

ASSIGNMENT-9

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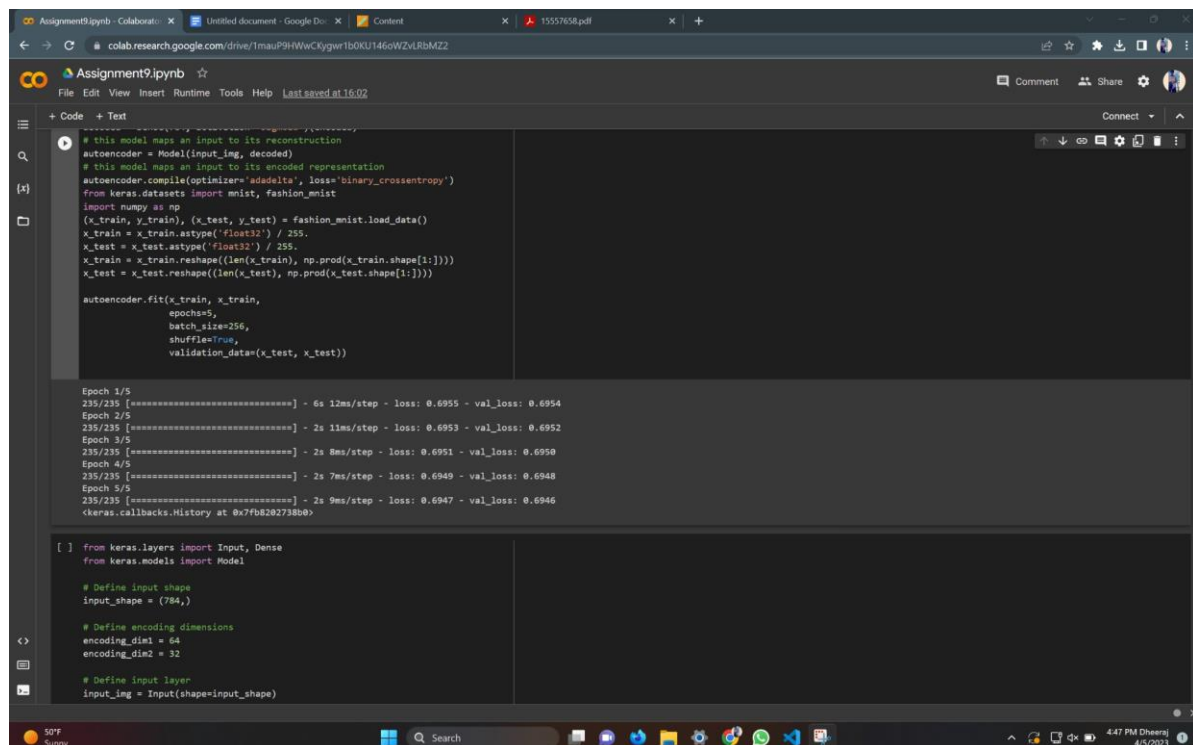
Github: <https://github.com/TejaswiPasupuleti/Neural/>

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

# this is the size of our encoded representations
encoding_dim = 32 # 32 floats -> compression of factor 24.5, assuming
the input is 784 floats

# this is our input placeholder
input_img = Input(shape=(784,))
# "encoded" is the encoded representation of the input
encoded = Dense(encoding_dim, activation='relu')(input_img)
# "decoded" is the lossy reconstruction of the input
decoded = Dense(784, activation='sigmoid')(encoded)
# this model maps an input to its reconstruction
autoencoder = Model(input_img, decoded)
# this model maps an input to its encoded representation
autoencoder.compile(optimizer='adadelta', loss='binary_crossentropy')
from keras.datasets import mnist, fashion_mnist
import numpy as np
(x_train, y_train), (x_test, y_test) = fashion_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:])))

autoencoder.fit(x_train, x_train,
                epochs=5,
                batch_size=256,
                shuffle=True,
                validation_data=(x_test, x_test))
```



```
# this model maps an input to its reconstruction
autoencoder = Model(input_img, decoded)
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autoencoder.compile(optimizer='adadelta', loss='binary_crossentropy')
from keras.datasets import mnist, fashion_mnist
import numpy as np

(x_train, y_train), (x_test, y_test) = fashion_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:])))

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 12ms/step - loss: 0.6955 - val_loss: 0.6954
Epoch 2/5
235/235 [=====] - 2s 11ms/step - loss: 0.6953 - val_loss: 0.6952
Epoch 3/5
235/235 [=====] - 2s 8ms/step - loss: 0.6951 - val_loss: 0.6950
Epoch 4/5
235/235 [=====] - 2s 7ms/step - loss: 0.6949 - val_loss: 0.6948
Epoch 5/5
235/235 [=====] - 2s 9ms/step - loss: 0.6947 - val_loss: 0.6946
<keras.callbacks.History at 0x7fb282738b0>

