ASSIGNMENT - 4

Name – Rahul Chalamalasetti

ID -700740966

NEURAL NETWORKS & DEEP LEARNING

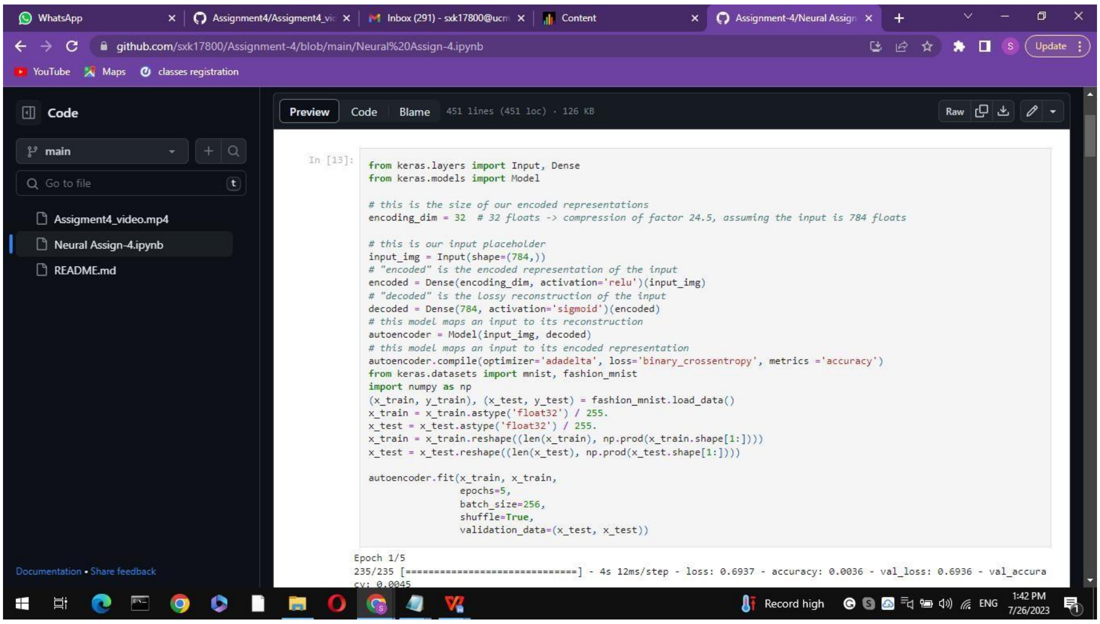
Github link : https://github.com/sxk17800/Assignment-4

Lesson Overview: In this lesson, we are going to discuss types and applications of Autoencoder.

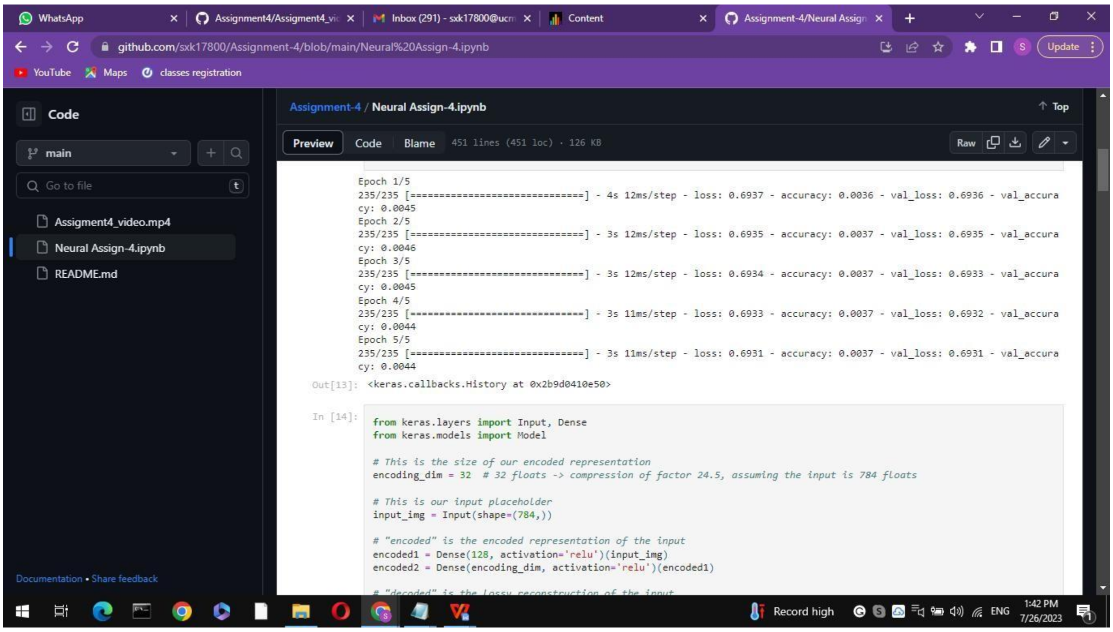
Programming elements:
1. Basics of Autoencoders.
2. Role of Autoencoders in unsupervised learning
3. Types of Autoencoders.
4. Use case: Simple autoencoder-Reconstructing the existing image, which will contain most important features of the image.
5. Use case: Stacked autoencoder.

In class programming:

1. Add one more hidden layer to autoencoder.
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. Repeat the question 2 on the denoisening autoencoder.
4. plot loss and accuracy using the history object.



