         """
         epochs = 2

         mnist_dataset = helper.Dataset('mnist', glob(os.path.join(data_dir, 'mnist/*.jpg')))
         with tf.Graph().as_default():
             # jcc: added lists for plotting discriminator and generator losses
             d_losses, g_losses = train(epochs, batch_size, z_dim, learning_rate, beta1, mnist_d
                   mnist_dataset.shape, mnist_dataset.image_mode)
```

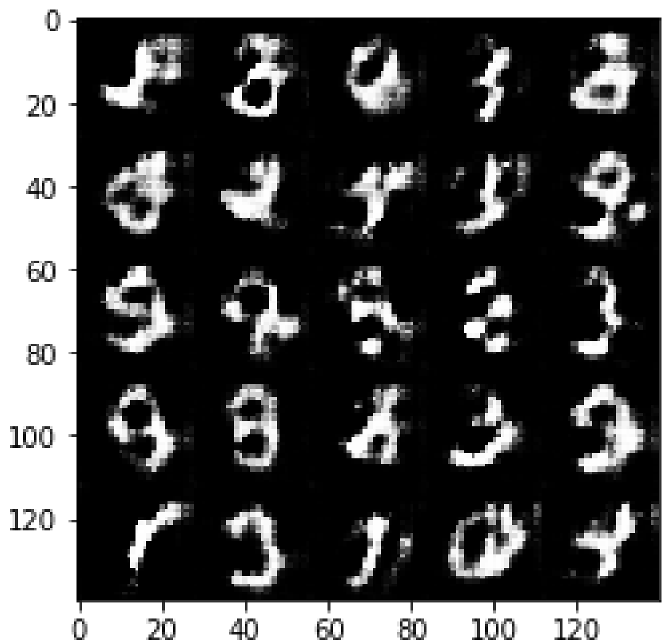
```
Epoch 1/2: batch 5/468:        time/batch: 1.61s       remaining time: 744s         d_loss: 1.
Epoch 1/2: batch 10/468:        time/batch: 1.24s       remaining time: 568s         d_loss: 0
Epoch 1/2: batch 15/468:        time/batch: 1.12s       remaining time: 506s         d_loss: 0
Epoch 1/2: batch 20/468:        time/batch: 1.06s       remaining time: 472s         d_loss: 0
Epoch 1/2: batch 25/468:        time/batch: 1.02s       remaining time: 450s         d_loss: 0
Epoch 1/2: batch 30/468:        time/batch: 0.99s       remaining time: 434s         d_loss: 0
Epoch 1/2: batch 35/468:        time/batch: 0.97s       remaining time: 421s         d_loss: 0
Epoch 1/2: batch 40/468:        time/batch: 0.96s       remaining time: 411s         d_loss: 0
Epoch 1/2: batch 45/468:        time/batch: 0.95s       remaining time: 402s         d_loss: 0
Epoch 1/2: batch 50/468:        time/batch: 0.94s       remaining time: 393s         d_loss: 0
Epoch 1/2: batch 55/468:        time/batch: 0.94s       remaining time: 386s         d_loss: 0
Epoch 1/2: batch 60/468:        time/batch: 0.93s       remaining time: 379s         d_loss: 1
Epoch 1/2: batch 65/468:        time/batch: 0.93s       remaining time: 373s         d_loss: 1
Epoch 1/2: batch 70/468:        time/batch: 0.92s       remaining time: 366s         d_loss: 0
Epoch 1/2: batch 75/468:        time/batch: 0.92s       remaining time: 360s         d_loss: 0
Epoch 1/2: batch 80/468:        time/batch: 0.92s       remaining time: 355s         d_loss: 0
Epoch 1/2: batch 85/468:        time/batch: 0.91s       remaining time: 349s         d_loss: 0
Epoch 1/2: batch 90/468:        time/batch: 0.91s       remaining time: 344s         d_loss: 0
Epoch 1/2: batch 95/468:        time/batch: 0.91s       remaining time: 338s         d_loss: 0
Epoch 1/2: batch 100/468:        time/batch: 0.91s       remaining time: 333s         d_loss:
```



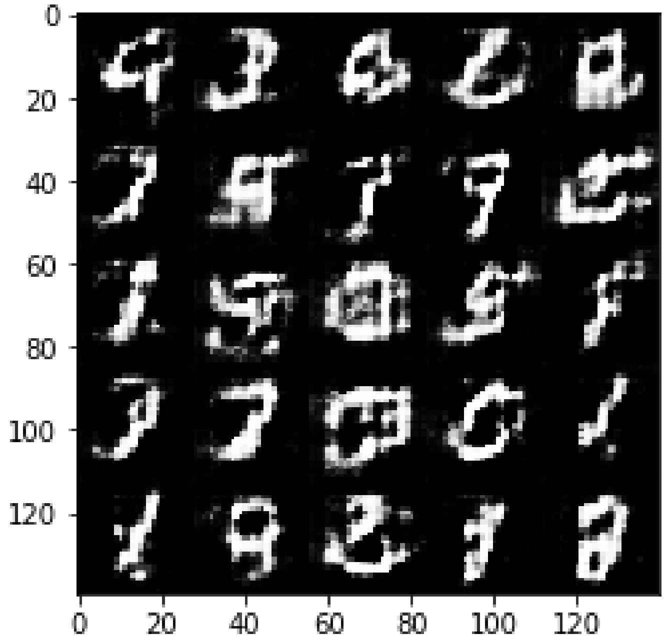