[ ] from keras.layers import Input, Dense
from keras.models import Model

# Define input shape
input_shape = (784,)

# Define encoding dimensions
encoding_dim1 = 64
encoding_dim2 = 32

# Define input layer
input_img = Input(shape=input_shape)
```

Here we added a new hidden layer to the encoder and the decoder

```
from keras.layers import Input, Dense
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```

```
# Define input shape
input_shape = (784,)
```

```
# Define encoding dimensions
encoding_dim1 = 64
encoding_dim2 = 32
```

```
# Define input layer
input_img = Input(shape=input_shape)
```

```
encoded1 = Dense(encoding_dim1, activation='relu')(input_img)
encoded2 = Dense(encoding_dim2, activation='relu')(encoded1)
decoded1 = Dense(encoding_dim1, activation='relu')(encoded2)
decoded2 = Dense(input_shape[0], activation='sigmoid')(decoded1)
autoencoder = Model(input_img, decoded2)
autoencoder.compile(optimizer='adadelta',
loss='binary_crossentropy', metrics=['accuracy'])
from keras.datasets import mnist, fashion_mnist
import numpy as np
```

```

(x_train, y_train), (x_test, y_test) = fashion_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:])))

# Train model
history = autoencoder.fit(x_train, x_train,
                          epochs=20,
                          batch_size=256,
                          shuffle=True,
                          validation_data=(x_test, x_test))

# Predict on test data
decoded_imgs = autoencoder.predict(x_test)

# Visualize reconstructed image and original image
import matplotlib.pyplot as plt

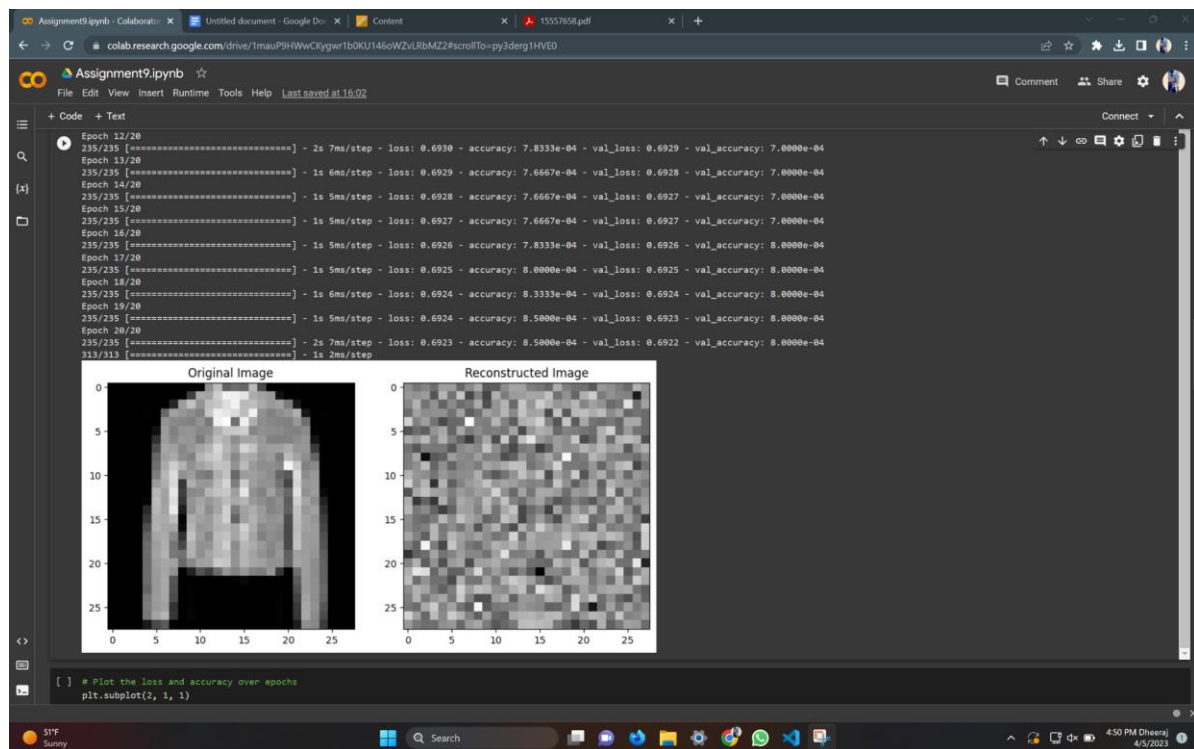
# Choose an index of a test image to visualize
idx = 10

# Reshape the test image
test_img = x_test[idx].reshape(28, 28)

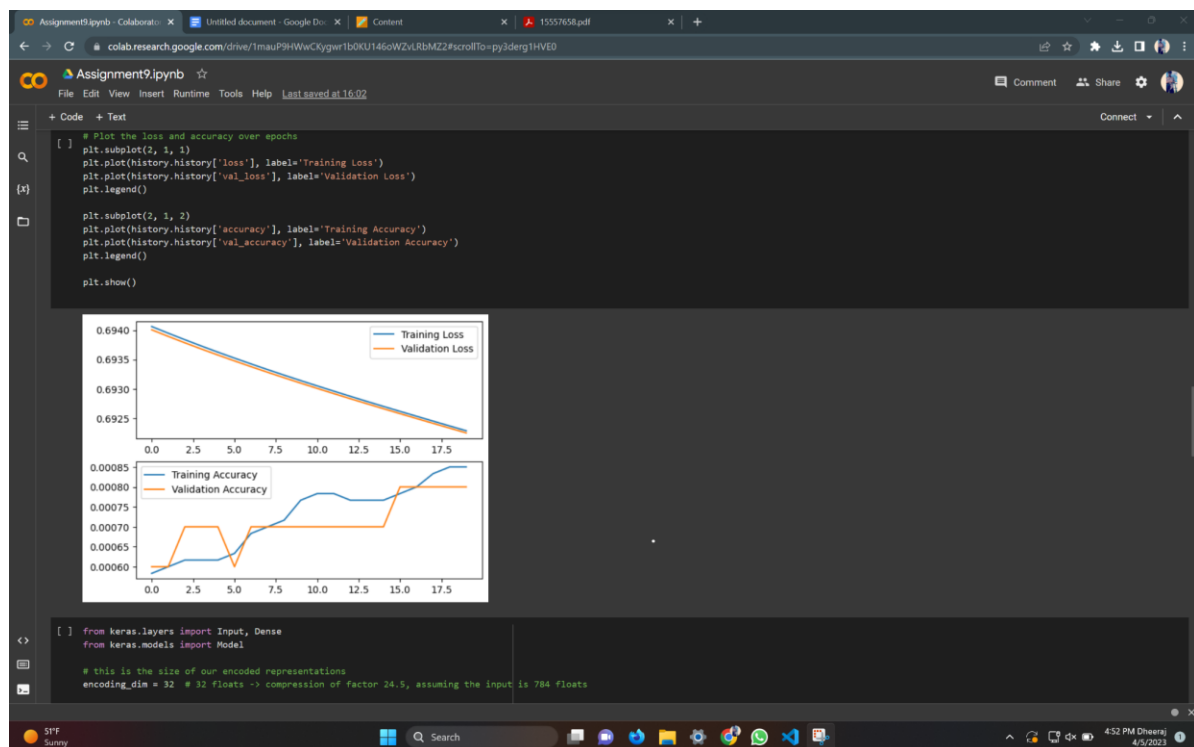
# Reshape the reconstructed image
reconstructed_img = decoded_imgs[idx].reshape(28, 28)

# Plot the original and reconstructed images side by side
plt.figure(figsize=(10, 5))
plt.subplot(1, 2, 1)
plt.imshow(test_img, cmap='gray')
plt.title('Original Image')
plt.subplot(1, 2, 2)
plt.imshow(reconstructed_img, cmap='gray')
plt.title('Reconstructed Image')
plt.show()