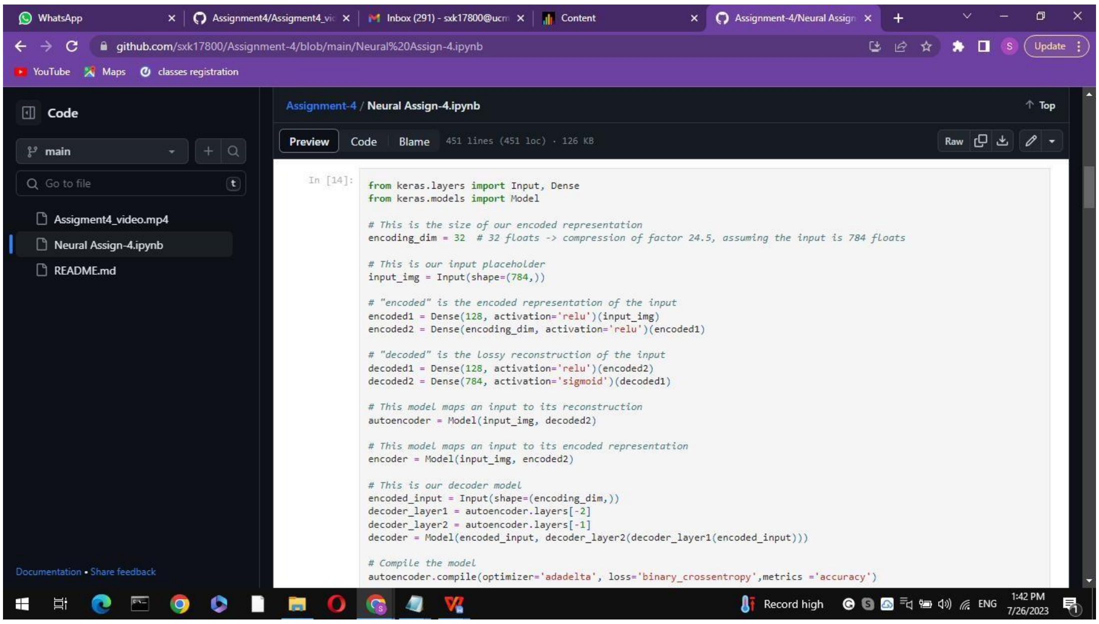
```
from keras.layers import Input, Dense
from keras.models import Model

# 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 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 [==============================] - 4s 12ms/step - loss: 0.6937 - accuracy: 0.0036 - val_loss: 0.6936 - val_accuracy: 0.0045
```



Assignment-4 / Neural Assign-4.ipynb

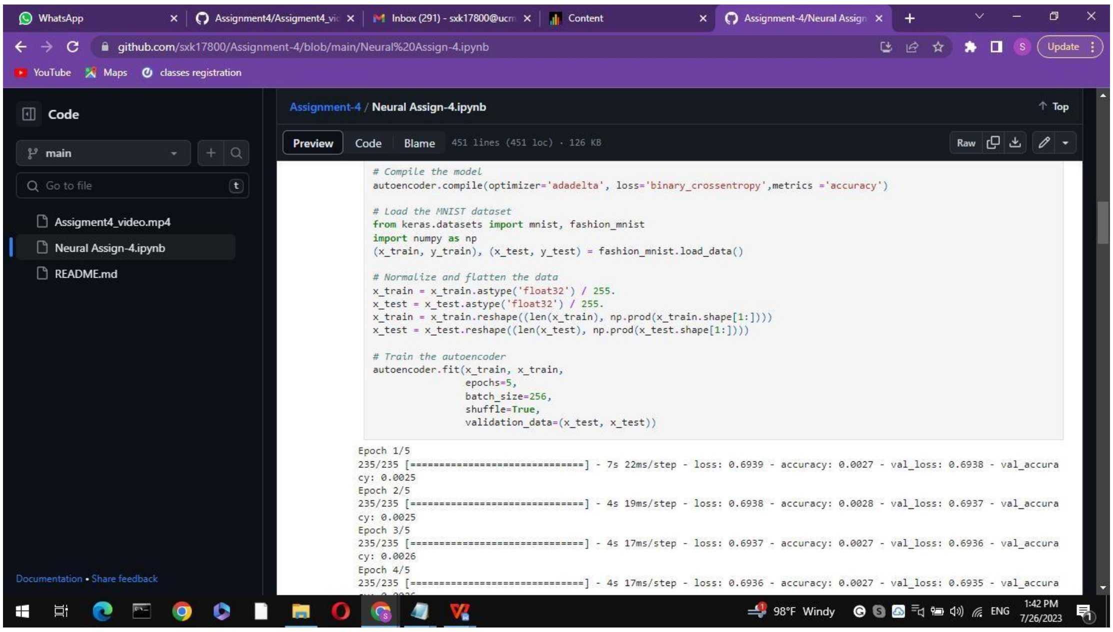
```
Epoch 1/5
235/235 [==============================] - 4s 12ms/step - loss: 0.6937 - accuracy: 0.0036 - val_loss: 0.6936 - val_accura
cy: 0.0045
Epoch 2/5
235/235 [==============================] - 3s 12ms/step - loss: 0.6935 - accuracy: 0.0037 - val_loss: 0.6935 - val_accura
cy: 0.0046
Epoch 3/5
235/235 [==============================] - 3s 12ms/step - loss: 0.6934 - accuracy: 0.0037 - val_loss: 0.6933 - val_accura
cy: 0.0045
Epoch 4/5
235/235 [==============================] - 3s 11ms/step - loss: 0.6933 - accuracy: 0.0037 - val_loss: 0.6932 - val_accura
cy: 0.0044
Epoch 5/5
235/235 [==============================] - 3s 11ms/step - loss: 0.6931 - accuracy: 0.0037 - val_loss: 0.6931 - val_accura
cy: 0.0044
Out[13]: <keras.callbacks.History at 0x2b9d0410e50>
```

```
In [14]:
from keras.layers import Input, Dense
from keras.models import Model

# This is the size of our encoded representation
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
encoded1 = Dense(128, activation='relu')(input_img)
encoded2 = Dense(encoding_dim, activation='relu')(encoded1)
```



Assignment-4 / Neural Assign-4.ipynb

```
In [14]:
from keras.layers import Input, Dense
from keras.models import Model

# This is the size of our encoded representation
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
encoded1 = Dense(128, activation='relu')(input_img)
encoded2 = Dense(encoding_dim, activation='relu')(encoded1)

# "decoded" is the lossy reconstruction of the input
decoded1 = Dense(128, activation='relu')(encoded2)
decoded2 = Dense(784, activation='sigmoid')(decoded1)

# This model maps an input to its reconstruction
autoencoder = Model(input_img, decoded2)

# This model maps an input to its encoded representation
encoder = Model(input_img, encoded2)

# This is our decoder model
encoded_input = Input(shape=(encoding_dim,))
decoder_layer1 = autoencoder.layers[-2]
decoder_layer2 = autoencoder.layers[-1]
decoder = Model(encoded_input, decoder_layer2(decoder_layer1(encoded_input)))

# Compile the model
autoencoder.compile(optimizer='adadelta', loss='binary_crossentropy',metrics ='accuracy')
```