```
Epoch 1/2: batch 105/468:        time/batch: 0.91s       remaining time: 329s        d_loss:
Epoch 1/2: batch 110/468:        time/batch: 0.91s       remaining time: 324s        d_loss:
Epoch 1/2: batch 115/468:        time/batch: 0.90s       remaining time: 319s        d_loss:
Epoch 1/2: batch 120/468:        time/batch: 0.90s       remaining time: 314s        d_loss:
Epoch 1/2: batch 125/468:        time/batch: 0.90s       remaining time: 309s        d_loss:
Epoch 1/2: batch 130/468:        time/batch: 0.90s       remaining time: 304s        d_loss:
Epoch 1/2: batch 135/468:        time/batch: 0.90s       remaining time: 299s        d_loss:
Epoch 1/2: batch 140/468:        time/batch: 0.90s       remaining time: 294s        d_loss:
Epoch 1/2: batch 145/468:        time/batch: 0.90s       remaining time: 290s        d_loss:
Epoch 1/2: batch 150/468:        time/batch: 0.90s       remaining time: 285s        d_loss:
Epoch 1/2: batch 155/468:        time/batch: 0.90s       remaining time: 280s        d_loss:
Epoch 1/2: batch 160/468:        time/batch: 0.90s       remaining time: 275s        d_loss:
Epoch 1/2: batch 165/468:        time/batch: 0.89s       remaining time: 271s        d_loss:
Epoch 1/2: batch 170/468:        time/batch: 0.89s       remaining time: 266s        d_loss:
Epoch 1/2: batch 175/468:        time/batch: 0.89s       remaining time: 261s        d_loss:
Epoch 1/2: batch 180/468:        time/batch: 0.89s       remaining time: 257s        d_loss:
Epoch 1/2: batch 185/468:        time/batch: 0.89s       remaining time: 252s        d_loss:
Epoch 1/2: batch 190/468:        time/batch: 0.89s       remaining time: 248s        d_loss:
Epoch 1/2: batch 195/468:        time/batch: 0.89s       remaining time: 243s        d_loss:
Epoch 1/2: batch 200/468:        time/batch: 0.89s       remaining time: 238s        d_loss:
```



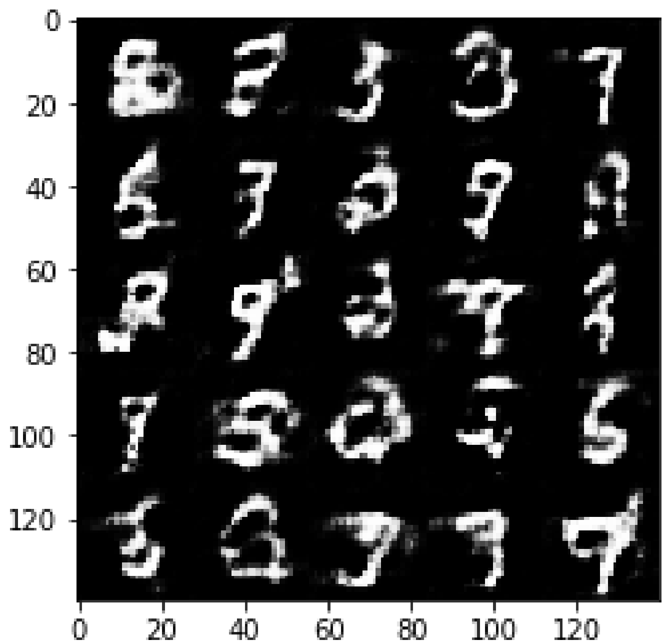
```
Epoch 1/2: batch 205/468:        time/batch: 0.89s        remaining time: 234s        d_loss:
Epoch 1/2: batch 210/468:        time/batch: 0.89s        remaining time: 230s        d_loss:
Epoch 1/2: batch 215/468:        time/batch: 0.89s        remaining time: 225s        d_loss:
Epoch 1/2: batch 220/468:        time/batch: 0.89s        remaining time: 220s        d_loss:
Epoch 1/2: batch 225/468:        time/batch: 0.89s        remaining time: 216s        d_loss:
Epoch 1/2: batch 230/468:        time/batch: 0.89s        remaining time: 211s        d_loss:
Epoch 2/2: batch 235/468:        time/batch: 0.89s        remaining time: 207s        d_loss:
Epoch 2/2: batch 240/468:        time/batch: 0.89s        remaining time: 202s        d_loss:
Epoch 2/2: batch 245/468:        time/batch: 0.89s        remaining time: 198s        d_loss:
Epoch 2/2: batch 250/468:        time/batch: 0.89s        remaining time: 193s        d_loss:
Epoch 2/2: batch 255/468:        time/batch: 0.89s        remaining time: 189s        d_loss:
Epoch 2/2: batch 260/468:        time/batch: 0.89s        remaining time: 184s        d_loss:
Epoch 2/2: batch 265/468:        time/batch: 0.89s        remaining time: 180s        d_loss:
Epoch 2/2: batch 270/468:        time/batch: 0.89s        remaining time: 175s        d_loss:
Epoch 2/2: batch 275/468:        time/batch: 0.89s        remaining time: 171s        d_loss:
Epoch 2/2: batch 280/468:        time/batch: 0.89s        remaining time: 166s        d_loss:
Epoch 2/2: batch 285/468:        time/batch: 0.89s        remaining time: 162s        d_loss:
Epoch 2/2: batch 290/468:        time/batch: 0.89s        remaining time: 157s        d_loss:
Epoch 2/2: batch 295/468:        time/batch: 0.89s        remaining time: 153s        d_loss:
Epoch 2/2: batch 300/468:        time/batch: 0.89s        remaining time: 148s        d_loss:
```



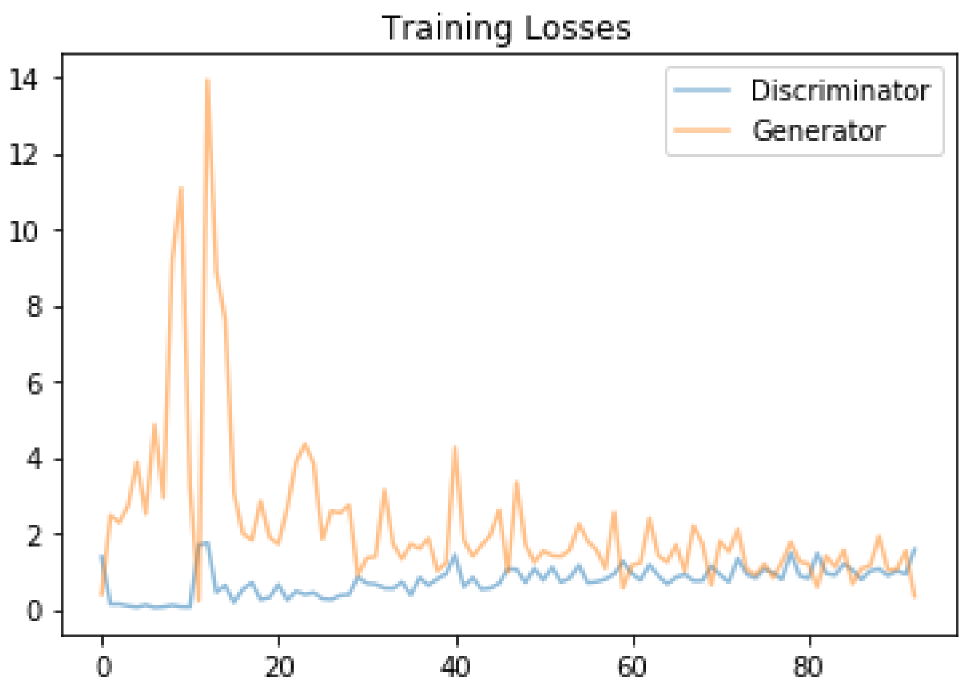
```
Epoch 2/2: batch 305/468:        time/batch: 0.89s        remaining time: 144s        d_loss:
Epoch 2/2: batch 310/468:        time/batch: 0.89s        remaining time: 140s        d_loss:
Epoch 2/2: batch 315/468:        time/batch: 0.89s        remaining time: 135s        d_loss:
Epoch 2/2: batch 320/468:        time/batch: 0.89s        remaining time: 131s        d_loss:
Epoch 2/2: batch 325/468:        time/batch: 0.89s        remaining time: 126s        d_loss:
Epoch 2/2: batch 330/468:        time/batch: 0.89s        remaining time: 122s        d_loss:
Epoch 2/2: batch 335/468:        time/batch: 0.89s        remaining time: 117s        d_loss:
Epoch 2/2: batch 340/468:        time/batch: 0.89s        remaining time: 113s        d_loss:
Epoch 2/2: batch 345/468:        time/batch: 0.89s        remaining time: 108s        d_loss:
Epoch 2/2: batch 350/468:        time/batch: 0.89s        remaining time: 104s        d_loss:
Epoch 2/2: batch 355/468:        time/batch: 0.89s        remaining time: 100s        d_loss:
Epoch 2/2: batch 360/468:        time/batch: 0.89s        remaining time: 95s        d_loss: 0
Epoch 2/2: batch 365/468:        time/batch: 0.89s        remaining time: 91s        d_loss: 1
Epoch 2/2: batch 370/468:        time/batch: 0.89s        remaining time: 86s        d_loss: 0
Epoch 2/2: batch 375/468:        time/batch: 0.88s        remaining time: 82s        d_loss: 0
Epoch 2/2: batch 380/468:        time/batch: 0.88s        remaining time: 77s        d_loss: 1
Epoch 2/2: batch 385/468:        time/batch: 0.88s        remaining time: 73s        d_loss: 0
Epoch 2/2: batch 390/468:        time/batch: 0.88s        remaining time: 68s        d_loss: 0
Epoch 2/2: batch 395/468:        time/batch: 0.88s        remaining time: 64s        d_loss: 1
Epoch 2/2: batch 400/468:        time/batch: 0.88s        remaining time: 60s        d_loss: 0
```




```
Epoch 2/2: batch 405/468:        time/batch: 0.88s        remaining time: 55s         d_loss: 0
Epoch 2/2: batch 410/468:        time/batch: 0.88s        remaining time: 51s         d_loss: 1
Epoch 2/2: batch 415/468:        time/batch: 0.88s        remaining time: 46s         d_loss: 0
Epoch 2/2: batch 420/468:        time/batch: 0.88s        remaining time: 42s         d_loss: 0
Epoch 2/2: batch 425/468:        time/batch: 0.88s        remaining time: 38s         d_loss: 1
Epoch 2/2: batch 430/468:        time/batch: 0.88s        remaining time: 33s         d_loss: 1
Epoch 2/2: batch 435/468:        time/batch: 0.88s        remaining time: 29s         d_loss: 0
Epoch 2/2: batch 440/468:        time/batch: 0.88s        remaining time: 24s         d_loss: 1
Epoch 2/2: batch 445/468:        time/batch: 0.88s        remaining time: 20s         d_loss: 1
Epoch 2/2: batch 450/468:        time/batch: 0.88s        remaining time: 15s         d_loss: 0
Epoch 2/2: batch 455/468:        time/batch: 0.88s        remaining time: 11s         d_loss: 1
Epoch 2/2: batch 460/468:        time/batch: 0.88s        remaining time: 7s         d_loss: 0.
Epoch 2/2: batch 465/468:        time/batch: 0.88s        remaining time: 2s         d_loss: 1.
```




```
In [26]: plot_losses(d_losses, g_losses)
```



1.3.8 Results:

Use parameters from MNIST run no. 1 as the starting point for CelebA dataset.

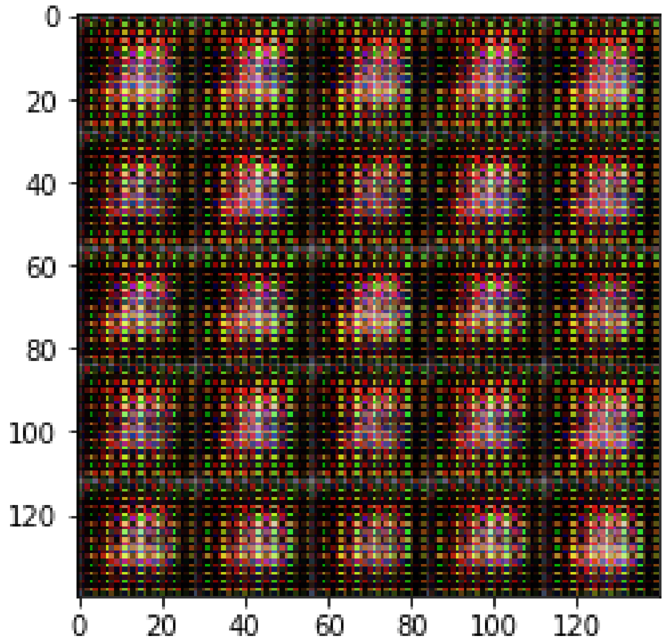
1.3.9 CelebA

Run your GANs on CelebA. It will take around 20 minutes on the average GPU to run one epoch. You can run the whole epoch or stop when it starts to generate realistic faces.

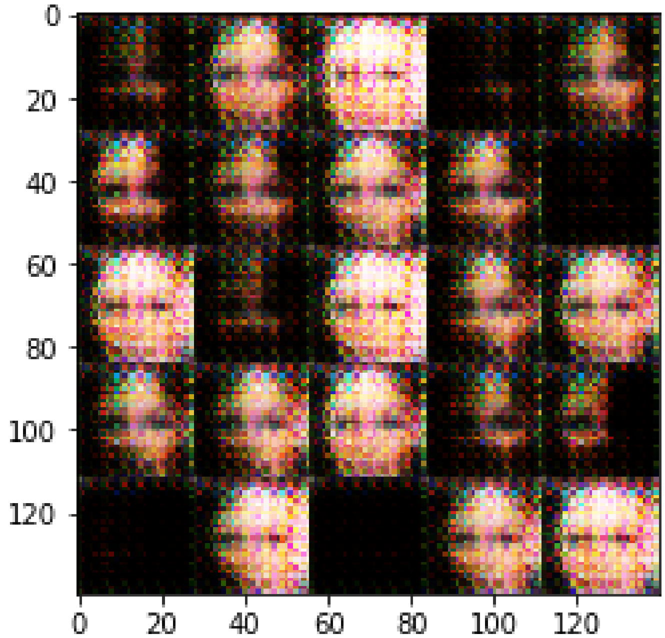
In [27]:
```
batch_size = 128
z_dim = 100
learning_rate = 0.0002
beta1 = 0.5

d_losses = []
g_losses = []