```



We are calculating the loss and accuracy of the model using the history object where in the compile metrics are set to accuracy



For the Denoising autoencoder we are adding the noise

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

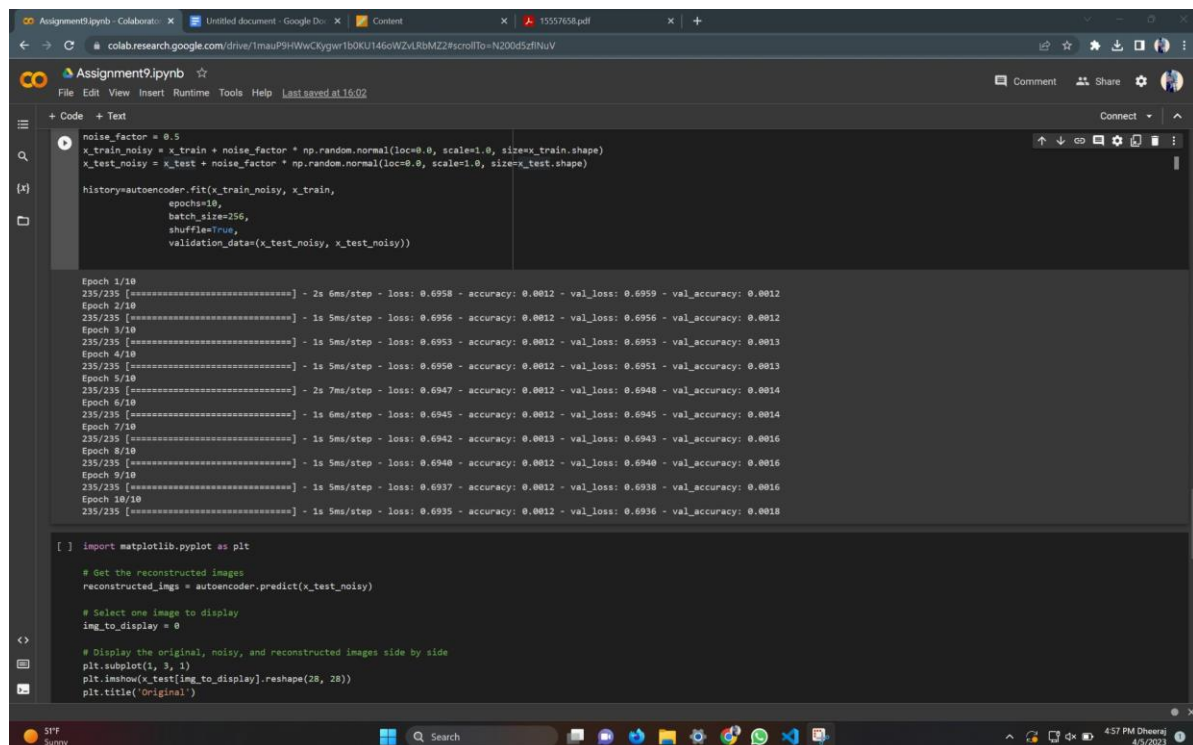
# this is the size of our encoded representations
encoding_dim = 32 # 32 floats -> compression of factor 24.5, assuming
the input is 784 floats

# this is our input placeholder
input_img = Input(shape=(784,))
# "encoded" is the encoded representation of the input
encoded = Dense(encoding_dim, activation='relu')(input_img)
# "decoded" is the lossy reconstruction of the input
decoded = Dense(784, activation='sigmoid')(encoded)
# this model maps an input to its reconstruction
autoencoder = Model(input_img, decoded)
# this model maps an input to its encoded representation
autoencoder.compile(optimizer='adadelta', loss='binary_crossentropy',
metrics=['accuracy'])

from keras.datasets import fashion_mnist
import numpy as np
(x_train, _), (x_test, _) = fashion_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:])))

#introducing noise
noise_factor = 0.5
x_train_noisy = x_train + noise_factor * np.random.normal(loc=0.0,
scale=1.0, size=x_train.shape)
x_test_noisy = x_test + noise_factor * np.random.normal(loc=0.0,
scale=1.0, size=x_test.shape)

history=autoencoder.fit(x_train_noisy, x_train,
                        epochs=10,
                        batch_size=256,
                        shuffle=True,
                        validation_data=(x_test_noisy, x_test_noisy))
```



```
noise_factor = 0.5
x_train_noisy = x_train + noise_factor * np.random.normal(loc=0.0, scale=1.0, size=x_train.shape)
x_test_noisy = x_test + noise_factor * np.random.normal(loc=0.0, scale=1.0, size=x_test.shape)

history=autoencoder.fit(x_train_noisy, x_train,
                        epochs=10,
                        batch_size=256,
                        shuffle=True,
                        validation_data=(x_test_noisy, x_test_noisy))