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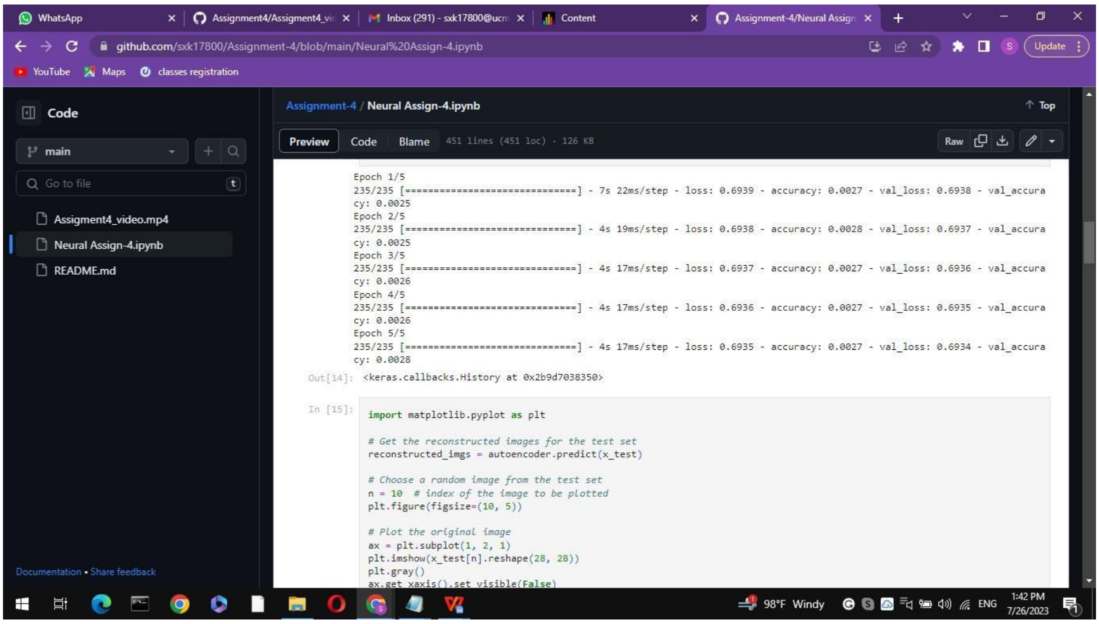
```python
# Compile the model
autoencoder.compile(optimizer='adadelta', loss='binary_crossentropy',metrics ='accuracy')

# Load the MNIST dataset
from keras.datasets import mnist, fashion_mnist
import numpy as np
(x_train, y_train), (x_test, y_test) = fashion_mnist.load_data()

# Normalize and flatten the 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 the autoencoder
autoencoder.fit(x_train, x_train,
                epochs=5,
                batch_size=256,
                shuffle=True,
                validation_data=(x_test, x_test))
```

```
Epoch 1/5
235/235 [==============================] - 7s 22ms/step - loss: 0.6939 - accuracy: 0.0027 - val_loss: 0.6938 - val_accura
cy: 0.0025
Epoch 2/5
235/235 [==============================] - 4s 19ms/step - loss: 0.6938 - accuracy: 0.0028 - val_loss: 0.6937 - val_accura
cy: 0.0025
Epoch 3/5
235/235 [==============================] - 4s 17ms/step - loss: 0.6937 - accuracy: 0.0027 - val_loss: 0.6936 - val_accura
cy: 0.0026
Epoch 4/5
235/235 [==============================] - 4s 17ms/step - loss: 0.6936 - accuracy: 0.0027 - val_loss: 0.6935 - val_accura
```



Assignment-4 / Neural Assign-4.ipynb

```
Epoch 1/5
235/235 [==============================] - 7s 22ms/step - loss: 0.6939 - accuracy: 0.0027 - val_loss: 0.6938 - val_accura
cy: 0.0025
Epoch 2/5
235/235 [==============================] - 4s 19ms/step - loss: 0.6938 - accuracy: 0.0028 - val_loss: 0.6937 - val_accura
cy: 0.0025
Epoch 3/5
235/235 [==============================] - 4s 17ms/step - loss: 0.6937 - accuracy: 0.0027 - val_loss: 0.6936 - val_accura
cy: 0.0026
Epoch 4/5
235/235 [==============================] - 4s 17ms/step - loss: 0.6936 - accuracy: 0.0027 - val_loss: 0.6935 - val_accura
cy: 0.0026
Epoch 5/5
235/235 [==============================] - 4s 17ms/step - loss: 0.6935 - accuracy: 0.0027 - val_loss: 0.6934 - val_accura
cy: 0.0028
Out[14]: <keras.callbacks.History at 0x2b9d7038350>
```