"""
DON'T MODIFY ANYTHING IN THIS CELL THAT IS BELOW THIS LINE
"""
epochs = 1

celeba_dataset = helper.Dataset('celeba', glob(os.path.join(data_dir, 'img_align_celeba
with tf.Graph().as_default():
    # jcc: added lists for plotting discriminator and generator losses
    d_losses, g_losses = train(epochs, batch_size, z_dim, learning_rate, beta1, celeba_
          celeba_dataset.shape, celeba_dataset.image_mode)
```

```
Epoch 1/1: batch 5/1582:        time/batch: 0.97s       remaining time: 1524s        d_loss:
Epoch 1/1: batch 10/1582:        time/batch: 0.83s       remaining time: 1306s        d_loss:
Epoch 1/1: batch 15/1582:        time/batch: 0.78s       remaining time: 1220s        d_loss:
Epoch 1/1: batch 20/1582:        time/batch: 0.75s       remaining time: 1174s        d_loss:
Epoch 1/1: batch 25/1582:        time/batch: 0.73s       remaining time: 1143s        d_loss:
Epoch 1/1: batch 30/1582:        time/batch: 0.72s       remaining time: 1124s        d_loss:
Epoch 1/1: batch 35/1582:        time/batch: 0.72s       remaining time: 1108s        d_loss:
Epoch 1/1: batch 40/1582:        time/batch: 0.71s       remaining time: 1095s        d_loss:
Epoch 1/1: batch 45/1582:        time/batch: 0.71s       remaining time: 1085s        d_loss:
Epoch 1/1: batch 50/1582:        time/batch: 0.70s       remaining time: 1075s        d_loss:
Epoch 1/1: batch 55/1582:        time/batch: 0.70s       remaining time: 1067s        d_loss:
Epoch 1/1: batch 60/1582:        time/batch: 0.70s       remaining time: 1060s        d_loss:
Epoch 1/1: batch 65/1582:        time/batch: 0.69s       remaining time: 1052s        d_loss:
Epoch 1/1: batch 70/1582:        time/batch: 0.69s       remaining time: 1046s        d_loss:
Epoch 1/1: batch 75/1582:        time/batch: 0.69s       remaining time: 1040s        d_loss:
Epoch 1/1: batch 80/1582:        time/batch: 0.69s       remaining time: 1034s        d_loss:
Epoch 1/1: batch 85/1582:        time/batch: 0.69s       remaining time: 1029s        d_loss:
Epoch 1/1: batch 90/1582:        time/batch: 0.69s       remaining time: 1025s        d_loss:
Epoch 1/1: batch 95/1582:        time/batch: 0.69s       remaining time: 1020s        d_loss:
```

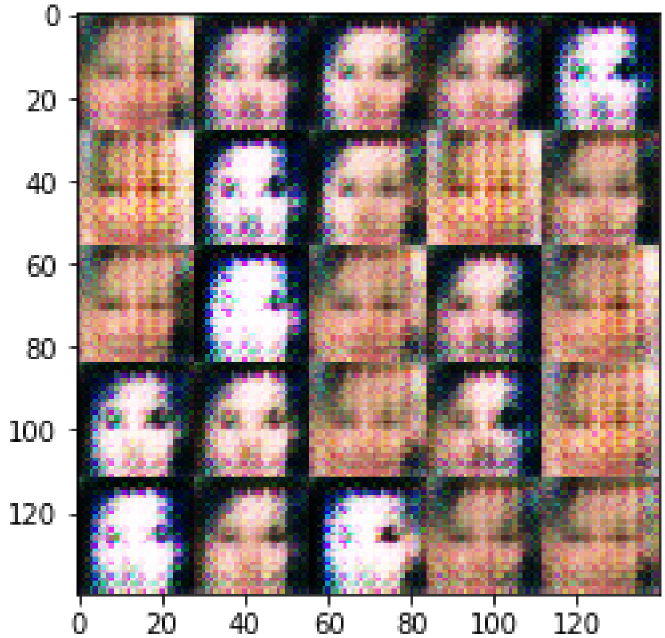
```
Epoch 1/1: batch 100/1582:        time/batch: 0.69s       remaining time: 1015s        d_loss
```



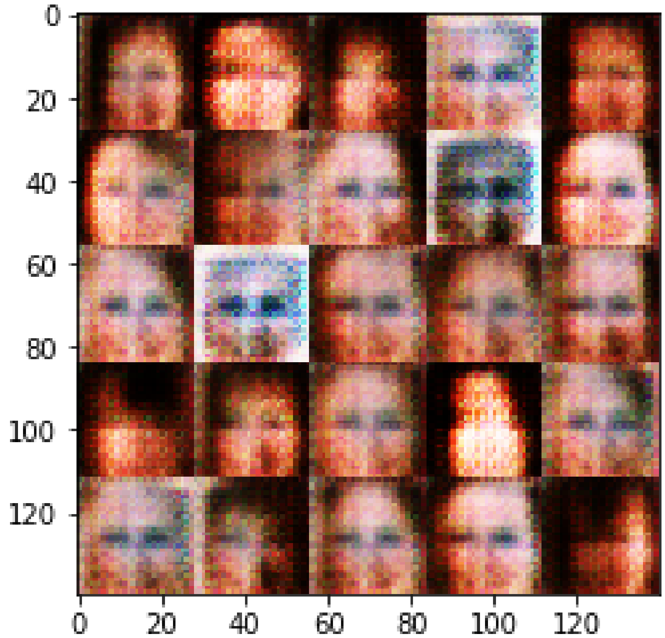

```
Epoch 1/1: batch 105/1582:        time/batch: 0.69s       remaining time: 1016s        d_loss
Epoch 1/1: batch 110/1582:        time/batch: 0.69s       remaining time: 1011s        d_loss
Epoch 1/1: batch 115/1582:        time/batch: 0.69s       remaining time: 1007s        d_loss
Epoch 1/1: batch 120/1582:        time/batch: 0.69s       remaining time: 1002s        d_loss
Epoch 1/1: batch 125/1582:        time/batch: 0.69s       remaining time: 998s        d_loss:
Epoch 1/1: batch 130/1582:        time/batch: 0.68s       remaining time: 994s        d_loss:
Epoch 1/1: batch 135/1582:        time/batch: 0.68s       remaining time: 989s        d_loss:
Epoch 1/1: batch 140/1582:        time/batch: 0.68s       remaining time: 985s        d_loss:
Epoch 1/1: batch 145/1582:        time/batch: 0.68s       remaining time: 981s        d_loss:
Epoch 1/1: batch 150/1582:        time/batch: 0.68s       remaining time: 977s        d_loss:
Epoch 1/1: batch 155/1582:        time/batch: 0.68s       remaining time: 973s        d_loss:
Epoch 1/1: batch 160/1582:        time/batch: 0.68s       remaining time: 969s        d_loss:
Epoch 1/1: batch 165/1582:        time/batch: 0.68s       remaining time: 966s        d_loss:
Epoch 1/1: batch 170/1582:        time/batch: 0.68s       remaining time: 962s        d_loss:
Epoch 1/1: batch 175/1582:        time/batch: 0.68s       remaining time: 958s        d_loss:
Epoch 1/1: batch 180/1582:        time/batch: 0.68s       remaining time: 954s        d_loss:
Epoch 1/1: batch 185/1582:        time/batch: 0.68s       remaining time: 950s        d_loss:
Epoch 1/1: batch 190/1582:        time/batch: 0.68s       remaining time: 946s        d_loss:
Epoch 1/1: batch 195/1582:        time/batch: 0.68s       remaining time: 943s        d_loss:
Epoch 1/1: batch 200/1582:        time/batch: 0.68s       remaining time: 939s        d_loss:
```



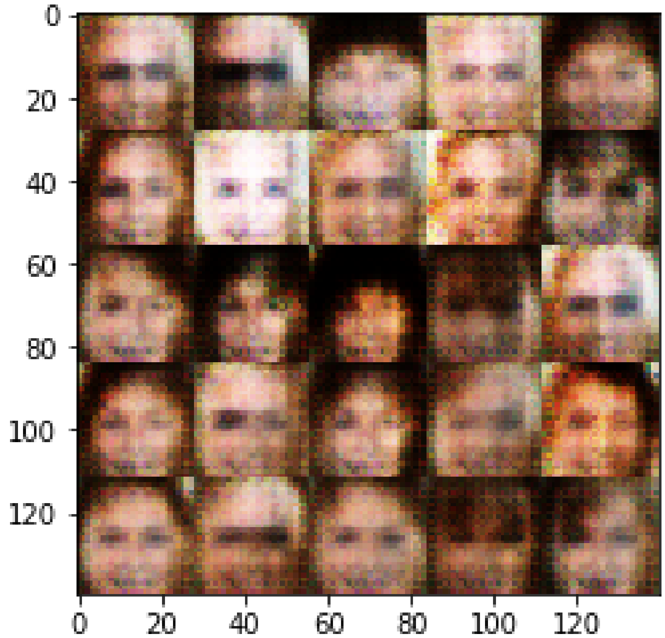

