VAMSHI MYLAVARAPU

700759652

ASSIGNMENT 8

NEURAL NETWORKS AND DEEP LEARNING

Link for the recording: https://drive.google.com/file/d/1Qz3VSx5Re55BJ4EDownk7T8qn1418vOX/view?usp=drive_link

```
from keras.layers import Input, Dense
from keras.models import Model
from keras.datasets import mnist
import numpy as np
```

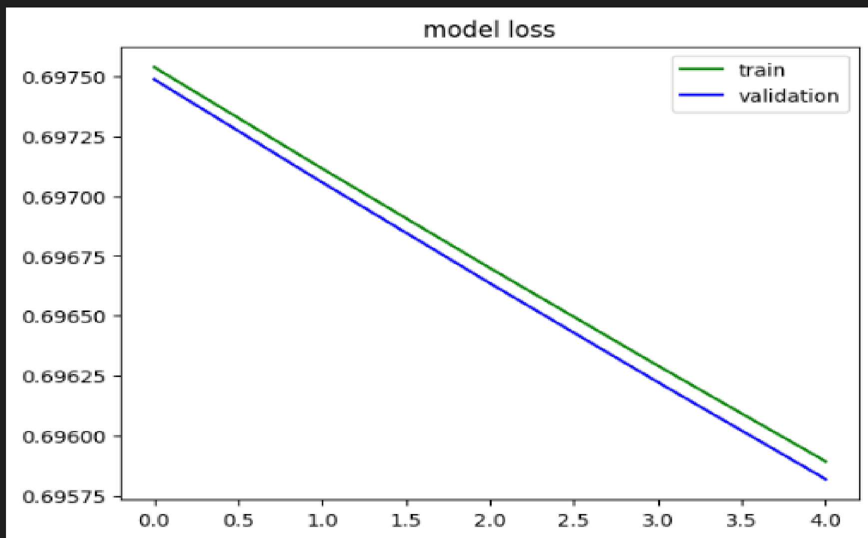
Autoencoder without hidden layer

```
encoding_dim = 64

input_img = Input(shape=(784,))

encoded = Dense(encoding_dim, activation='relu')(input_img)
decoded = Dense(784, activation='sigmoid')(encoded)
autoencoder = Model(input_img, decoded)
encoder = Model(input_img, encoded)

encoded_input = Input(shape=(encoding_dim,))
decoder_layer = autoencoder.layers[-1]
decoder = Model(encoded_input, decoder_layer(encoded_input))

autoencoder.compile(optimizer='adadelta', loss='binary_crossentropy')
```

```
(x_train, _), (x_test, _) = mnist.load_data()
x_train = x_train.astype('float32') / 255.
x_test = x_test.astype('float32') / 255.
x_train = x_train.reshape((len(x_train), np.prod(x_train.shape[1:])))
x_test = x_test.reshape((len(x_test), np.prod(x_test.shape[1:])))
history = autoencoder.fit(x_train, x_train,
                epochs=5,
                batch_size=256,
                shuffle=True,
                validation_data=(x_test, x_test))

encoded_imgs = encoder.predict(x_test)
decoded_imgs = decoder.predict(encoded_imgs)
```

```
Epoch 1/5
235/235 [==============================] - 8s 30ms/step - loss: 0.6975 - val_loss: 0.6975
Epoch 2/5
235/235 [==============================] - 7s 29ms/step - loss: 0.6971 - val_loss: 0.6971
Epoch 3/5
235/235 [==============================] - 6s 24ms/step - loss: 0.6967 - val_loss: 0.6966
Epoch 4/5
235/235 [==============================] - 4s 17ms/step - loss: 0.6963 - val_loss: 0.6962
Epoch 5/5
235/235 [==============================] - 3s 14ms/step - loss: 0.6959 - val_loss: 0.6958
313/313 [==============================] - 1s 1ms/step
313/313 [==============================] - 1s 2ms/step
```

```
# graph
import matplotlib.pyplot as plt
plt.plot(history.history['loss'], color="green")
plt.plot(history.history['val_loss'], color="blue")
plt.title('model loss')
plt.legend(['train', 'validation'], loc='upper right')
plt.show()
```



