# Autoencoder 예제 및 실습

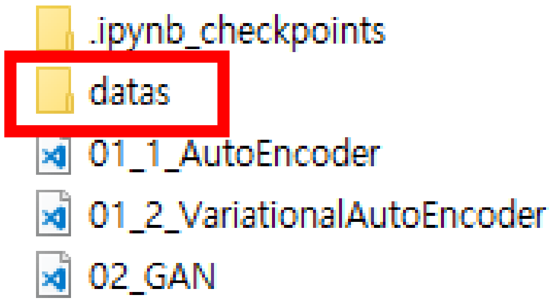
# 수업목표

- MNIST dataset
- Autoencoder

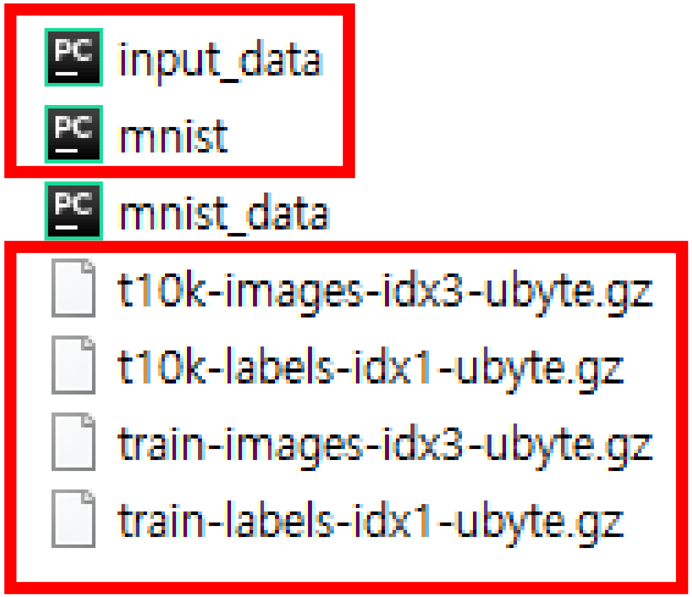
# MNIST dataset

# MNIST dataset

1. Import MNIST data set(local)



.ipynb_checkpoints
datas
01_1_AutoEncoder
01_2_VariationalAutoEncoder
02_GAN

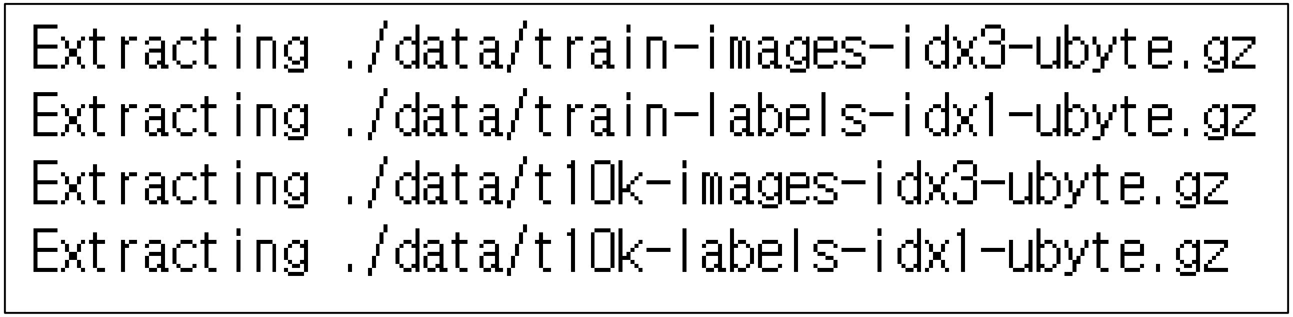


input_data
mnist
mnist_data
t10k-images-idx3-ubyte.gz
t10k-labels-idx1-ubyte.gz
train-images-idx3-ubyte.gz
train-labels-idx1-ubyte.gz