```
Epoch 1/1: batch 205/1582:         time/batch: 0.68s        remaining time: 937s        d_loss:
Epoch 1/1: batch 210/1582:         time/batch: 0.68s        remaining time: 934s        d_loss:
Epoch 1/1: batch 215/1582:         time/batch: 0.68s        remaining time: 930s        d_loss:
Epoch 1/1: batch 220/1582:         time/batch: 0.68s        remaining time: 926s        d_loss:
Epoch 1/1: batch 225/1582:         time/batch: 0.68s        remaining time: 922s        d_loss:
Epoch 1/1: batch 230/1582:         time/batch: 0.68s        remaining time: 919s        d_loss:
Epoch 1/1: batch 235/1582:         time/batch: 0.68s        remaining time: 915s        d_loss:
Epoch 1/1: batch 240/1582:         time/batch: 0.68s        remaining time: 911s        d_loss:
Epoch 1/1: batch 245/1582:         time/batch: 0.68s        remaining time: 908s        d_loss:
Epoch 1/1: batch 250/1582:         time/batch: 0.68s        remaining time: 904s        d_loss:
Epoch 1/1: batch 255/1582:         time/batch: 0.68s        remaining time: 901s        d_loss:
Epoch 1/1: batch 260/1582:         time/batch: 0.68s        remaining time: 897s        d_loss:
Epoch 1/1: batch 265/1582:         time/batch: 0.68s        remaining time: 893s        d_loss:
Epoch 1/1: batch 270/1582:         time/batch: 0.68s        remaining time: 889s        d_loss:
Epoch 1/1: batch 275/1582:         time/batch: 0.68s        remaining time: 886s        d_loss:
Epoch 1/1: batch 280/1582:         time/batch: 0.68s        remaining time: 882s        d_loss:
Epoch 1/1: batch 285/1582:         time/batch: 0.68s        remaining time: 879s        d_loss:
Epoch 1/1: batch 290/1582:         time/batch: 0.68s        remaining time: 875s        d_loss:
Epoch 1/1: batch 295/1582:         time/batch: 0.68s        remaining time: 871s        d_loss:
Epoch 1/1: batch 300/1582:         time/batch: 0.68s        remaining time: 868s        d_loss:
```



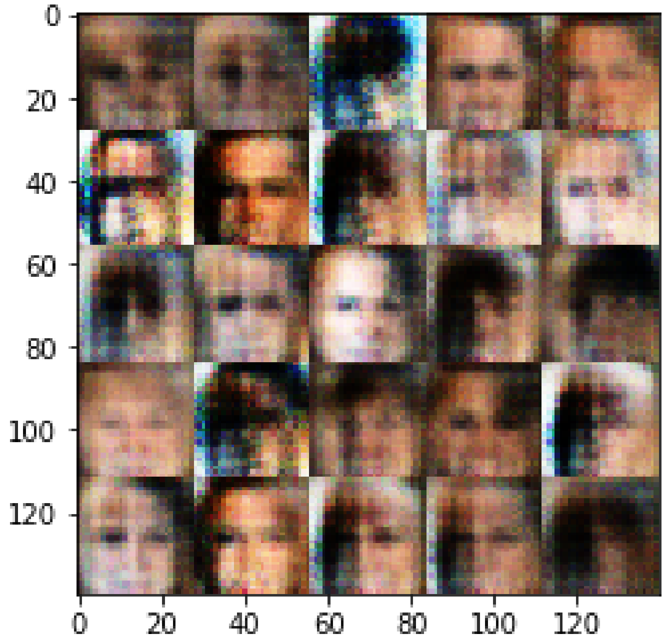

```
Epoch 1/1: batch 305/1582:        time/batch: 0.68s        remaining time: 866s        d_loss:
Epoch 1/1: batch 310/1582:        time/batch: 0.68s        remaining time: 863s        d_loss:
Epoch 1/1: batch 315/1582:        time/batch: 0.68s        remaining time: 859s        d_loss:
Epoch 1/1: batch 320/1582:        time/batch: 0.68s        remaining time: 856s        d_loss:
Epoch 1/1: batch 325/1582:        time/batch: 0.68s        remaining time: 852s        d_loss:
Epoch 1/1: batch 330/1582:        time/batch: 0.68s        remaining time: 849s        d_loss:
Epoch 1/1: batch 335/1582:        time/batch: 0.68s        remaining time: 845s        d_loss:
Epoch 1/1: batch 340/1582:        time/batch: 0.68s        remaining time: 842s        d_loss:
Epoch 1/1: batch 345/1582:        time/batch: 0.68s        remaining time: 838s        d_loss:
Epoch 1/1: batch 350/1582:        time/batch: 0.68s        remaining time: 835s        d_loss:
Epoch 1/1: batch 355/1582:        time/batch: 0.68s        remaining time: 831s        d_loss:
Epoch 1/1: batch 360/1582:        time/batch: 0.68s        remaining time: 827s        d_loss:
Epoch 1/1: batch 365/1582:        time/batch: 0.68s        remaining time: 824s        d_loss:
Epoch 1/1: batch 370/1582:        time/batch: 0.68s        remaining time: 821s        d_loss:
Epoch 1/1: batch 375/1582:        time/batch: 0.68s        remaining time: 817s        d_loss:
Epoch 1/1: batch 380/1582:        time/batch: 0.68s        remaining time: 814s        d_loss:
Epoch 1/1: batch 385/1582:        time/batch: 0.68s        remaining time: 810s        d_loss:
Epoch 1/1: batch 390/1582:        time/batch: 0.68s        remaining time: 807s        d_loss:
Epoch 1/1: batch 395/1582:        time/batch: 0.68s        remaining time: 803s        d_loss:
Epoch 1/1: batch 400/1582:        time/batch: 0.68s        remaining time: 800s        d_loss:
```



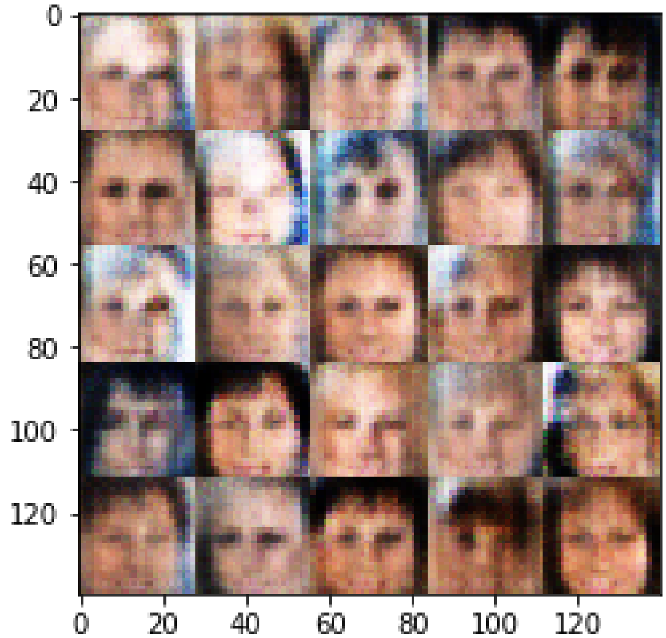

