Madhulika Dayal

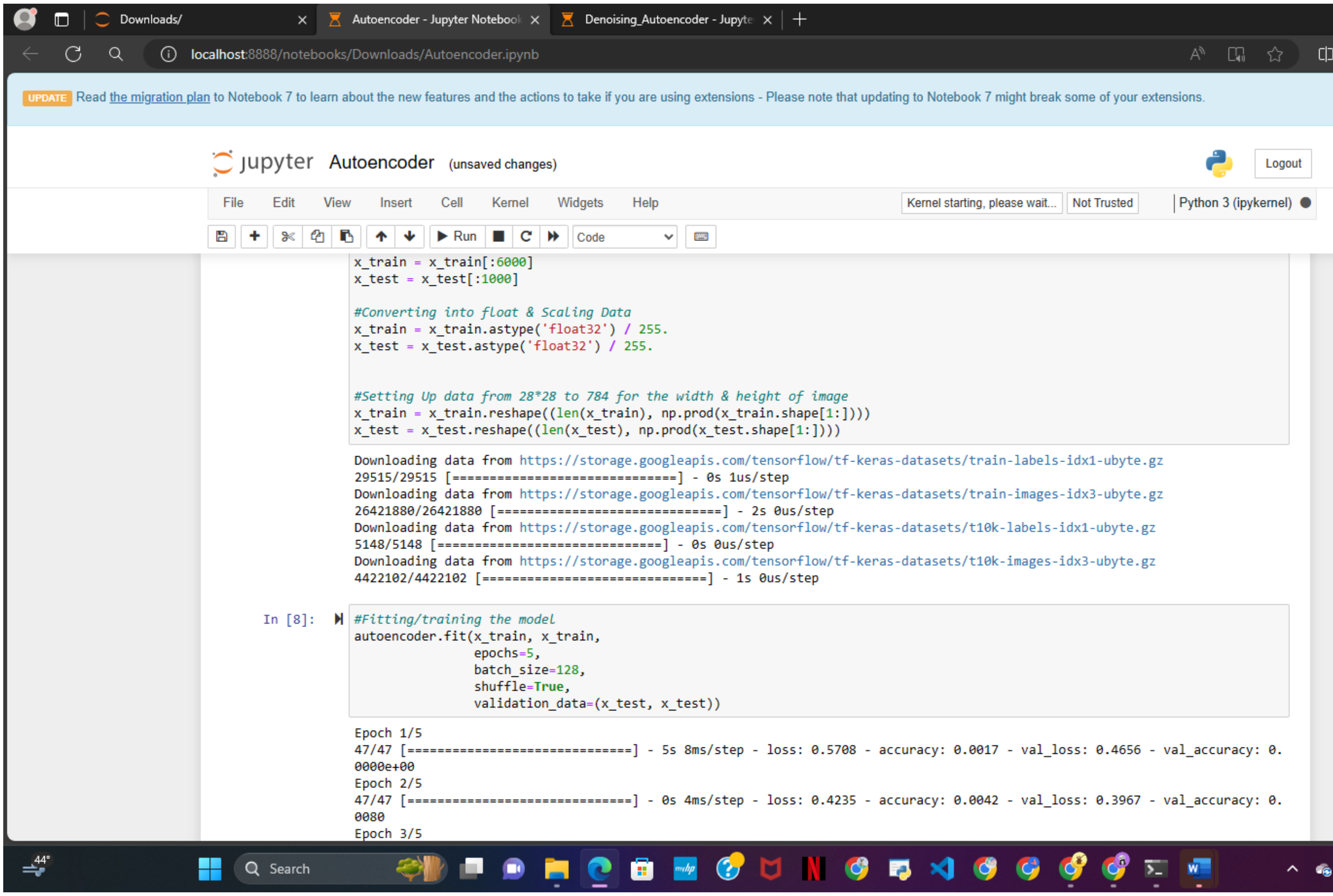
700743206

Assignment – 8

Github Link : https://github.com/Madhulika014/Assignment-8

Solution:

- These are the ouput screenshots of the following code: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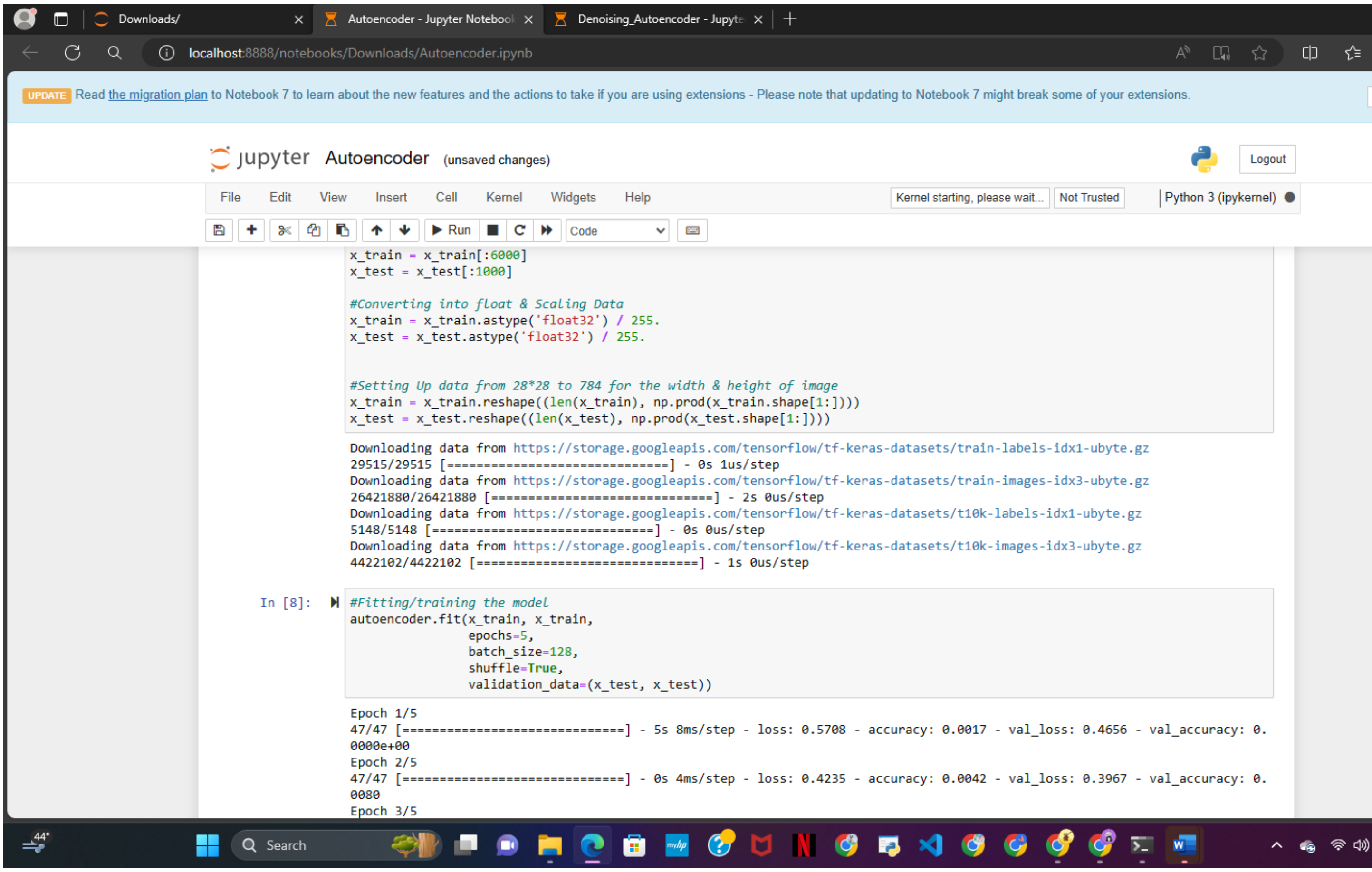
```
x_train = x_train[:6000]
x_test = x_test[:1000]

#Converting into float & Scaling Data
x_train = x_train.astype('float32') / 255.
x_test = x_test.astype('float32') / 255.


#Setting Up data from 28*28 to 784 for the width & height of image
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:])))
```

```
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/train-labels-idx1-ubyte.gz
29515/29515 [==============================] - 0s 1us/step
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/train-images-idx3-ubyte.gz
26421880/26421880 [==============================] - 2s 0us/step
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/t10k-labels-idx1-ubyte.gz
5148/5148 [==============================] - 0s 0us/step
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/t10k-images-idx3-ubyte.gz
4422102/4422102 [==============================] - 1s 0us/step
```

```
In [8]:  #Fitting/training the model
         autoencoder.fit(x_train, x_train,
                         epochs=5,
                         batch_size=128,
                         shuffle=True,
                         validation_data=(x_test, x_test))
```

```
Epoch 1/5
47/47 [==============================] - 5s 8ms/step - loss: 0.5708 - accuracy: 0.0017 - val_loss: 0.4656 - val_accuracy: 0.
0000e+00
Epoch 2/5
47/47 [==============================] - 0s 4ms/step - loss: 0.4235 - accuracy: 0.0042 - val_loss: 0.3967 - val_accuracy: 0.