# MNIST dataset

## 2. Extract

- from data import input_data
- mnist = input_data.read_data_sets("./data/", one_hot=True)

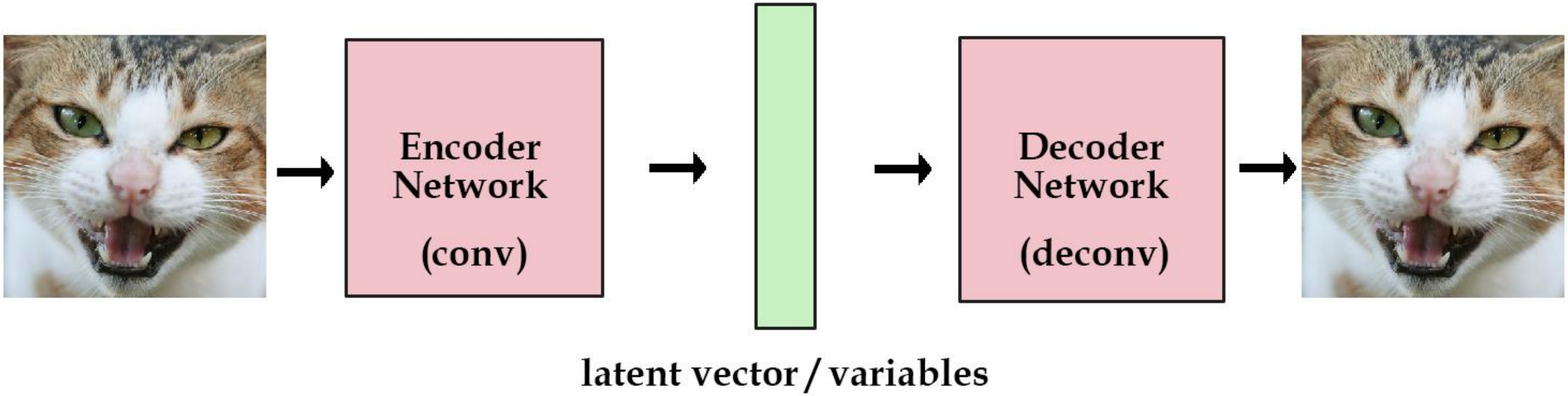


```
Extracting ./data/train-images-idx3-ubyte.gz
Extracting ./data/train-labels-idx1-ubyte.gz
Extracting ./data/t10k-images-idx3-ubyte.gz
Extracting ./data/t10k-labels-idx1-ubyte.gz
```

# Autoencoder

# Autoencoder

## 1. Overview



# Autoencoder

## 2. Import library

- import matplotlib.pyplot as plt
- import numpy as np
- import tensorflow as tf

# Autoencoder

3. Set parameters(training)

- learning_rate = 0.01 # learning late
- num_steps = 30000 # epoch
- batch_size = 256 # batch size

- display_step = 1000 # display step(unit)