```
Epoch 1/1: batch 405/1582:          time/batch: 0.68s          remaining time: 797s          d_loss:
Epoch 1/1: batch 410/1582:          time/batch: 0.68s          remaining time: 794s          d_loss:
Epoch 1/1: batch 415/1582:          time/batch: 0.68s          remaining time: 790s          d_loss:
Epoch 1/1: batch 420/1582:          time/batch: 0.68s          remaining time: 787s          d_loss:
Epoch 1/1: batch 425/1582:          time/batch: 0.68s          remaining time: 783s          d_loss:
Epoch 1/1: batch 430/1582:          time/batch: 0.68s          remaining time: 780s          d_loss:
Epoch 1/1: batch 435/1582:          time/batch: 0.68s          remaining time: 776s          d_loss:
Epoch 1/1: batch 440/1582:          time/batch: 0.68s          remaining time: 773s          d_loss:
Epoch 1/1: batch 445/1582:          time/batch: 0.68s          remaining time: 769s          d_loss:
Epoch 1/1: batch 450/1582:          time/batch: 0.68s          remaining time: 766s          d_loss:
Epoch 1/1: batch 455/1582:          time/batch: 0.68s          remaining time: 762s          d_loss:
Epoch 1/1: batch 460/1582:          time/batch: 0.68s          remaining time: 759s          d_loss:
Epoch 1/1: batch 465/1582:          time/batch: 0.68s          remaining time: 755s          d_loss:
Epoch 1/1: batch 470/1582:          time/batch: 0.68s          remaining time: 752s          d_loss:
Epoch 1/1: batch 475/1582:          time/batch: 0.68s          remaining time: 748s          d_loss:
Epoch 1/1: batch 480/1582:          time/batch: 0.68s          remaining time: 745s          d_loss:
Epoch 1/1: batch 485/1582:          time/batch: 0.68s          remaining time: 742s          d_loss:
Epoch 1/1: batch 490/1582:          time/batch: 0.68s          remaining time: 738s          d_loss:
Epoch 1/1: batch 495/1582:          time/batch: 0.68s          remaining time: 735s          d_loss:
Epoch 1/1: batch 500/1582:          time/batch: 0.68s          remaining time: 731s          d_loss:
```



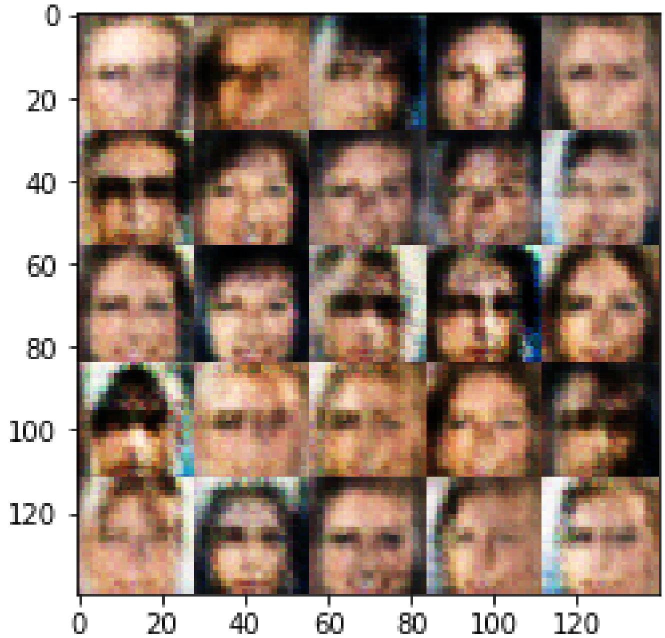

```
Epoch 1/1: batch 505/1582:         time/batch: 0.68s         remaining time: 729s         d_loss:
Epoch 1/1: batch 510/1582:         time/batch: 0.68s         remaining time: 725s         d_loss:
Epoch 1/1: batch 515/1582:         time/batch: 0.68s         remaining time: 722s         d_loss:
Epoch 1/1: batch 520/1582:         time/batch: 0.68s         remaining time: 718s         d_loss:
Epoch 1/1: batch 525/1582:         time/batch: 0.68s         remaining time: 715s         d_loss:
Epoch 1/1: batch 530/1582:         time/batch: 0.68s         remaining time: 711s         d_loss:
Epoch 1/1: batch 535/1582:         time/batch: 0.68s         remaining time: 708s         d_loss:
Epoch 1/1: batch 540/1582:         time/batch: 0.68s         remaining time: 704s         d_loss:
Epoch 1/1: batch 545/1582:         time/batch: 0.68s         remaining time: 701s         d_loss:
Epoch 1/1: batch 550/1582:         time/batch: 0.68s         remaining time: 697s         d_loss:
Epoch 1/1: batch 555/1582:         time/batch: 0.68s         remaining time: 694s         d_loss:
Epoch 1/1: batch 560/1582:         time/batch: 0.68s         remaining time: 691s         d_loss:
Epoch 1/1: batch 565/1582:         time/batch: 0.68s         remaining time: 687s         d_loss:
Epoch 1/1: batch 570/1582:         time/batch: 0.68s         remaining time: 684s         d_loss:
Epoch 1/1: batch 575/1582:         time/batch: 0.68s         remaining time: 680s         d_loss:
Epoch 1/1: batch 580/1582:         time/batch: 0.68s         remaining time: 677s         d_loss:
Epoch 1/1: batch 585/1582:         time/batch: 0.68s         remaining time: 674s         d_loss:
Epoch 1/1: batch 590/1582:         time/batch: 0.68s         remaining time: 670s         d_loss:
Epoch 1/1: batch 595/1582:         time/batch: 0.68s         remaining time: 667s         d_loss:
Epoch 1/1: batch 600/1582:         time/batch: 0.68s         remaining time: 663s         d_loss:
```



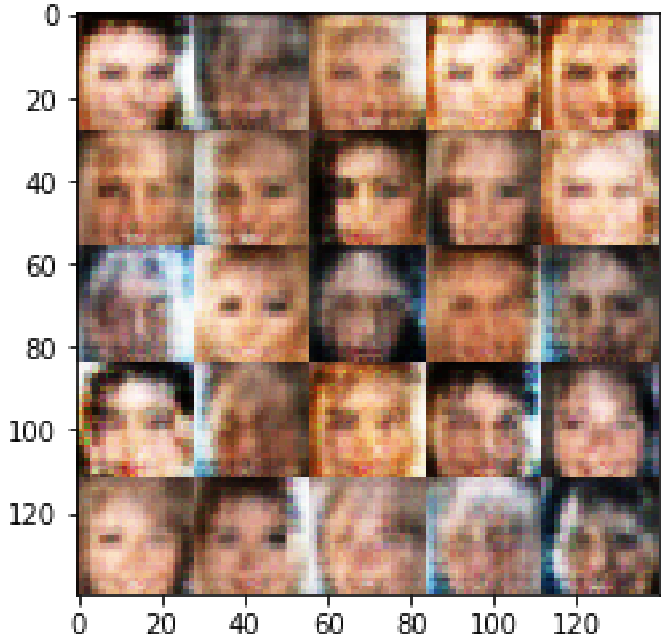

```
Epoch 1/1: batch 605/1582:        time/batch: 0.68s        remaining time: 660s        d_loss:
Epoch 1/1: batch 610/1582:        time/batch: 0.68s        remaining time: 657s        d_loss:
Epoch 1/1: batch 615/1582:        time/batch: 0.68s        remaining time: 654s        d_loss:
Epoch 1/1: batch 620/1582:        time/batch: 0.68s        remaining time: 650s        d_loss:
Epoch 1/1: batch 625/1582:        time/batch: 0.68s        remaining time: 647s        d_loss:
Epoch 1/1: batch 630/1582:        time/batch: 0.68s        remaining time: 643s        d_loss:
Epoch 1/1: batch 635/1582:        time/batch: 0.68s        remaining time: 640s        d_loss:
Epoch 1/1: batch 640/1582:        time/batch: 0.68s        remaining time: 636s        d_loss:
Epoch 1/1: batch 645/1582:        time/batch: 0.68s        remaining time: 633s        d_loss:
Epoch 1/1: batch 650/1582:        time/batch: 0.68s        remaining time: 629s        d_loss:
Epoch 1/1: batch 655/1582:        time/batch: 0.68s        remaining time: 626s        d_loss:
Epoch 1/1: batch 660/1582:        time/batch: 0.68s        remaining time: 623s        d_loss:
Epoch 1/1: batch 665/1582:        time/batch: 0.68s        remaining time: 619s        d_loss:
Epoch 1/1: batch 670/1582:        time/batch: 0.68s        remaining time: 616s        d_loss:
Epoch 1/1: batch 675/1582:        time/batch: 0.68s        remaining time: 612s        d_loss:
Epoch 1/1: batch 680/1582:        time/batch: 0.68s        remaining time: 609s        d_loss:
Epoch 1/1: batch 685/1582:        time/batch: 0.68s        remaining time: 606s        d_loss:
Epoch 1/1: batch 690/1582:        time/batch: 0.68s        remaining time: 602s        d_loss:
Epoch 1/1: batch 695/1582:        time/batch: 0.68s        remaining time: 599s        d_loss:
Epoch 1/1: batch 700/1582:        time/batch: 0.68s        remaining time: 595s        d_loss:
```



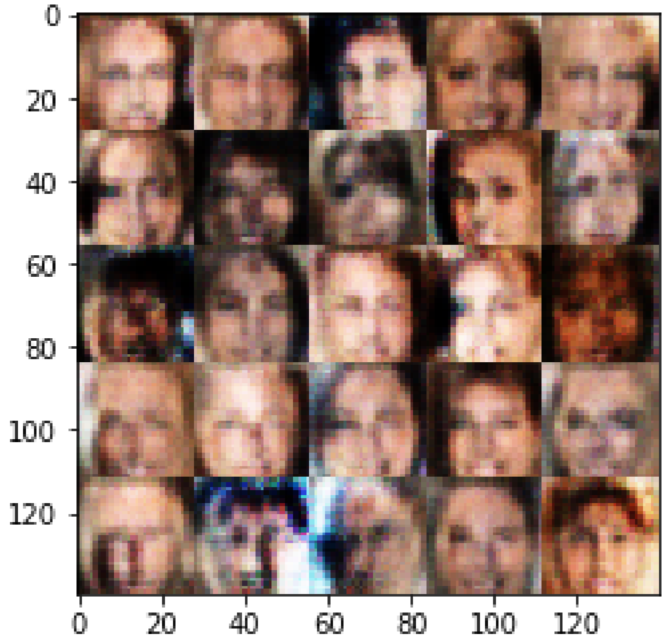