Autoencoder with hidden layer

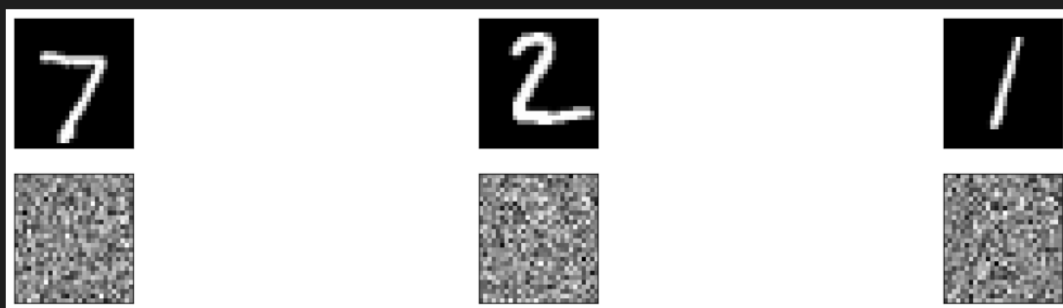
```
input_size = 784
hidden_size = 128
code_size = 32

input_img = Input(shape=(input_size,))
hidden_1 = Dense(hidden_size, activation='relu')(input_img)
code = Dense(code_size, activation='relu')(hidden_1)
hidden_2 = Dense(hidden_size, activation='relu')(code)
output_img = Dense(input_size, activation='sigmoid')(hidden_2)

autoencoder = Model(input_img, output_img)
autoencoder.compile(optimizer='adam', loss='binary_crossentropy')
```

```
(x_train, _), (x_test, _) = mnist.load_data()
x_train = x_train.astype('float32') / 255.
x_test = x_test.astype('float32') / 255.
x_train = x_train.reshape((len(x_train), np.prod(x_train.shape[1:])))
x_test = x_test.reshape((len(x_test), np.prod(x_test.shape[1:])))
history = autoencoder.fit(x_train, x_train,
                epochs=5,
                batch_size=256,
                shuffle=True,
                validation_data=(x_test, x_test))
```

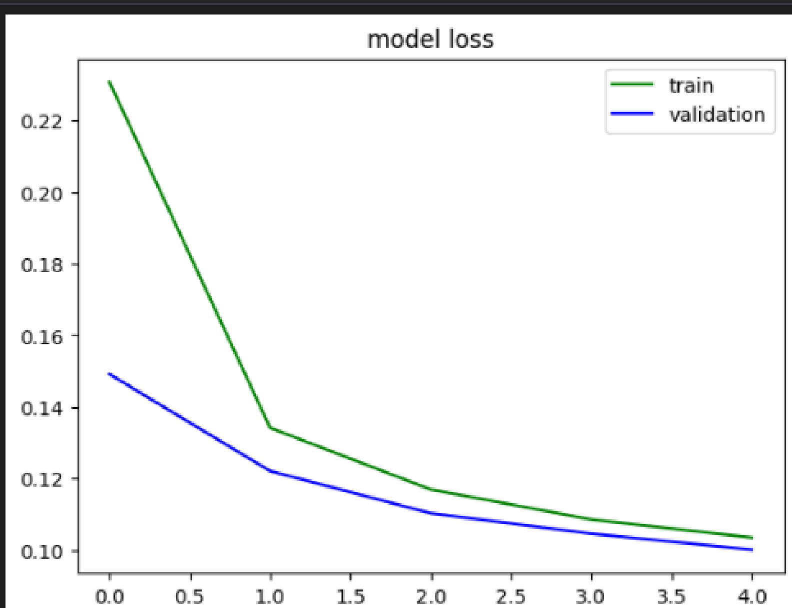
```
Epoch 1/5
235/235 [==============================] - 6s 23ms/step - loss: 0.2308 - val_loss: 0.1491
Epoch 2/5
235/235 [==============================] - 4s 17ms/step - loss: 0.1342 - val_loss: 0.1221
Epoch 3/5
235/235 [==============================] - 4s 18ms/step - loss: 0.1169 - val_loss: 0.1103
Epoch 4/5
235/235 [==============================] - 5s 20ms/step - loss: 0.1085 - val_loss: 0.1046
Epoch 5/5
235/235 [==============================] - 4s 17ms/step - loss: 0.1035 - val_loss: 0.1001
```

```python
encoded_imgs = encoder.predict(x_test)
decoded_imgs = decoder.predict(encoded_imgs)

import matplotlib.pyplot as plt

n = 3
plt.figure(figsize=(20, 4))
for i in range(n):
    # display original
    ax = plt.subplot(2, n, i + 1)
    plt.imshow(x_test[i].reshape(28, 28))
    plt.gray()
    ax.get_xaxis().set_visible(False)
    ax.get_yaxis().set_visible(False)

    # display reconstruction
    ax = plt.subplot(2, n, i + 1 + n)
    plt.imshow(decoded_imgs[i].reshape(28, 28))
    plt.gray()
    ax.get_xaxis().set_visible(False)
    ax.get_yaxis().set_visible(False)
plt.show()
```

```
313/313 [==============================] - 0s 1ms/step
313/313 [==============================] - 1s 2ms/step
```



```python
# graph
plt.plot(history.history['loss'], color="green")
plt.plot(history.history['val_loss'], color="blue")
plt.title('model loss')
plt.legend(['train', 'validation'], loc='upper right')
plt.show()
```