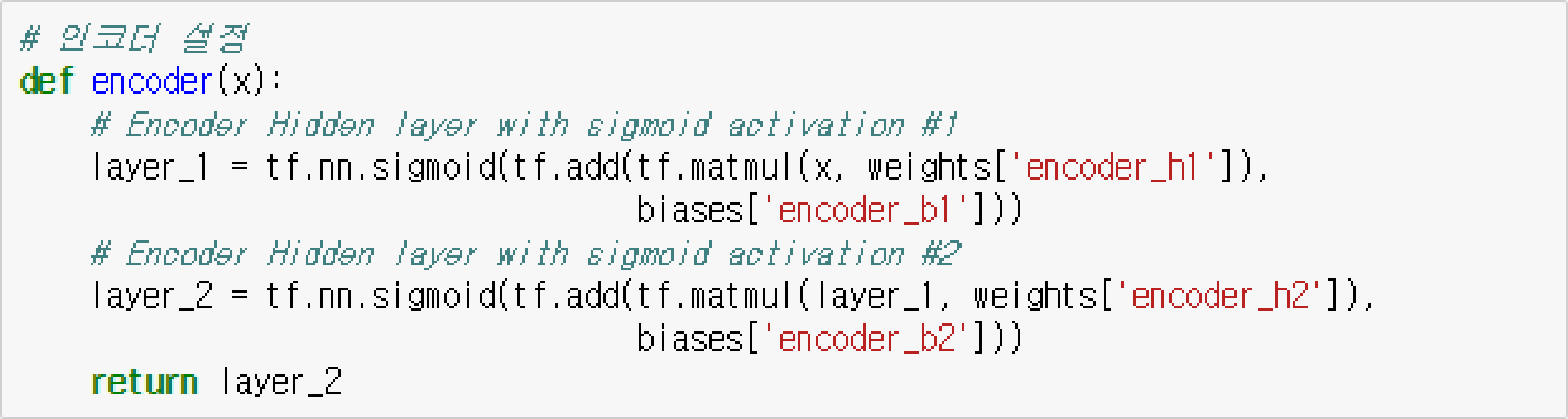
# Autoencoder

4. Set parameters(network)

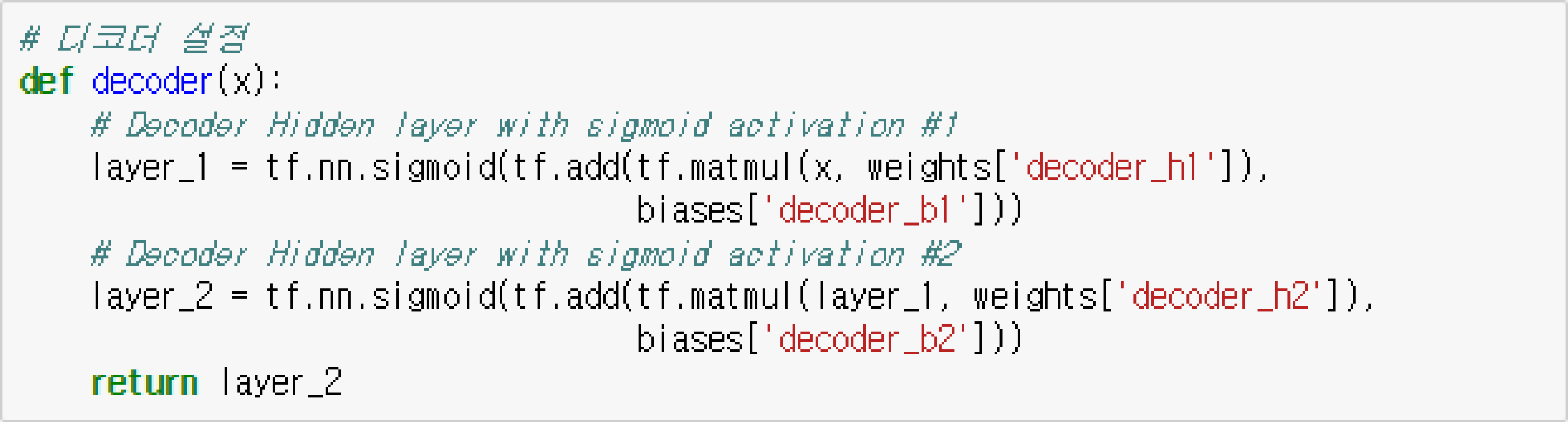
- num_hidden_1 = 256 # 첫번째 hidden layer
- num_hidden_2 = 128 # 두번째 hidden layer
- num_input = 784 # MNIST 28*28