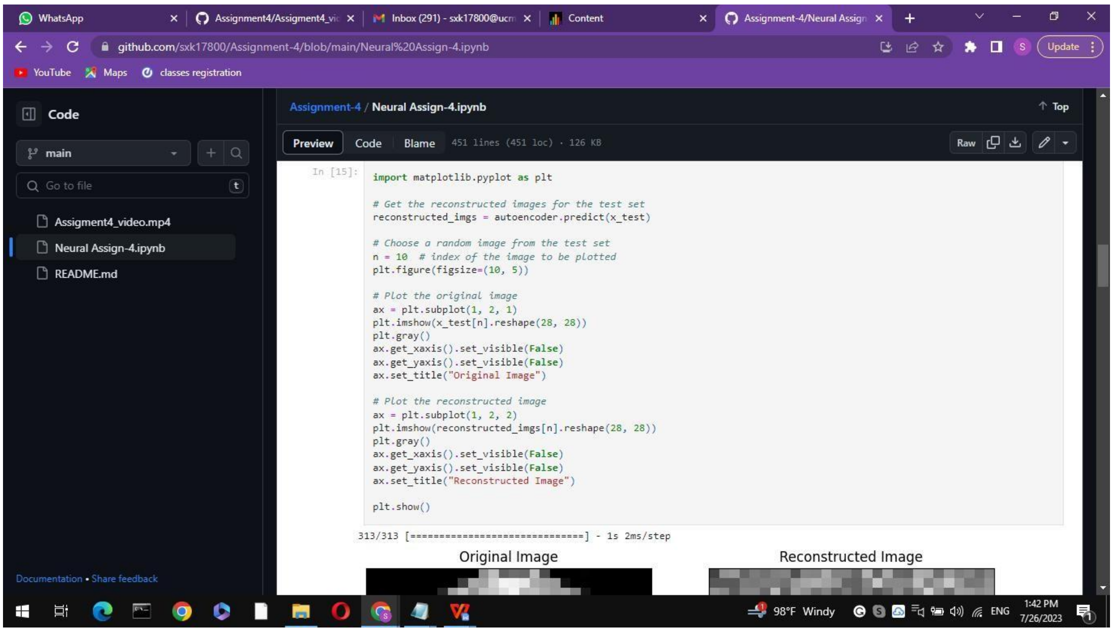
In [15]:

```python
import matplotlib.pyplot as plt

# Get the reconstructed images for the test set
reconstructed_imgs = autoencoder.predict(x_test)

# Choose a random image from the test set
n = 10  # index of the image to be plotted
plt.figure(figsize=(10, 5))

# Plot the original image
ax = plt.subplot(1, 2, 1)
plt.imshow(x_test[n].reshape(28, 28))
plt.gray()
ax.get_xaxis().set_visible(False)
```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Inbox (291) - sxk17800@ucm
Content
Assignment-4/Neural Assign
github.com/sxk17800/Assignment-4/blob/main/Neural%20Assign-4.ipynb
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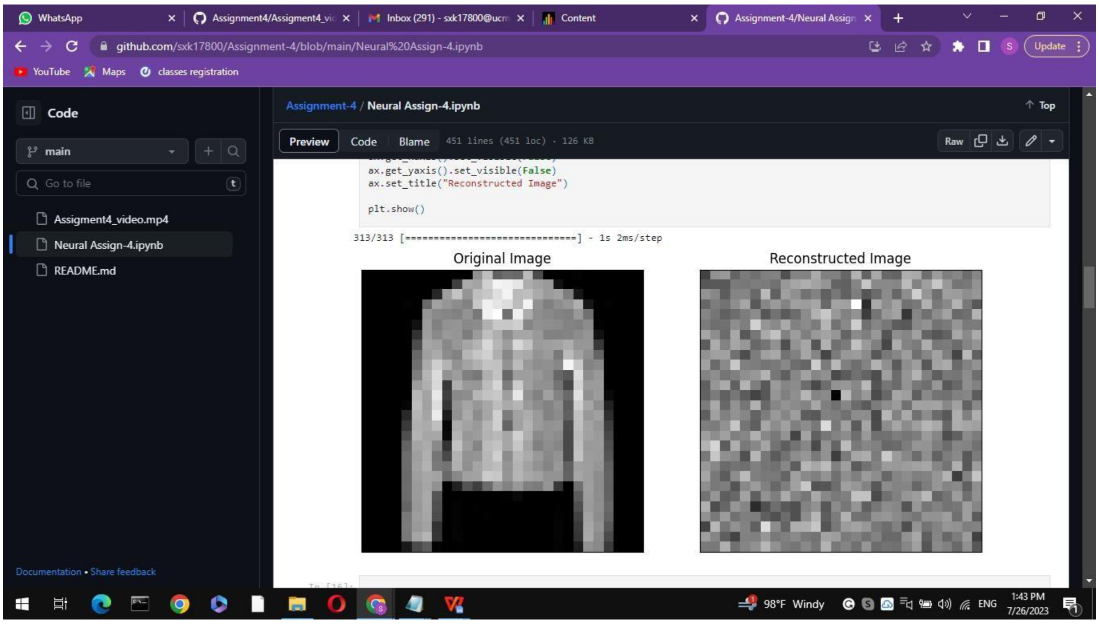
451 lines (451 loc) · 126 KB
Raw
In [15]:
import matplotlib.pyplot as plt
# Get the reconstructed images for the test set
reconstructed_imgs = autoencoder.predict(x_test)
# Choose a random image from the test set
n = 10 # index of the image to be plotted
plt.figure(figsize=(10, 5))
# Plot the original image
ax = plt.subplot(1, 2, 1)
plt.imshow(x_test[n].reshape(28, 28))
plt.gray()
ax.get_xaxis().set_visible(False)
ax.get_yaxis().set_visible(False)
ax.set_title("Original Image")
# Plot the reconstructed image
ax = plt.subplot(1, 2, 2)
plt.imshow(reconstructed_imgs[n].reshape(28, 28))
plt.gray()
ax.get_xaxis().set_visible(False)
ax.get_yaxis().set_visible(False)
ax.set_title("Reconstructed Image")
plt.show()
313/313 [==============================] - 1s 2ms/step
Original Image
Reconstructed Image
98°F Windy
ENG
1:42 PM
7/26/2023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Inbox (291) - sxk17800@ucm
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github.com/sxk17800/Assignment-4/blob/main/Neural%20Assign-4.ipynb
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Code
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Code
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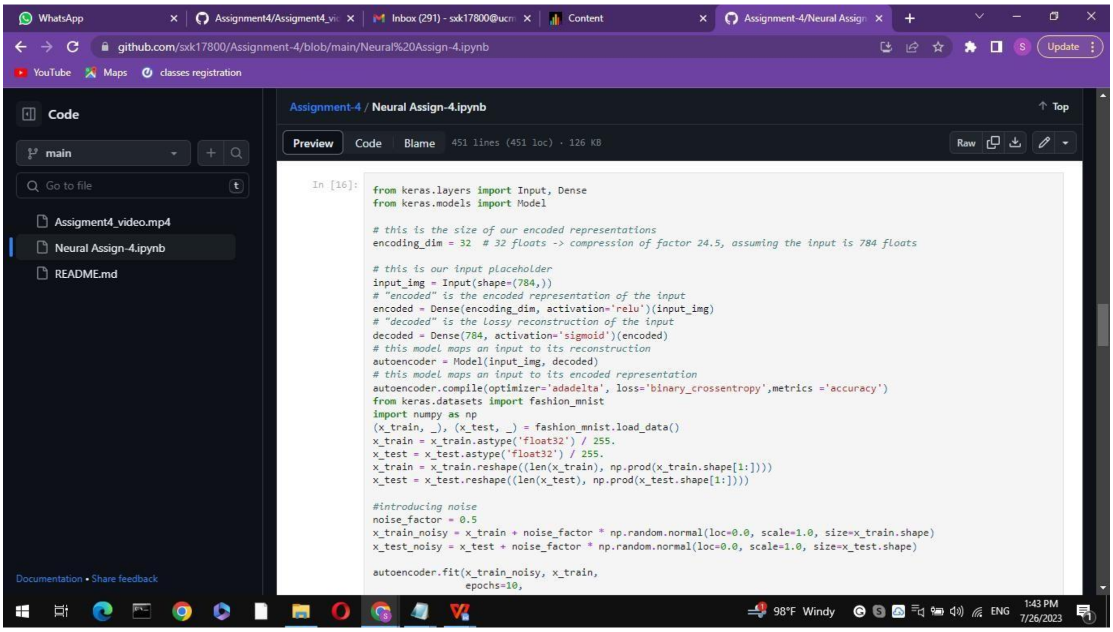
451 lines (451 loc) · 126 KB
Raw
ax.get_yaxis().set_visible(False)
ax.set_title("Reconstructed Image")
plt.show()
313/313 [==============================] - 1s 2ms/step
Original Image
Reconstructed Image
98°F Windy
ENG
1:43 PM
7/26/2023