```
Epoch 1/1: batch 705/1582:        time/batch: 0.68s        remaining time: 592s        d_loss:
Epoch 1/1: batch 710/1582:        time/batch: 0.68s        remaining time: 589s        d_loss:
Epoch 1/1: batch 715/1582:        time/batch: 0.68s        remaining time: 586s        d_loss:
Epoch 1/1: batch 720/1582:        time/batch: 0.68s        remaining time: 582s        d_loss:
Epoch 1/1: batch 725/1582:        time/batch: 0.68s        remaining time: 579s        d_loss:
Epoch 1/1: batch 730/1582:        time/batch: 0.68s        remaining time: 575s        d_loss:
Epoch 1/1: batch 735/1582:        time/batch: 0.68s        remaining time: 572s        d_loss:
Epoch 1/1: batch 740/1582:        time/batch: 0.68s        remaining time: 568s        d_loss:
Epoch 1/1: batch 745/1582:        time/batch: 0.68s        remaining time: 565s        d_loss:
Epoch 1/1: batch 750/1582:        time/batch: 0.68s        remaining time: 562s        d_loss:
Epoch 1/1: batch 755/1582:        time/batch: 0.68s        remaining time: 558s        d_loss:
Epoch 1/1: batch 760/1582:        time/batch: 0.68s        remaining time: 555s        d_loss:
Epoch 1/1: batch 765/1582:        time/batch: 0.68s        remaining time: 551s        d_loss:
Epoch 1/1: batch 770/1582:        time/batch: 0.68s        remaining time: 548s        d_loss:
Epoch 1/1: batch 775/1582:        time/batch: 0.68s        remaining time: 545s        d_loss:
Epoch 1/1: batch 780/1582:        time/batch: 0.68s        remaining time: 541s        d_loss:
Epoch 1/1: batch 785/1582:        time/batch: 0.68s        remaining time: 538s        d_loss:
Epoch 1/1: batch 790/1582:        time/batch: 0.68s        remaining time: 534s        d_loss:
Epoch 1/1: batch 795/1582:        time/batch: 0.68s        remaining time: 531s        d_loss:
Epoch 1/1: batch 800/1582:        time/batch: 0.68s        remaining time: 528s        d_loss:
```



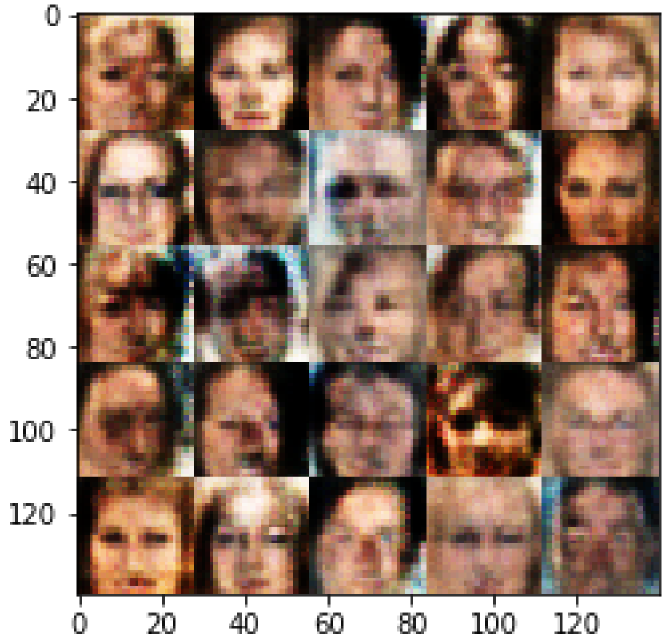
```
Epoch 1/1: batch 805/1582:        time/batch: 0.68s        remaining time: 524s        d_loss:
Epoch 1/1: batch 810/1582:        time/batch: 0.68s        remaining time: 521s        d_loss:
Epoch 1/1: batch 815/1582:        time/batch: 0.68s        remaining time: 518s        d_loss:
Epoch 1/1: batch 820/1582:        time/batch: 0.68s        remaining time: 514s        d_loss:
Epoch 1/1: batch 825/1582:        time/batch: 0.68s        remaining time: 511s        d_loss:
Epoch 1/1: batch 830/1582:        time/batch: 0.68s        remaining time: 507s        d_loss:
Epoch 1/1: batch 835/1582:        time/batch: 0.68s        remaining time: 504s        d_loss:
Epoch 1/1: batch 840/1582:        time/batch: 0.68s        remaining time: 501s        d_loss:
Epoch 1/1: batch 845/1582:        time/batch: 0.68s        remaining time: 497s        d_loss:
Epoch 1/1: batch 850/1582:        time/batch: 0.68s        remaining time: 494s        d_loss:
Epoch 1/1: batch 855/1582:        time/batch: 0.68s        remaining time: 490s        d_loss:
Epoch 1/1: batch 860/1582:        time/batch: 0.68s        remaining time: 487s        d_loss:
Epoch 1/1: batch 865/1582:        time/batch: 0.68s        remaining time: 484s        d_loss:
Epoch 1/1: batch 870/1582:        time/batch: 0.68s        remaining time: 480s        d_loss:
Epoch 1/1: batch 875/1582:        time/batch: 0.68s        remaining time: 477s        d_loss:
Epoch 1/1: batch 880/1582:        time/batch: 0.67s        remaining time: 473s        d_loss:
Epoch 1/1: batch 885/1582:        time/batch: 0.67s        remaining time: 470s        d_loss:
Epoch 1/1: batch 890/1582:        time/batch: 0.67s        remaining time: 467s        d_loss:
Epoch 1/1: batch 895/1582:        time/batch: 0.67s        remaining time: 463s        d_loss:
Epoch 1/1: batch 900/1582:        time/batch: 0.67s        remaining time: 460s        d_loss:
```



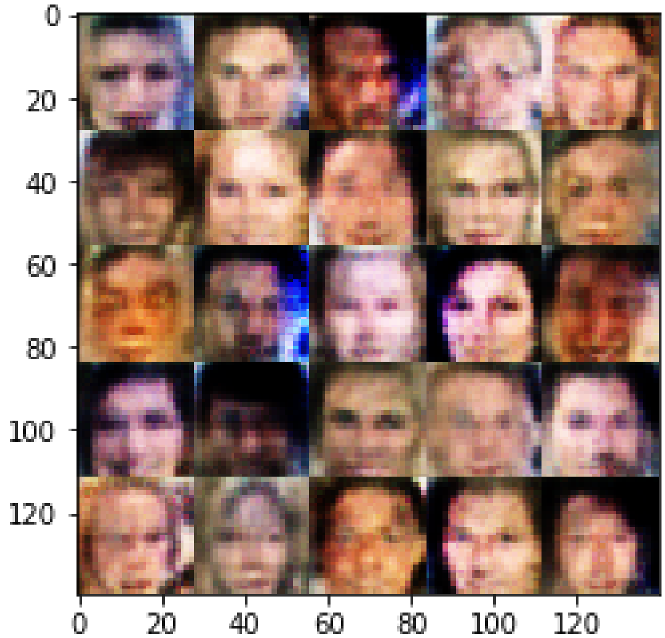
```
Epoch 1/1: batch 905/1582:         time/batch: 0.68s        remaining time: 457s         d_loss:
Epoch 1/1: batch 910/1582:         time/batch: 0.68s        remaining time: 453s         d_loss:
Epoch 1/1: batch 915/1582:         time/batch: 0.68s        remaining time: 450s         d_loss:
Epoch 1/1: batch 920/1582:         time/batch: 0.68s        remaining time: 446s         d_loss:
Epoch 1/1: batch 925/1582:         time/batch: 0.68s        remaining time: 443s         d_loss:
Epoch 1/1: batch 930/1582:         time/batch: 0.68s        remaining time: 440s         d_loss:
Epoch 1/1: batch 935/1582:         time/batch: 0.68s        remaining time: 436s         d_loss:
Epoch 1/1: batch 940/1582:         time/batch: 0.68s        remaining time: 433s         d_loss:
Epoch 1/1: batch 945/1582:         time/batch: 0.68s        remaining time: 430s         d_loss:
Epoch 1/1: batch 950/1582:         time/batch: 0.68s        remaining time: 426s         d_loss:
Epoch 1/1: batch 955/1582:         time/batch: 0.67s        remaining time: 423s         d_loss:
Epoch 1/1: batch 960/1582:         time/batch: 0.67s        remaining time: 419s         d_loss:
Epoch 1/1: batch 965/1582:         time/batch: 0.67s        remaining time: 416s         d_loss:
Epoch 1/1: batch 970/1582:         time/batch: 0.67s        remaining time: 413s         d_loss:
Epoch 1/1: batch 975/1582:         time/batch: 0.67s        remaining time: 409s         d_loss:
Epoch 1/1: batch 980/1582:         time/batch: 0.67s        remaining time: 406s         d_loss:
Epoch 1/1: batch 985/1582:         time/batch: 0.67s        remaining time: 402s         d_loss:
Epoch 1/1: batch 990/1582:         time/batch: 0.67s        remaining time: 399s         d_loss:
Epoch 1/1: batch 995/1582:         time/batch: 0.67s        remaining time: 396s         d_loss:
Epoch 1/1: batch 1000/1582:         time/batch: 0.67s        remaining time: 392s         d_loss
```



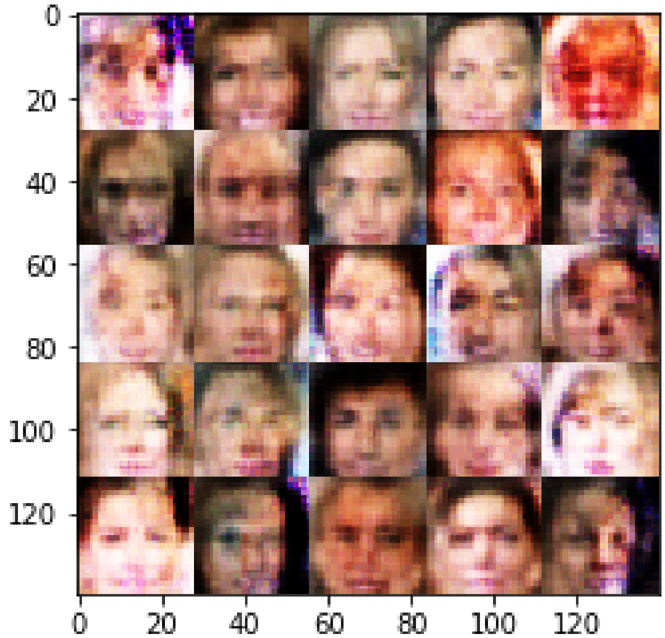