# Autoencoder

5. Encoder, decoder 정의



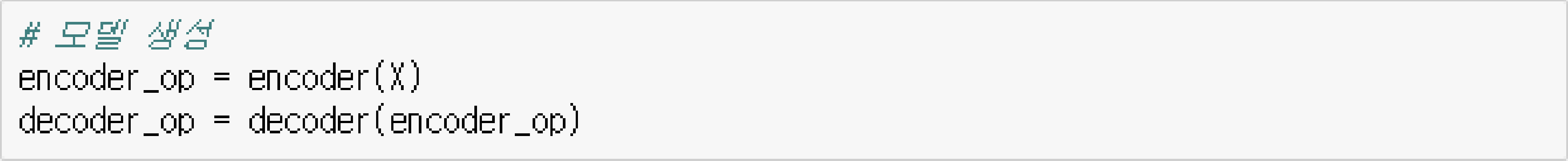
```
# 인코더 설정
def encoder(x):
    # Encoder Hidden layer with sigmoid activation #1
    layer_1 = tf.nn.sigmoid(tf.add(tf.matmul(x, weights['encoder_h1']),
                                   biases['encoder_b1']))
    # Encoder Hidden layer with sigmoid activation #2
    layer_2 = tf.nn.sigmoid(tf.add(tf.matmul(layer_1, weights['encoder_h2']),
                                   biases['encoder_b2']))
    return layer_2
```



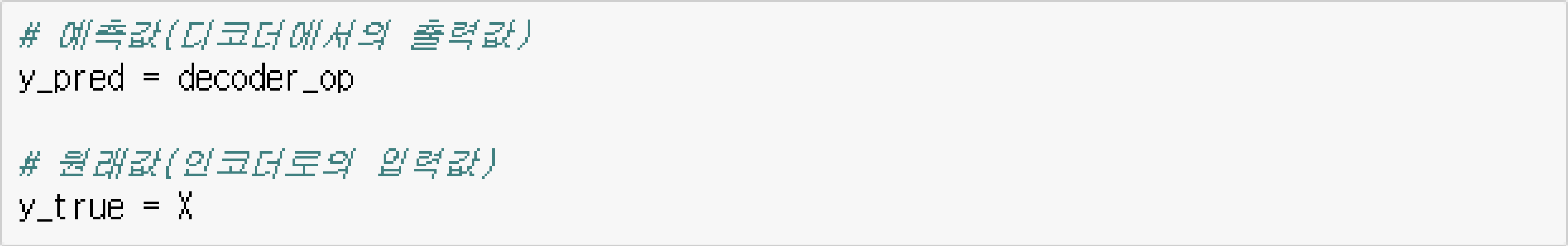
```
# 디코더 설정
def decoder(x):
    # Decoder Hidden layer with sigmoid activation #1
    layer_1 = tf.nn.sigmoid(tf.add(tf.matmul(x, weights['decoder_h1']),
                                   biases['decoder_b1']))
    # Decoder Hidden layer with sigmoid activation #2
    layer_2 = tf.nn.sigmoid(tf.add(tf.matmul(layer_1, weights['decoder_h2']),
                                   biases['decoder_b2']))
    return layer_2
```

# Autoencoder

## 6. Build model



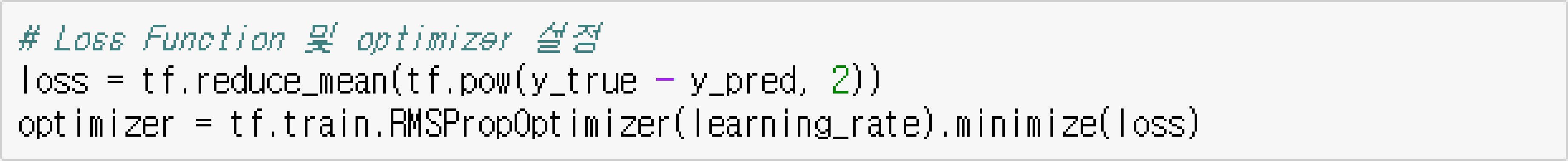
```
# 모델 생성
encoder_op = encoder(X)
decoder_op = decoder(encoder_op)
```



```
# 예측값(디코더에서의 출력값)
y_pred = decoder_op

# 원래값(인코더로의 입력값)
y_true = X
```