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In [16]:

```
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
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# 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)

autoencoder.fit(x_train_noisy, x_train,
                epochs=10,
```

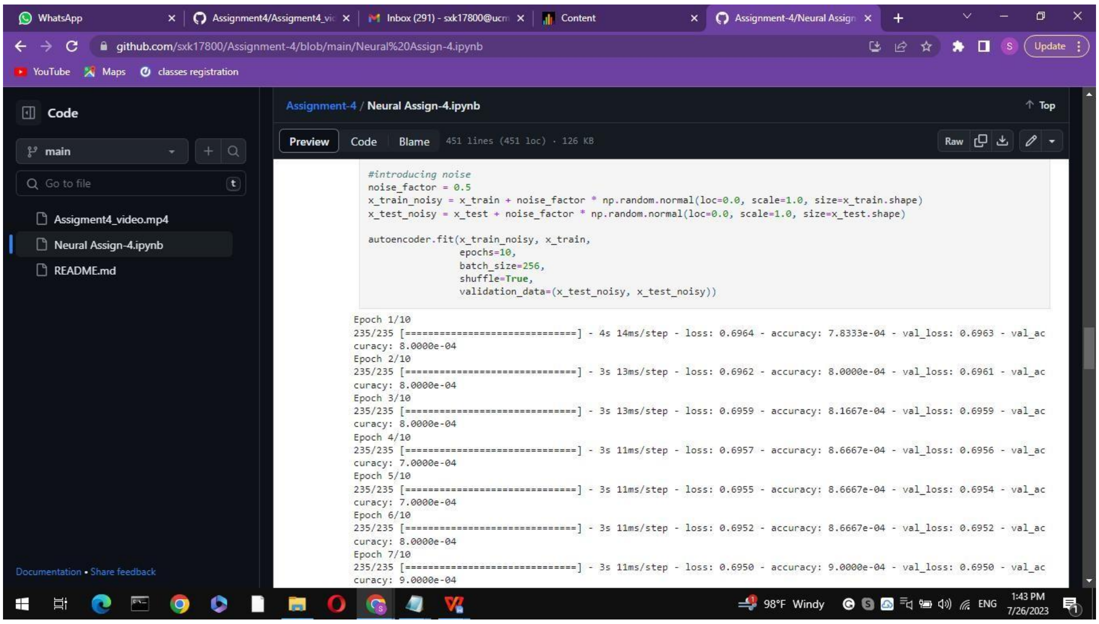

Assignment-4 / Neural Assign-4.ipynb

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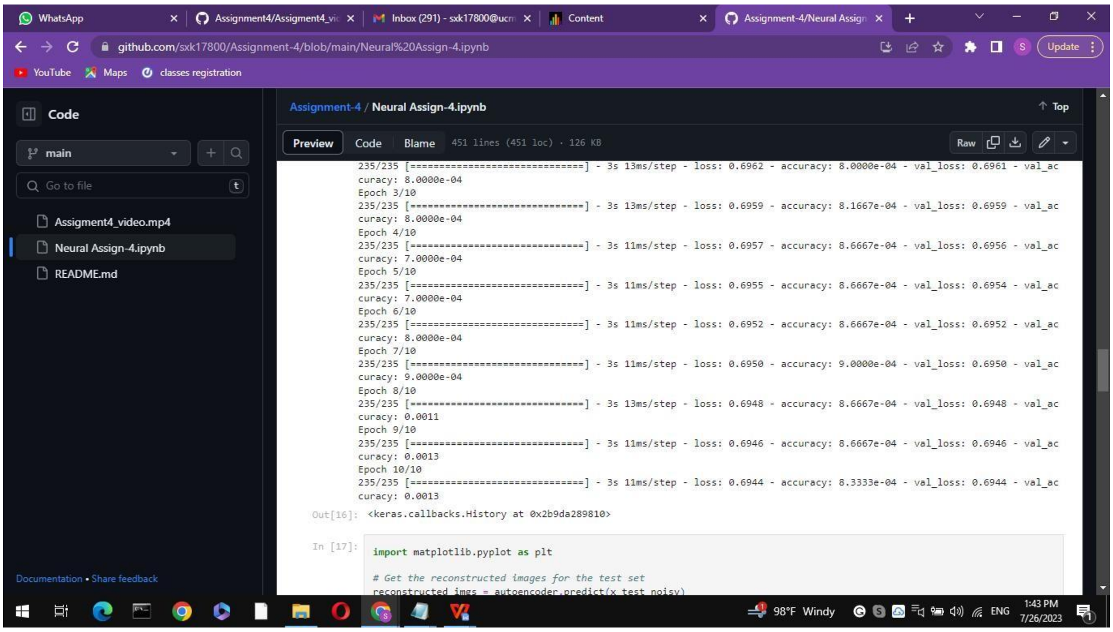
```
#introducing noise
noise_factor = 0.5
x_train_noisy = x_train + noise_factor * np.random.normal(loc=0.0, scale=1.0, size=x_train.shape)
x_test_noisy = x_test + noise_factor * np.random.normal(loc=0.0, scale=1.0, size=x_test.shape)

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 [==============================] - 4s 14ms/step - loss: 0.6964 - accuracy: 7.8333e-04 - val_loss: 0.6963 - val_ac
curacy: 8.0000e-04
Epoch 2/10
235/235 [==============================] - 3s 13ms/step - loss: 0.6962 - accuracy: 8.0000e-04 - val_loss: 0.6961 - val_ac
curacy: 8.0000e-04
Epoch 3/10
235/235 [==============================] - 3s 13ms/step - loss: 0.6959 - accuracy: 8.1667e-04 - val_loss: 0.6959 - val_ac
curacy: 8.0000e-04
Epoch 4/10
235/235 [==============================] - 3s 11ms/step - loss: 0.6957 - accuracy: 8.6667e-04 - val_loss: 0.6956 - val_ac
curacy: 7.0000e-04
Epoch 5/10
235/235 [==============================] - 3s 11ms/step - loss: 0.6955 - accuracy: 8.6667e-04 - val_loss: 0.6954 - val_ac
curacy: 7.0000e-04
Epoch 6/10
235/235 [==============================] - 3s 11ms/step - loss: 0.6952 - accuracy: 8.6667e-04 - val_loss: 0.6952 - val_ac
curacy: 8.0000e-04
Epoch 7/10
235/235 [==============================] - 3s 11ms/step - loss: 0.6950 - accuracy: 9.0000e-04 - val_loss: 0.6950 - val_ac
curacy: 9.0000e-04
```



