ICP 5

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Google drive link :
https://drive.google.com/file/d/1xr-PQCeZskoDscxQZrOnugvnnu_5H-Ub/view?usp=drive_link

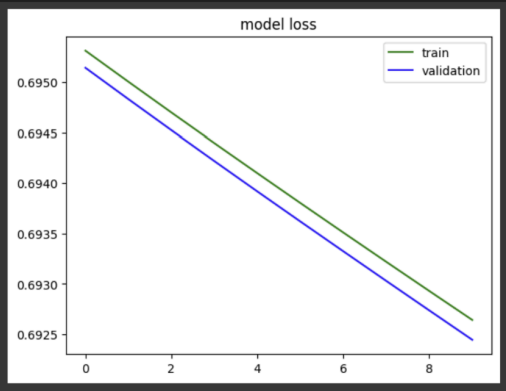
Github Link : https://github.com/Nagi-131/ICP-5

Autoencoder without hidden layer

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

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=10,
                batch_size=256,
                shuffle=True,
                validation_data=(x_test, x_test))

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

```
Epoch 1/10
235/235 [==============================] - 3s 12ms/step - loss: 0.6953 - val_loss: 0.6951
Epoch 2/10
235/235 [==============================] - 3s 11ms/step - loss: 0.6950 - val_loss: 0.6948
Epoch 3/10
235/235 [==============================] - 3s 11ms/step - loss: 0.6947 - val_loss: 0.6945
Epoch 4/10
235/235 [==============================] - 4s 18ms/step - loss: 0.6944 - val_loss: 0.6942
Epoch 5/10
235/235 [==============================] - 3s 11ms/step - loss: 0.6941 - val_loss: 0.6939
Epoch 6/10
235/235 [==============================] - 3s 11ms/step - loss: 0.6938 - val_loss: 0.6936
Epoch 7/10
235/235 [==============================] - 3s 11ms/step - loss: 0.6935 - val_loss: 0.6933
Epoch 8/10
235/235 [==============================] - 3s 13ms/step - loss: 0.6932 - val_loss: 0.6930
Epoch 9/10
235/235 [==============================] - 3s 14ms/step - loss: 0.6929 - val_loss: 0.6927
Epoch 10/10
235/235 [==============================] - 3s 11ms/step - loss: 0.6926 - val_loss: 0.6924
313/313 [==============================] - 0s 1ms/step
313/313 [==============================] - 1s 2ms/step
```

```python
# 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()
```



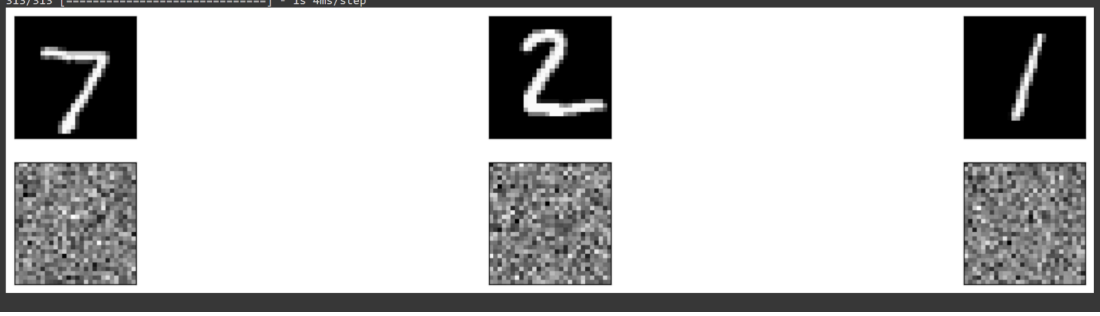
Autoencoder with hidden layer

```python
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=10,
                batch_size=256,
                shuffle=True,
                validation_data=(x_test, x_test))
```

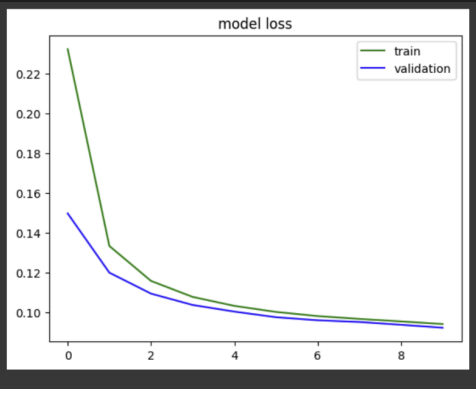
```
Epoch 1/10
235/235 [==============================] - 4s 15ms/step - loss: 0.2323 - val_loss: 0.1497
Epoch 2/10
235/235 [==============================] - 4s 18ms/step - loss: 0.1333 - val_loss: 0.1199
Epoch 3/10
235/235 [==============================] - 4s 15ms/step - loss: 0.1157 - val_loss: 0.1093
Epoch 4/10
235/235 [==============================] - 3s 14ms/step - loss: 0.1077 - val_loss: 0.1036
Epoch 5/10
235/235 [==============================] - 3s 14ms/step - loss: 0.1032 - val_loss: 0.1003
Epoch 6/10
235/235 [==============================] - 5s 20ms/step - loss: 0.1001 - val_loss: 0.0975
Epoch 7/10
235/235 [==============================] - 3s 15ms/step - loss: 0.0980 - val_loss: 0.0959
Epoch 8/10
235/235 [==============================] - 3s 15ms/step - loss: 0.0966 - val_loss: 0.0951
Epoch 9/10
235/235 [==============================] - 4s 18ms/step - loss: 0.0953 - val_loss: 0.0937
Epoch 10/10
235/235 [==============================] - 4s 16ms/step - loss: 0.0940 - val_loss: 0.0922
```

```
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 4ms/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()
```



2. 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.

```python
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)
```

```
Compression factor: 12.25
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 dense_10 (Dense)            (None, 64)                50240

 dense_11 (Dense)            (None, 784)               50960

=================================================================
Total params: 101200 (395.31 KB)
Trainable params: 101200 (395.31 KB)
Non-trainable params: 0 (0.00 Byte)
_________________________________________________________________
Model: "model_10"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 input_8 (InputLayer)        [(None, 784)]             0

 dense_10 (Dense)            (None, 64)                50240

=================================================================
Total params: 50240 (196.25 KB)
Trainable params: 50240 (196.25 KB)
Non-trainable params: 0 (0.00 Byte)
_________________________________________________________________
Epoch 1/5
235/235 [==============================] - 4s 11ms/step - loss: 0.2447 - val_loss: 0.1628
Epoch 2/5
235/235 [==============================] - 2s 10ms/step - loss: 0.1445 - val_loss: 0.1278
Epoch 3/5
235/235 [==============================] - 3s 11ms/step - loss: 0.1195 - val_loss: 0.1096
Epoch 4/5
235/235 [==============================] - 3s 13ms/step - loss: 0.1047 - val_loss: 0.0980
Epoch 5/5
235/235 [==============================] - 3s 14ms/step - loss: 0.0951 - val_loss: 0.0903
313/313 [==============================] - 0s 1ms/step
313/313 [==============================] - 1s 2ms/step
```