# GAN

## 7. Loss function / Optimizer



```
# Loss Function 및 optimizer 설정
loss = tf.reduce_mean(tf.pow(y_true - y_pred, 2))
optimizer = tf.train.RMSPropOptimizer(learning_rate).minimize(loss)
```

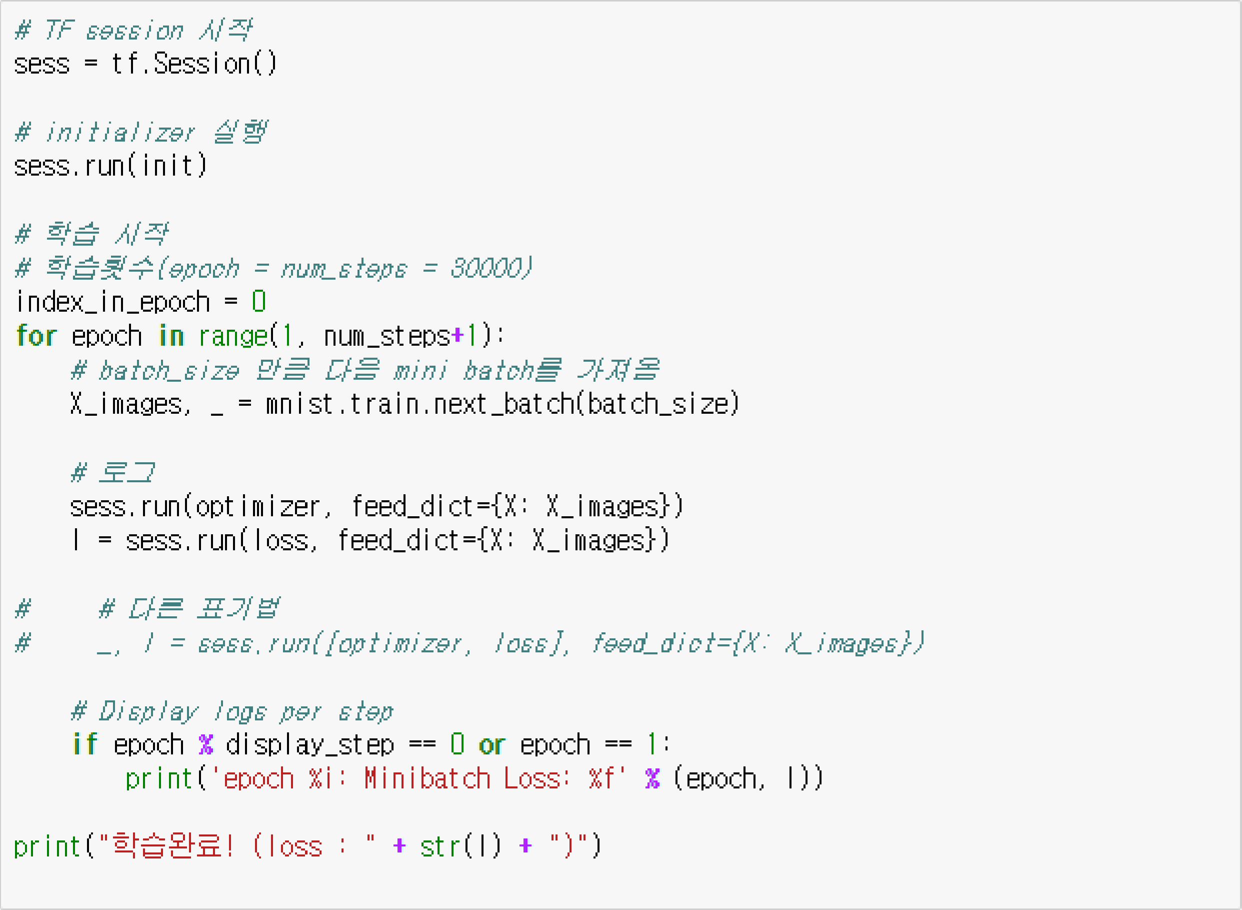
# Autoencoder

## 8. 변수 초기화

- Global variables initializer 사용
- weight, bias 초기화

# Autoencoder

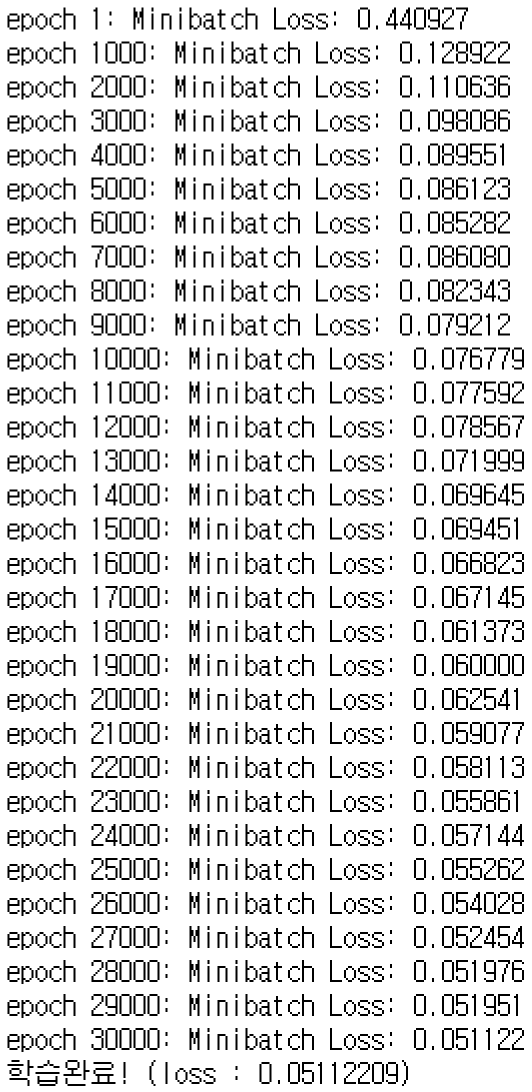
## 9. Training



```
# TF session 시작
sess = tf.Session()

# initializer 실행
sess.run(init)

# 학습 시작
# 학습횟수(epoch = num_steps = 30000)
index_in_epoch = 0
for epoch in range(1, num_steps+1):
    # batch_size 만큼 다음 mini batch를 가져옴
    X_images, _ = mnist.train.next_batch(batch_size)

    # 로그
    sess.run(optimizer, feed_dict={X: X_images})
    l = sess.run(loss, feed_dict={X: X_images})

#     # 다른 표기법
#     _, l = sess.run([optimizer, loss], feed_dict={X: X_images})

    # Display logs per step
    if epoch % display_step == 0 or epoch == 1:
        print('epoch %i: Minibatch Loss: %f' % (epoch, l))

print("학습완료! (loss : " + str(l) + ")")
```