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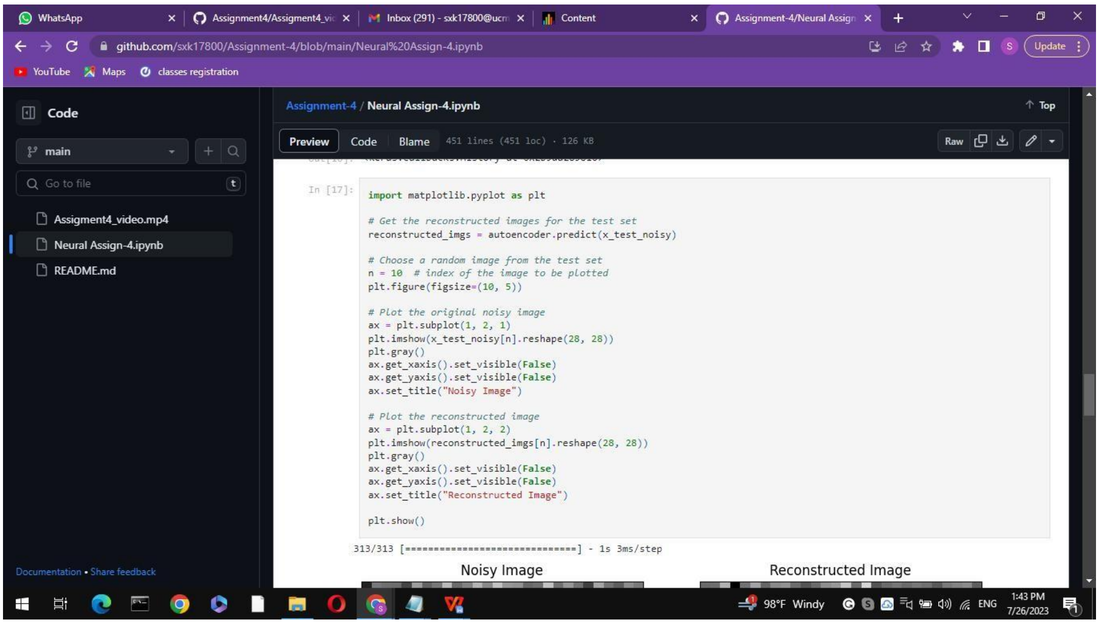
```
235/235 [==============================] - 3s 13ms/step - loss: 0.6962 - accuracy: 8.0000e-04 - val_loss: 0.6961 - val_ac
curacy: 8.0000e-04
Epoch 3/10
235/235 [==============================] - 3s 13ms/step - loss: 0.6959 - accuracy: 8.1667e-04 - val_loss: 0.6959 - val_ac
curacy: 8.0000e-04
Epoch 4/10
235/235 [==============================] - 3s 11ms/step - loss: 0.6957 - accuracy: 8.6667e-04 - val_loss: 0.6956 - val_ac
curacy: 7.0000e-04
Epoch 5/10
235/235 [==============================] - 3s 11ms/step - loss: 0.6955 - accuracy: 8.6667e-04 - val_loss: 0.6954 - val_ac
curacy: 7.0000e-04
Epoch 6/10
235/235 [==============================] - 3s 11ms/step - loss: 0.6952 - accuracy: 8.6667e-04 - val_loss: 0.6952 - val_ac
curacy: 8.0000e-04
Epoch 7/10
235/235 [==============================] - 3s 11ms/step - loss: 0.6950 - accuracy: 9.0000e-04 - val_loss: 0.6950 - val_ac
curacy: 9.0000e-04
Epoch 8/10
235/235 [==============================] - 3s 13ms/step - loss: 0.6948 - accuracy: 8.6667e-04 - val_loss: 0.6948 - val_ac
curacy: 0.0011
Epoch 9/10
235/235 [==============================] - 3s 11ms/step - loss: 0.6946 - accuracy: 8.6667e-04 - val_loss: 0.6946 - val_ac
curacy: 0.0013
Epoch 10/10
235/235 [==============================] - 3s 11ms/step - loss: 0.6944 - accuracy: 8.3333e-04 - val_loss: 0.6944 - val_ac
curacy: 0.0013
Out[16]: <keras.callbacks.History at 0x2b9da289810>
```

```
In [17]:
import matplotlib.pyplot as plt

# Get the reconstructed images for the test set
```



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```
In [17]:
import matplotlib.pyplot as plt

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

# Choose a random image from the test set
n = 10  # index of the image to be plotted
plt.figure(figsize=(10, 5))

# Plot the original noisy image
ax = plt.subplot(1, 2, 1)
plt.imshow(x_test_noisy[n].reshape(28, 28))
plt.gray()
ax.get_xaxis().set_visible(False)
ax.get_yaxis().set_visible(False)
ax.set_title("Noisy Image")