```
Epoch 1/1: batch 1005/1582:        time/batch: 0.68s       remaining time: 389s        d_loss
Epoch 1/1: batch 1010/1582:        time/batch: 0.67s       remaining time: 386s        d_loss
Epoch 1/1: batch 1015/1582:        time/batch: 0.67s       remaining time: 382s        d_loss
Epoch 1/1: batch 1020/1582:        time/batch: 0.67s       remaining time: 379s        d_loss
Epoch 1/1: batch 1025/1582:        time/batch: 0.67s       remaining time: 375s        d_loss
Epoch 1/1: batch 1030/1582:        time/batch: 0.67s       remaining time: 372s        d_loss
Epoch 1/1: batch 1035/1582:        time/batch: 0.67s       remaining time: 369s        d_loss
Epoch 1/1: batch 1040/1582:        time/batch: 0.67s       remaining time: 365s        d_loss
Epoch 1/1: batch 1045/1582:        time/batch: 0.67s       remaining time: 362s        d_loss
Epoch 1/1: batch 1050/1582:        time/batch: 0.67s       remaining time: 358s        d_loss
Epoch 1/1: batch 1055/1582:        time/batch: 0.67s       remaining time: 355s        d_loss
Epoch 1/1: batch 1060/1582:        time/batch: 0.67s       remaining time: 352s        d_loss
Epoch 1/1: batch 1065/1582:        time/batch: 0.67s       remaining time: 348s        d_loss
Epoch 1/1: batch 1070/1582:        time/batch: 0.67s       remaining time: 345s        d_loss
Epoch 1/1: batch 1075/1582:        time/batch: 0.67s       remaining time: 342s        d_loss
Epoch 1/1: batch 1080/1582:        time/batch: 0.67s       remaining time: 338s        d_loss
Epoch 1/1: batch 1085/1582:        time/batch: 0.67s       remaining time: 335s        d_loss
Epoch 1/1: batch 1090/1582:        time/batch: 0.67s       remaining time: 331s        d_loss
Epoch 1/1: batch 1095/1582:        time/batch: 0.67s       remaining time: 328s        d_loss
Epoch 1/1: batch 1100/1582:        time/batch: 0.67s       remaining time: 325s        d_loss
```



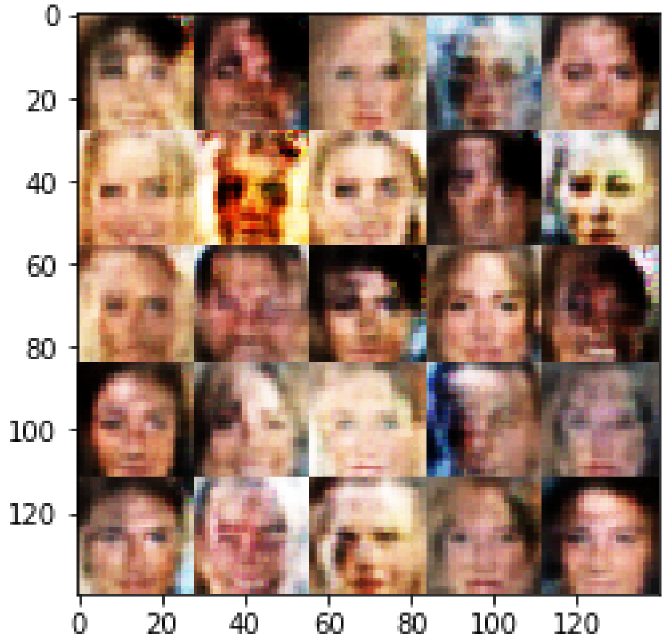

```
Epoch 1/1: batch 1105/1582:        time/batch: 0.67s        remaining time: 321s        d_loss
Epoch 1/1: batch 1110/1582:        time/batch: 0.67s        remaining time: 318s        d_loss
Epoch 1/1: batch 1115/1582:        time/batch: 0.67s        remaining time: 315s        d_loss
Epoch 1/1: batch 1120/1582:        time/batch: 0.67s        remaining time: 311s        d_loss
Epoch 1/1: batch 1125/1582:        time/batch: 0.67s        remaining time: 308s        d_loss
Epoch 1/1: batch 1130/1582:        time/batch: 0.67s        remaining time: 305s        d_loss
Epoch 1/1: batch 1135/1582:        time/batch: 0.67s        remaining time: 301s        d_loss
Epoch 1/1: batch 1140/1582:        time/batch: 0.67s        remaining time: 298s        d_loss
Epoch 1/1: batch 1145/1582:        time/batch: 0.67s        remaining time: 294s        d_loss
Epoch 1/1: batch 1150/1582:        time/batch: 0.67s        remaining time: 291s        d_loss
Epoch 1/1: batch 1155/1582:        time/batch: 0.67s        remaining time: 288s        d_loss
Epoch 1/1: batch 1160/1582:        time/batch: 0.67s        remaining time: 284s        d_loss
Epoch 1/1: batch 1165/1582:        time/batch: 0.67s        remaining time: 281s        d_loss
Epoch 1/1: batch 1170/1582:        time/batch: 0.67s        remaining time: 277s        d_loss
Epoch 1/1: batch 1175/1582:        time/batch: 0.67s        remaining time: 274s        d_loss
Epoch 1/1: batch 1180/1582:        time/batch: 0.67s        remaining time: 271s        d_loss
Epoch 1/1: batch 1185/1582:        time/batch: 0.67s        remaining time: 267s        d_loss
Epoch 1/1: batch 1190/1582:        time/batch: 0.67s        remaining time: 264s        d_loss
Epoch 1/1: batch 1195/1582:        time/batch: 0.67s        remaining time: 261s        d_loss
Epoch 1/1: batch 1200/1582:        time/batch: 0.67s        remaining time: 257s        d_loss
```



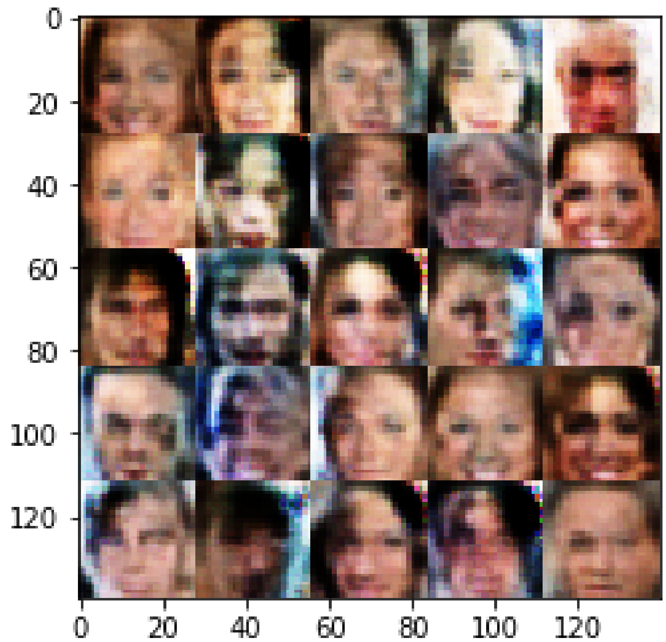
```
Epoch 1/1: batch 1205/1582:        time/batch: 0.67s        remaining time: 254s        d_loss
Epoch 1/1: batch 1210/1582:        time/batch: 0.67s        remaining time: 251s        d_loss
Epoch 1/1: batch 1215/1582:        time/batch: 0.67s        remaining time: 247s        d_loss
Epoch 1/1: batch 1220/1582:        time/batch: 0.67s        remaining time: 244s        d_loss
Epoch 1/1: batch 1225/1582:        time/batch: 0.67s        remaining time: 240s        d_loss
Epoch 1/1: batch 1230/1582:        time/batch: 0.67s        remaining time: 237s        d_loss
Epoch 1/1: batch 1235/1582:        time/batch: 0.67s        remaining time: 234s        d_loss
Epoch 1/1: batch 1240/1582:        time/batch: 0.67s        remaining time: 230s        d_loss
Epoch 1/1: batch 1245/1582:        time/batch: 0.67s        remaining time: 227s        d_loss
Epoch 1/1: batch 1250/1582:        time/batch: 0.67s        remaining time: 223s        d_loss
Epoch 1/1: batch 1255/1582:        time/batch: 0.67s        remaining time: 220s        d_loss
Epoch 1/1: batch 1260/1582:        time/batch: 0.67s        remaining time: 217s        d_loss
Epoch 1/1: batch 1265/1582:        time/batch: 0.67s        remaining time: 213s        d_loss
Epoch 1/1: batch 1270/1582:        time/batch: 0.67s        remaining time: 210s        d_loss
Epoch 1/1: batch 1275/1582:        time/batch: 0.67s        remaining time: 207s        d_loss
Epoch 1/1: batch 1280/1582:        time/batch: 0.67s        remaining time: 203s        d_loss
Epoch 1/1: batch 1285/1582:        time/batch: 0.67s        remaining time: 200s        d_loss
Epoch 1/1: batch 1290/1582:        time/batch: 0.67s        remaining time: 196s        d_loss
Epoch 1/1: batch 1295/1582:        time/batch: 0.67s        remaining time: 193s        d_loss
Epoch 1/1: batch 1300/1582:        time/batch: 0.67s        remaining time: 190s        d_loss
```



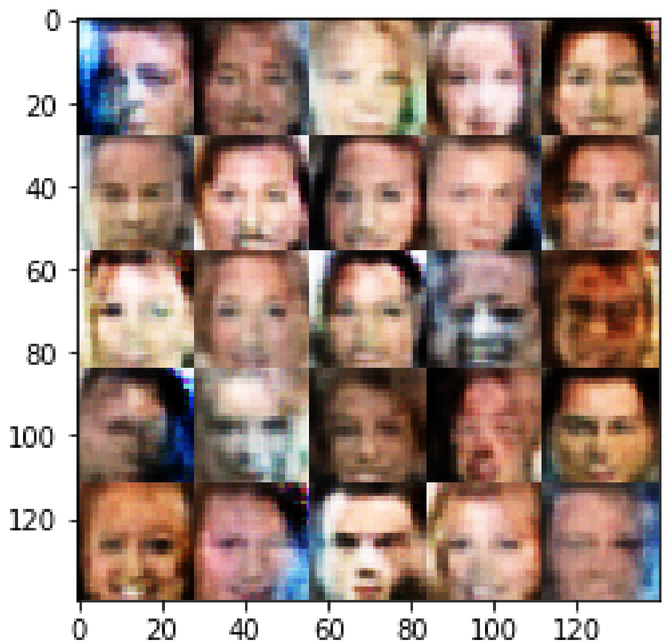