# Autoencoder

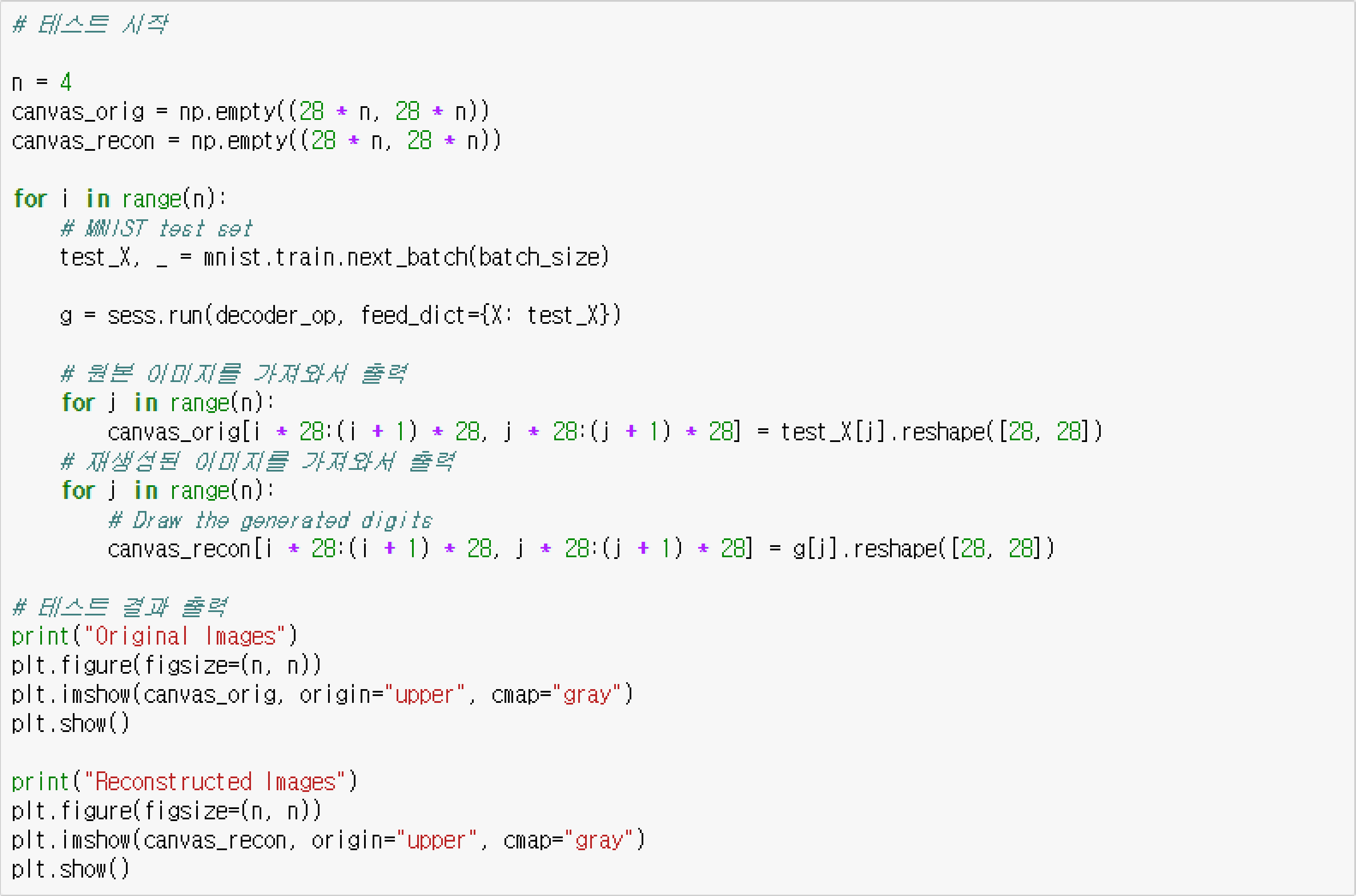
## 9. Training - Result



```
epoch 1: Minibatch Loss: 0.440927
epoch 1000: Minibatch Loss: 0.128922
epoch 2000: Minibatch Loss: 0.110636
epoch 3000: Minibatch Loss: 0.098086
epoch 4000: Minibatch Loss: 0.089551
epoch 5000: Minibatch Loss: 0.086123
epoch 6000: Minibatch Loss: 0.085282
epoch 7000: Minibatch Loss: 0.086080
epoch 8000: Minibatch Loss: 0.082343
epoch 9000: Minibatch Loss: 0.079212
epoch 10000: Minibatch Loss: 0.076779
epoch 11000: Minibatch Loss: 0.077592
epoch 12000: Minibatch Loss: 0.078567
epoch 13000: Minibatch Loss: 0.071999
epoch 14000: Minibatch Loss: 0.069645
epoch 15000: Minibatch Loss: 0.069451
epoch 16000: Minibatch Loss: 0.066823
epoch 17000: Minibatch Loss: 0.067145
epoch 18000: Minibatch Loss: 0.061373
epoch 19000: Minibatch Loss: 0.060000
epoch 20000: Minibatch Loss: 0.062541
epoch 21000: Minibatch Loss: 0.059077
epoch 22000: Minibatch Loss: 0.058113
epoch 23000: Minibatch Loss: 0.055861
epoch 24000: Minibatch Loss: 0.057144
epoch 25000: Minibatch Loss: 0.055262
epoch 26000: Minibatch Loss: 0.054028
epoch 27000: Minibatch Loss: 0.052454
epoch 28000: Minibatch Loss: 0.051976
epoch 29000: Minibatch Loss: 0.051951
epoch 30000: Minibatch Loss: 0.051122
학습완료! (loss : 0.05112209)
```