Epoch 1/10
235/235 [=====] - 2s 6ms/step - loss: 0.6958 - accuracy: 0.0012 - val_loss: 0.6959 - val_accuracy: 0.0012
Epoch 2/10
235/235 [=====] - 1s 5ms/step - loss: 0.6956 - accuracy: 0.0012 - val_loss: 0.6956 - val_accuracy: 0.0012
Epoch 3/10
235/235 [=====] - 1s 5ms/step - loss: 0.6953 - accuracy: 0.0012 - val_loss: 0.6953 - val_accuracy: 0.0013
Epoch 4/10
235/235 [=====] - 1s 5ms/step - loss: 0.6950 - accuracy: 0.0012 - val_loss: 0.6951 - val_accuracy: 0.0013
Epoch 5/10
235/235 [=====] - 2s 7ms/step - loss: 0.6947 - accuracy: 0.0012 - val_loss: 0.6948 - val_accuracy: 0.0014
Epoch 6/10
235/235 [=====] - 1s 6ms/step - loss: 0.6945 - accuracy: 0.0012 - val_loss: 0.6945 - val_accuracy: 0.0014
Epoch 7/10
235/235 [=====] - 1s 5ms/step - loss: 0.6942 - accuracy: 0.0013 - val_loss: 0.6943 - val_accuracy: 0.0016
Epoch 8/10
235/235 [=====] - 1s 5ms/step - loss: 0.6940 - accuracy: 0.0012 - val_loss: 0.6940 - val_accuracy: 0.0016
Epoch 9/10
235/235 [=====] - 1s 5ms/step - loss: 0.6937 - accuracy: 0.0012 - val_loss: 0.6938 - val_accuracy: 0.0016
Epoch 10/10
235/235 [=====] - 1s 5ms/step - loss: 0.6935 - accuracy: 0.0012 - val_loss: 0.6936 - val_accuracy: 0.0018

[ ] import matplotlib.pyplot as plt

# Get the reconstructed images
reconstructed_imgs = autoencoder.predict(x_test_noisy)

# Select one image to display
img_to_display = 0

# Display the original, noisy, and reconstructed images side by side
plt.subplot(1, 3, 1)
plt.imshow(x_test[img_to_display].reshape(28, 28))
plt.title('Original')

plt.subplot(1, 3, 2)
plt.imshow(x_test_noisy[img_to_display].reshape(28, 28))
plt.title('Noisy')

plt.subplot(1, 3, 3)
plt.imshow(reconstructed_imgs[img_to_display].reshape(28, 28))
plt.title('Reconstructed')

plt.show()
```

We are plotting the original image and the reconstructed image using the Matplotlib library

```
import matplotlib.pyplot as plt
```

```
# Get the reconstructed images
```

```
reconstructed_imgs = autoencoder.predict(x_test_noisy)
```

```
# Select one image to display
```

```
img_to_display = 0
```

```
# Display the original, noisy, and reconstructed images side by side
```

```
plt.subplot(1, 3, 1)
```

```
plt.imshow(x_test[img_to_display].reshape(28, 28))
```

```
plt.title('Original')
```

```
plt.subplot(1, 3, 2)
```

```
plt.imshow(x_test_noisy[img_to_display].reshape(28, 28))
```

```
plt.title('Noisy')
```

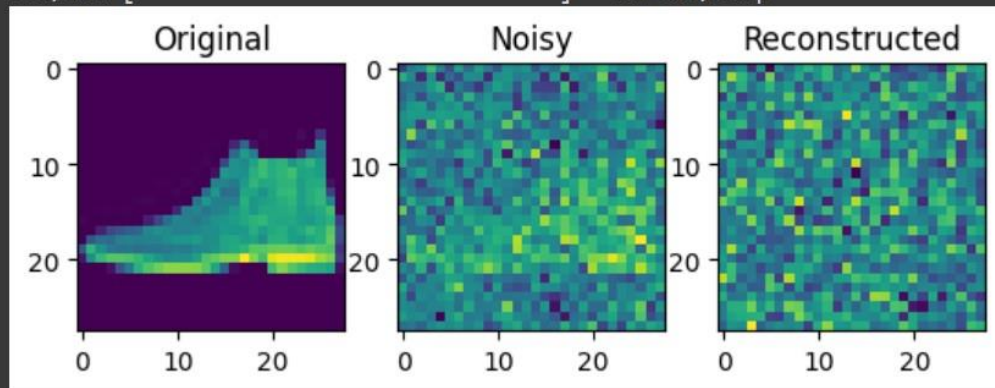
```
plt.subplot(1, 3, 3)
```

```
plt.imshow(reconstructed_imgs[img_to_display].reshape(28, 28))
```

```
plt.title('Reconstructed')
```

```
plt.show()
```

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



```
# Plot the loss and accuracy over epochs
plt.subplot(2, 1, 1)
plt.plot(history.history['loss'], label='Training Loss')
plt.plot(history.history['val_loss'], label='Validation Loss')
plt.legend()

plt.subplot(2, 1, 2)
plt.plot(history.history['accuracy'], label='Training Accuracy')
plt.plot(history.history['val_accuracy'], label='Validation Accuracy')
plt.legend()

plt.show()
```