Do the prediction on the test data and then visualize one of the reconstructed version of that test data. Also, visualize the same test data before reconstruction using Matplotlib

3. Use denoisening autoencoder, to reconstruct the input,

4. Plot loss and accuracy using the history object.

```
from keras.layers import Input, Dense
from keras.models import Model, Sequential

# Scales the training and test data to range between 0 and 1.
max_value = float(x_train.max())
x_train = x_train.astype('float32') / max_value
x_test = x_test.astype('float32') / max_value
x_train.shape, x_test.shape
x_train = x_train.reshape((len(x_train), np.prod(x_train.shape[1:])))
x_test = x_test.reshape((len(x_test), np.prod(x_test.shape[1:])))

(x_train.shape, x_test.shape)
input_dim = x_train.shape[1]
encoding_dim = 64

compression_factor = float(input_dim) / encoding_dim
print("Compression factor: %s" % compression_factor)

autoencoder = Sequential()
autoencoder.add(
    Dense(encoding_dim, input_shape=(input_dim,), activation='relu')
)
autoencoder.add(
    Dense(input_dim, activation='sigmoid')
)
```

```
autoencoder.summary()
input_img = Input(shape=(input_dim,))
encoder_layer = autoencoder.layers[0]
encoder = Model(input_img, encoder_layer(input_img))

encoder.summary()
autoencoder.compile(optimizer='adam', loss='binary_crossentropy')
history = autoencoder.fit(x_train, x_train,
                          epochs=5,
                          batch_size=256,
                          shuffle=True,
                          validation_data=(x_test, x_test))
num_images = 5
np.random.seed(42)
random_test_images = np.random.randint(x_test.shape[0], size=num_images)

noise = np.random.normal(loc=0.1, scale=0.1, size=x_test.shape)
noised_images = x_test + noise
encoded_imgs = encoder.predict(noised_images)
decoded_imgs = autoencoder.predict(noised_images)
```

```
Output exceeds the size limit. Open the full output data in a text editor
Compression factor: 12.25
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 dense_6 (Dense)             (None, 64)                50240

 dense_7 (Dense)             (None, 784)               50960

=================================================================
Total params: 101,200
Trainable params: 101,200
Non-trainable params: 0
_________________________________________________________________
Model: "model_4"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 input_4 (InputLayer)        [(None, 784)]             0

 dense_6 (Dense)             (None, 64)                50240

=================================================================
Total params: 50,240
Trainable params: 50,240
...
Epoch 5/5
235/235 [==============================] - 3s 13ms/step - loss: 0.0957 - val_loss: 0.0908
313/313 [==============================] - 1s 1ms/step
313/313 [==============================] - 1s 2ms/step
```