```
Epoch 1/1: batch 1305/1582:        time/batch: 0.67s        remaining time: 186s        d_loss
Epoch 1/1: batch 1310/1582:        time/batch: 0.67s        remaining time: 183s        d_loss
Epoch 1/1: batch 1315/1582:        time/batch: 0.67s        remaining time: 180s        d_loss
Epoch 1/1: batch 1320/1582:        time/batch: 0.67s        remaining time: 176s        d_loss
Epoch 1/1: batch 1325/1582:        time/batch: 0.67s        remaining time: 173s        d_loss
Epoch 1/1: batch 1330/1582:        time/batch: 0.67s        remaining time: 169s        d_loss
Epoch 1/1: batch 1335/1582:        time/batch: 0.67s        remaining time: 166s        d_loss
Epoch 1/1: batch 1340/1582:        time/batch: 0.67s        remaining time: 163s        d_loss
Epoch 1/1: batch 1345/1582:        time/batch: 0.67s        remaining time: 159s        d_loss
Epoch 1/1: batch 1350/1582:        time/batch: 0.67s        remaining time: 156s        d_loss
Epoch 1/1: batch 1355/1582:        time/batch: 0.67s        remaining time: 153s        d_loss
Epoch 1/1: batch 1360/1582:        time/batch: 0.67s        remaining time: 149s        d_loss
Epoch 1/1: batch 1365/1582:        time/batch: 0.67s        remaining time: 146s        d_loss
Epoch 1/1: batch 1370/1582:        time/batch: 0.67s        remaining time: 142s        d_loss
Epoch 1/1: batch 1375/1582:        time/batch: 0.67s        remaining time: 139s        d_loss
Epoch 1/1: batch 1380/1582:        time/batch: 0.67s        remaining time: 136s        d_loss
Epoch 1/1: batch 1385/1582:        time/batch: 0.67s        remaining time: 132s        d_loss
Epoch 1/1: batch 1390/1582:        time/batch: 0.67s        remaining time: 129s        d_loss
Epoch 1/1: batch 1395/1582:        time/batch: 0.67s        remaining time: 126s        d_loss
Epoch 1/1: batch 1400/1582:        time/batch: 0.67s        remaining time: 122s        d_loss
```




```
Epoch 1/1: batch 1405/1582:        time/batch: 0.67s        remaining time: 119s        d_loss
Epoch 1/1: batch 1410/1582:        time/batch: 0.67s        remaining time: 116s        d_loss
Epoch 1/1: batch 1415/1582:        time/batch: 0.67s        remaining time: 112s        d_loss
Epoch 1/1: batch 1420/1582:        time/batch: 0.67s        remaining time: 109s        d_loss
Epoch 1/1: batch 1425/1582:        time/batch: 0.67s        remaining time: 105s        d_loss
Epoch 1/1: batch 1430/1582:        time/batch: 0.67s        remaining time: 102s        d_loss
Epoch 1/1: batch 1435/1582:        time/batch: 0.67s        remaining time: 99s        d_loss:
Epoch 1/1: batch 1440/1582:        time/batch: 0.67s        remaining time: 95s        d_loss:
Epoch 1/1: batch 1445/1582:        time/batch: 0.67s        remaining time: 92s        d_loss:
Epoch 1/1: batch 1450/1582:        time/batch: 0.67s        remaining time: 89s        d_loss:
Epoch 1/1: batch 1455/1582:        time/batch: 0.67s        remaining time: 85s        d_loss:
Epoch 1/1: batch 1460/1582:        time/batch: 0.67s        remaining time: 82s        d_loss:
Epoch 1/1: batch 1465/1582:        time/batch: 0.67s        remaining time: 78s        d_loss:
Epoch 1/1: batch 1470/1582:        time/batch: 0.67s        remaining time: 75s        d_loss:
Epoch 1/1: batch 1475/1582:        time/batch: 0.67s        remaining time: 72s        d_loss:
Epoch 1/1: batch 1480/1582:        time/batch: 0.67s        remaining time: 68s        d_loss:
Epoch 1/1: batch 1485/1582:        time/batch: 0.67s        remaining time: 65s        d_loss:
Epoch 1/1: batch 1490/1582:        time/batch: 0.67s        remaining time: 62s        d_loss:
Epoch 1/1: batch 1495/1582:        time/batch: 0.67s        remaining time: 58s        d_loss:
Epoch 1/1: batch 1500/1582:        time/batch: 0.67s        remaining time: 55s        d_loss:
```




```
Epoch 1/1: batch 1505/1582:        time/batch: 0.67s        remaining time: 51s        d_loss:
Epoch 1/1: batch 1510/1582:        time/batch: 0.67s        remaining time: 48s        d_loss:
Epoch 1/1: batch 1515/1582:        time/batch: 0.67s        remaining time: 45s        d_loss:
Epoch 1/1: batch 1520/1582:        time/batch: 0.67s        remaining time: 41s        d_loss:
Epoch 1/1: batch 1525/1582:        time/batch: 0.67s        remaining time: 38s        d_loss:
Epoch 1/1: batch 1530/1582:        time/batch: 0.67s        remaining time: 35s        d_loss:
Epoch 1/1: batch 1535/1582:        time/batch: 0.67s        remaining time: 31s        d_loss:
Epoch 1/1: batch 1540/1582:        time/batch: 0.67s        remaining time: 28s        d_loss:
Epoch 1/1: batch 1545/1582:        time/batch: 0.67s        remaining time: 24s        d_loss:
Epoch 1/1: batch 1550/1582:        time/batch: 0.67s        remaining time: 21s        d_loss:
Epoch 1/1: batch 1555/1582:        time/batch: 0.67s        remaining time: 18s        d_loss:
Epoch 1/1: batch 1560/1582:        time/batch: 0.67s        remaining time: 14s        d_loss:
Epoch 1/1: batch 1565/1582:        time/batch: 0.67s        remaining time: 11s        d_loss:
Epoch 1/1: batch 1570/1582:        time/batch: 0.67s        remaining time: 8s        d_loss:
Epoch 1/1: batch 1575/1582:        time/batch: 0.67s        remaining time: 4s        d_loss:
Epoch 1/1: batch 1580/1582:        time/batch: 0.67s        remaining time: 1s        d_loss:
```



```
In [28]: plot_losses(d_losses, g_losses)
```

1.3.10 Submitting This Project

When submitting this project, make sure to run all the cells before saving the notebook. Save the notebook file as "dlnd_face_generation.ipynb" and save it as a HTML file under "File" -> "Download as". Include the "helper.py" and "problem_unittests.py" files in your submission.