# Autoencoder

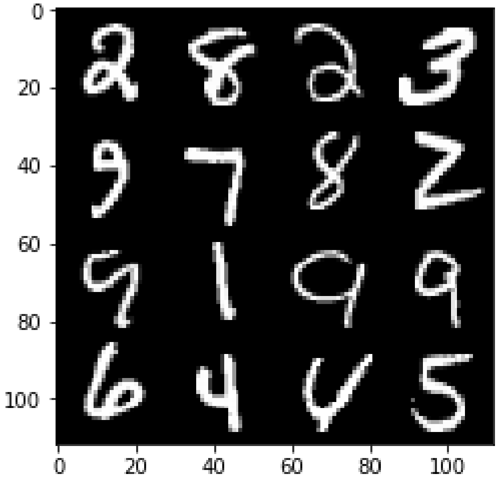
## 10. T

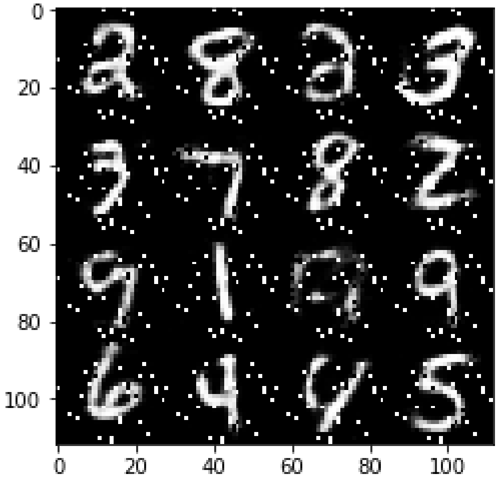


```
# 테스트 시작

n = 4
canvas_orig = np.empty((28 * n, 28 * n))
canvas_recon = np.empty((28 * n, 28 * n))

for i in range(n):
    # MNIST test set
    test_X, _ = mnist.train.next_batch(batch_size)

    g = sess.run(decoder_op, feed_dict={X: test_X})

    # 원본 이미지를 가져와서 출력
    for j in range(n):
        canvas_orig[i * 28:(i + 1) * 28, j * 28:(j + 1) * 28] = test_X[j].reshape([28, 28])
    # 재생성된 이미지를 가져와서 출력
    for j in range(n):
        # Draw the generated digits
        canvas_recon[i * 28:(i + 1) * 28, j * 28:(j + 1) * 28] = g[j].reshape([28, 28])

# 테스트 결과 출력
print("Original Images")
plt.figure(figsize=(n, n))
plt.imshow(canvas_orig, origin="upper", cmap="gray")
plt.show()

print("Reconstructed Images")
plt.figure(figsize=(n, n))
plt.imshow(canvas_recon, origin="upper", cmap="gray")
plt.show()
```

# Autoencoder

## 10. Test - Result


Original Images


Reconstructed Images