# Plot the reconstructed image
ax = plt.subplot(1, 2, 2)
plt.imshow(reconstructed_imgs[n].reshape(28, 28))
plt.gray()
ax.get_xaxis().set_visible(False)
ax.get_yaxis().set_visible(False)
ax.set_title("Reconstructed Image")

plt.show()
```

```
313/313 [==============================] - 1s 3ms/step
```

Noisy Image   Reconstructed Image

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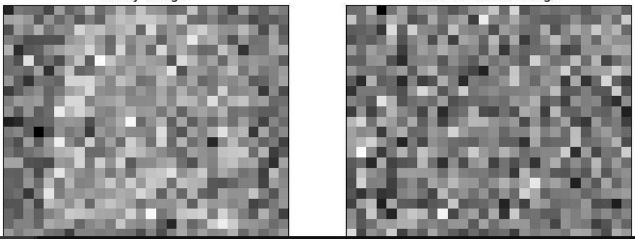
```
ax.set_title("Noisy Image")

# Plot the reconstructed image
ax = plt.subplot(1, 2, 2)
plt.imshow(reconstructed_imgs[n].reshape(28, 28))
plt.gray()
ax.get_xaxis().set_visible(False)
ax.get_yaxis().set_visible(False)
ax.set_title("Reconstructed Image")

plt.show()
```

```
313/313 [==============================] - 1s 3ms/step
```

Noisy Image Reconstructed Image



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In [18]:

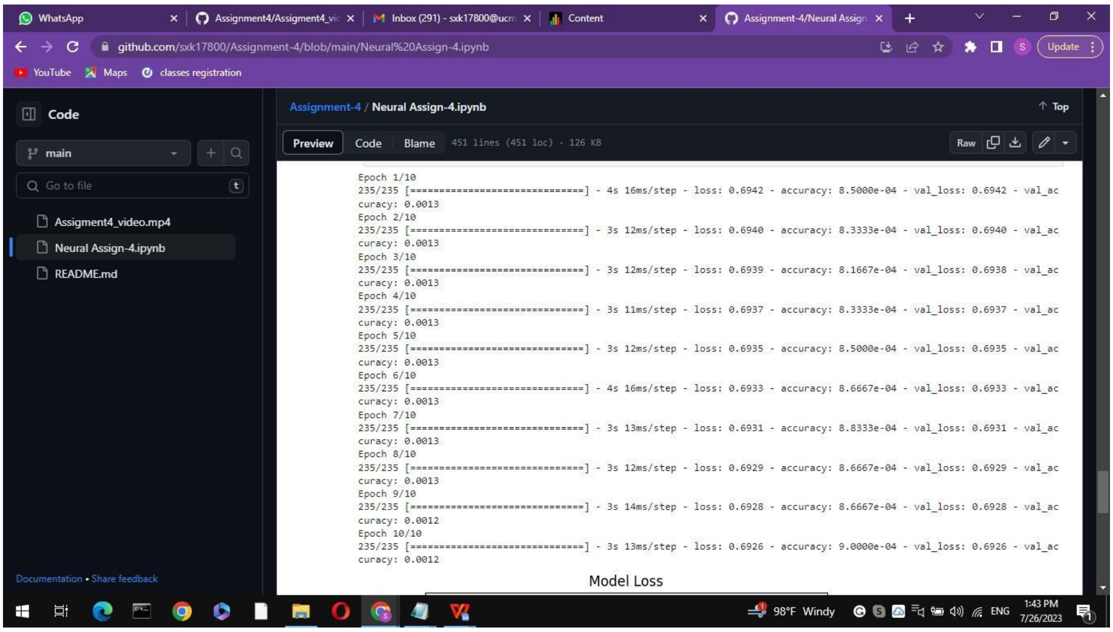
```
import matplotlib.pyplot as plt

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

# Plot the loss
plt.plot(history.history['loss'], label='train')
plt.plot(history.history['val_loss'], label='test')
plt.title('Model Loss')
plt.ylabel('Loss')
plt.xlabel('Epoch')
plt.legend()
plt.show()

# Plot the accuracy
plt.plot(history.history['accuracy'], label='train')
plt.plot(history.history['val_accuracy'], label='test')
plt.title('Model Accuracy')
plt.ylabel('Accuracy')
plt.xlabel('Epoch')
plt.legend()
plt.show()
```

```
Epoch 1/10
235/235 [==============================] - 4s 16ms/step - loss: 0.6942 - accuracy: 8.5000e-04 - val_loss: 0.6942 - val_ac
curacy: 0.0013
Epoch 2/10
```


github.com/sxk17800/Assignment-4/blob/main/Neural%20Assign-4.ipynb
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Code
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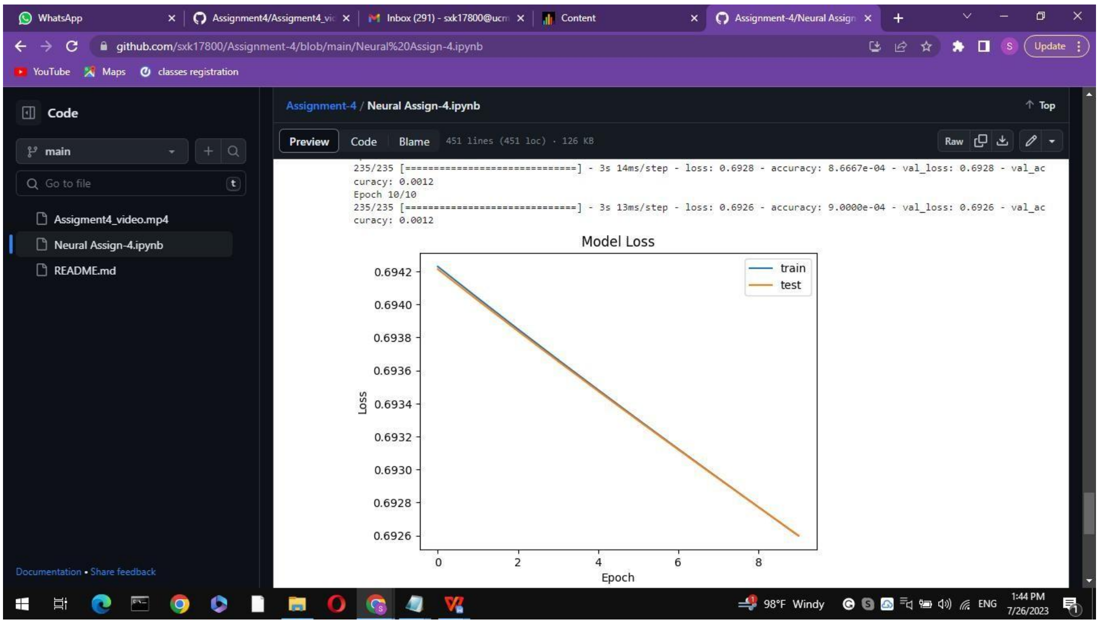
Raw
Epoch 1/10
235/235 [==============================] - 4s 16ms/step - loss: 0.6942 - accuracy: 8.5000e-04 - val_loss: 0.6942 - val_accuracy: 0.0013
Epoch 2/10
235/235 [==============================] - 3s 12ms/step - loss: 0.6940 - accuracy: 8.3333e-04 - val_loss: 0.6940 - val_accuracy: 0.0013
Epoch 3/10
235/235 [==============================] - 3s 12ms/step - loss: 0.6939 - accuracy: 8.1667e-04 - val_loss: 0.6938 - val_accuracy: 0.0013
Epoch 4/10
235/235 [==============================] - 3s 11ms/step - loss: 0.6937 - accuracy: 8.3333e-04 - val_loss: 0.6937 - val_accuracy: 0.0013
Epoch 5/10
235/235 [==============================] - 3s 12ms/step - loss: 0.6935 - accuracy: 8.5000e-04 - val_loss: 0.6935 - val_accuracy: 0.0013
Epoch 6/10
235/235 [==============================] - 4s 16ms/step - loss: 0.6933 - accuracy: 8.6667e-04 - val_loss: 0.6933 - val_accuracy: 0.0013
Epoch 7/10
235/235 [==============================] - 3s 13ms/step - loss: 0.6931 - accuracy: 8.8333e-04 - val_loss: 0.6931 - val_accuracy: 0.0013
Epoch 8/10
235/235 [==============================] - 3s 12ms/step - loss: 0.6929 - accuracy: 8.6667e-04 - val_loss: 0.6929 - val_accuracy: 0.0013
Epoch 9/10
235/235 [==============================] - 3s 14ms/step - loss: 0.6928 - accuracy: 8.6667e-04 - val_loss: 0.6928 - val_accuracy: 0.0012
Epoch 10/10
235/235 [==============================] - 3s 13ms/step - loss: 0.6926 - accuracy: 9.0000e-04 - val_loss: 0.6926 - val_accuracy: 0.0012
Model Loss
1:43 PM
7/26/2023


github.com/sxk17800/Assignment-4/blob/main/Neural%20Assign-4.ipynb
Assignment-4 / Neural Assign-4.ipynb
235/235 [==============================] - 3s 14ms/step - loss: 0.6928 - accuracy: 8.6667e-04 - val_loss: 0.6928 - val_accuracy: 0.0012
Epoch 10/10
235/235 [==============================] - 3s 13ms/step - loss: 0.6926 - accuracy: 9.0000e-04 - val_loss: 0.6926 - val_accuracy: 0.0012
Model Loss
train
test
Loss
Epoch
1:44 PM
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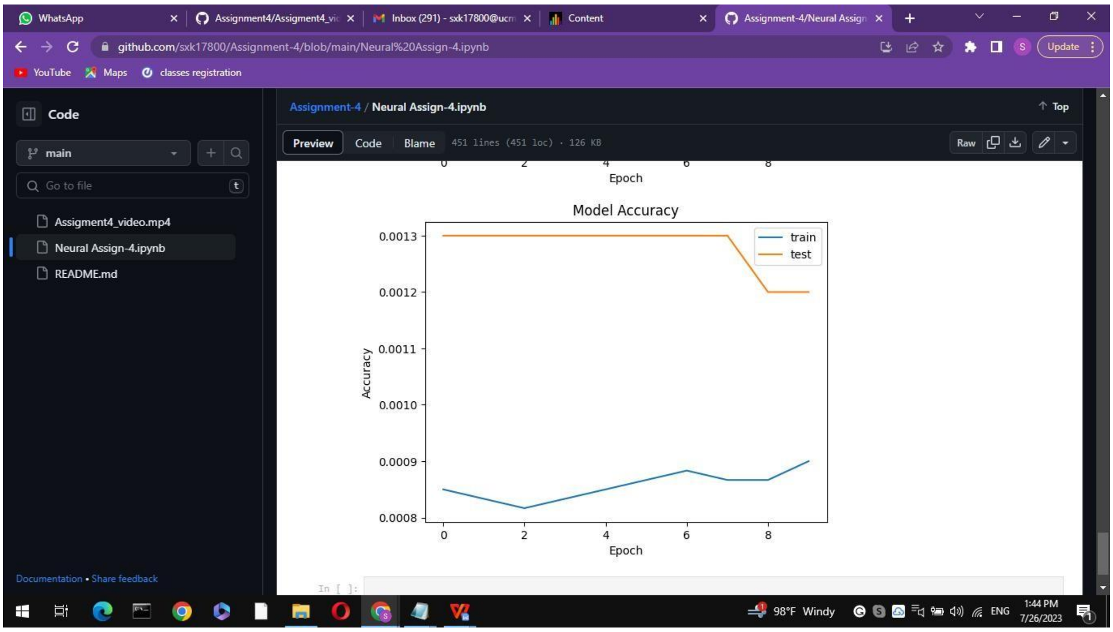
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Assignment4/Assigment4_vi
Inbox (291) - sxk17800@ucm
Content
Assignment-4/Neural Assign
github.com/sxk17800/Assignment-4/blob/main/Neural%20Assign-4.ipynb
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Model Accuracy
train
test
Accuracy
0.0013
0.0012
0.0011
0.0010
0.0009
0.0008
0
2
4
6
8
Epoch
In [ ]:
98°F Windy
ENG
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