0080
Epoch 3/5
```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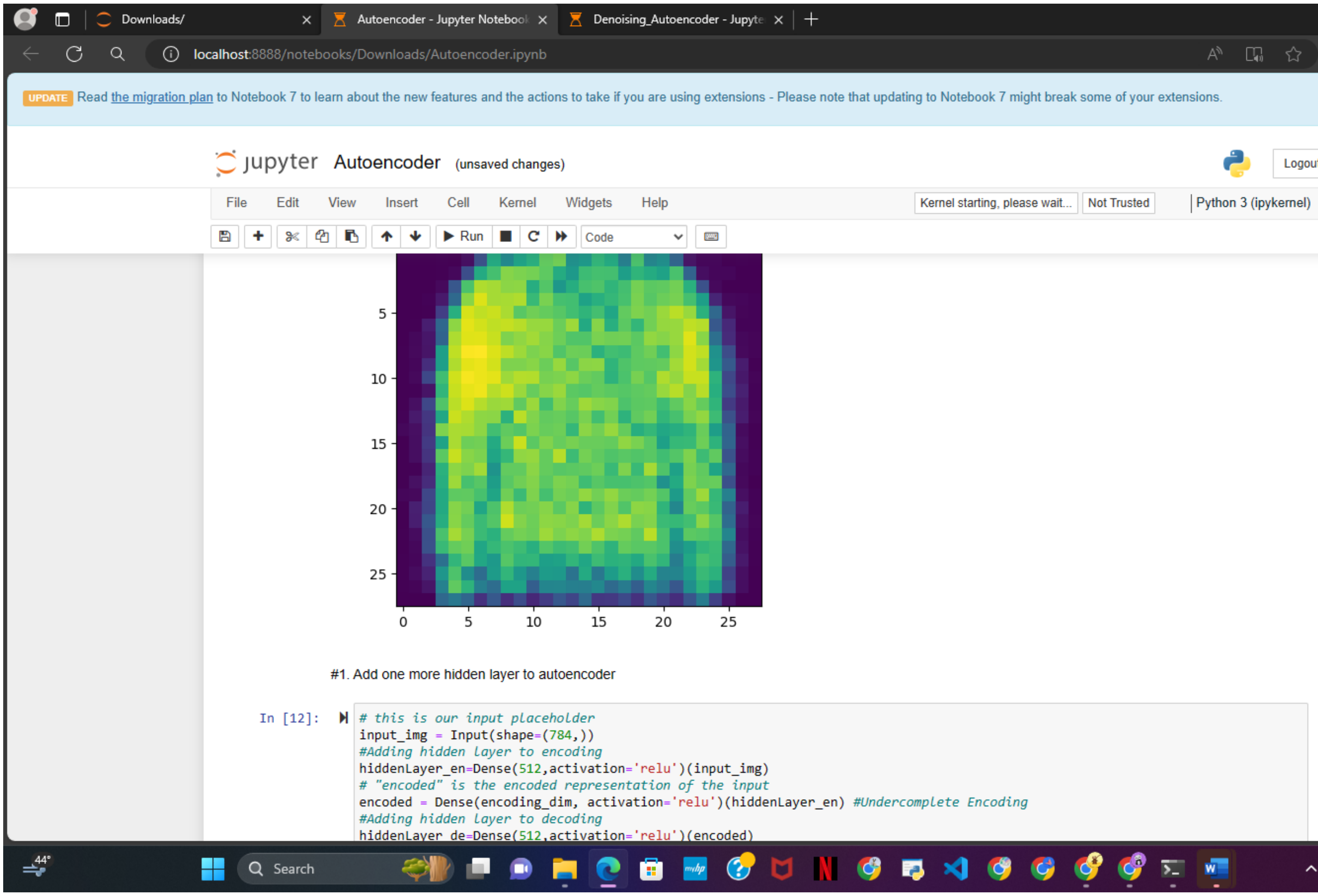
```
x_train = x_train[:6000]
x_test = x_test[:1000]

#Converting into float & Scaling Data
x_train = x_train.astype('float32') / 255.
x_test = x_test.astype('float32') / 255.


#Setting Up data from 28*28 to 784 for the width & height of image
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:])))
```

```
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/train-labels-idx1-ubyte.gz
29515/29515 [==============================] - 0s 1us/step
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/train-images-idx3-ubyte.gz
26421880/26421880 [==============================] - 2s 0us/step
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/t10k-labels-idx1-ubyte.gz
5148/5148 [==============================] - 0s 0us/step
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/t10k-images-idx3-ubyte.gz
4422102/4422102 [==============================] - 1s 0us/step
```

In [8]:

```
#Fitting/training the model
autoencoder.fit(x_train, x_train,
                epochs=5,
                batch_size=128,
                shuffle=True,
                validation_data=(x_test, x_test))
```

```
Epoch 1/5
47/47 [==============================] - 5s 8ms/step - loss: 0.5708 - accuracy: 0.0017 - val_loss: 0.4656 - val_accuracy: 0.
0000e+00
Epoch 2/5
47/47 [==============================] - 0s 4ms/step - loss: 0.4235 - accuracy: 0.0042 - val_loss: 0.3967 - val_accuracy: 0.
0080
Epoch 3/5
```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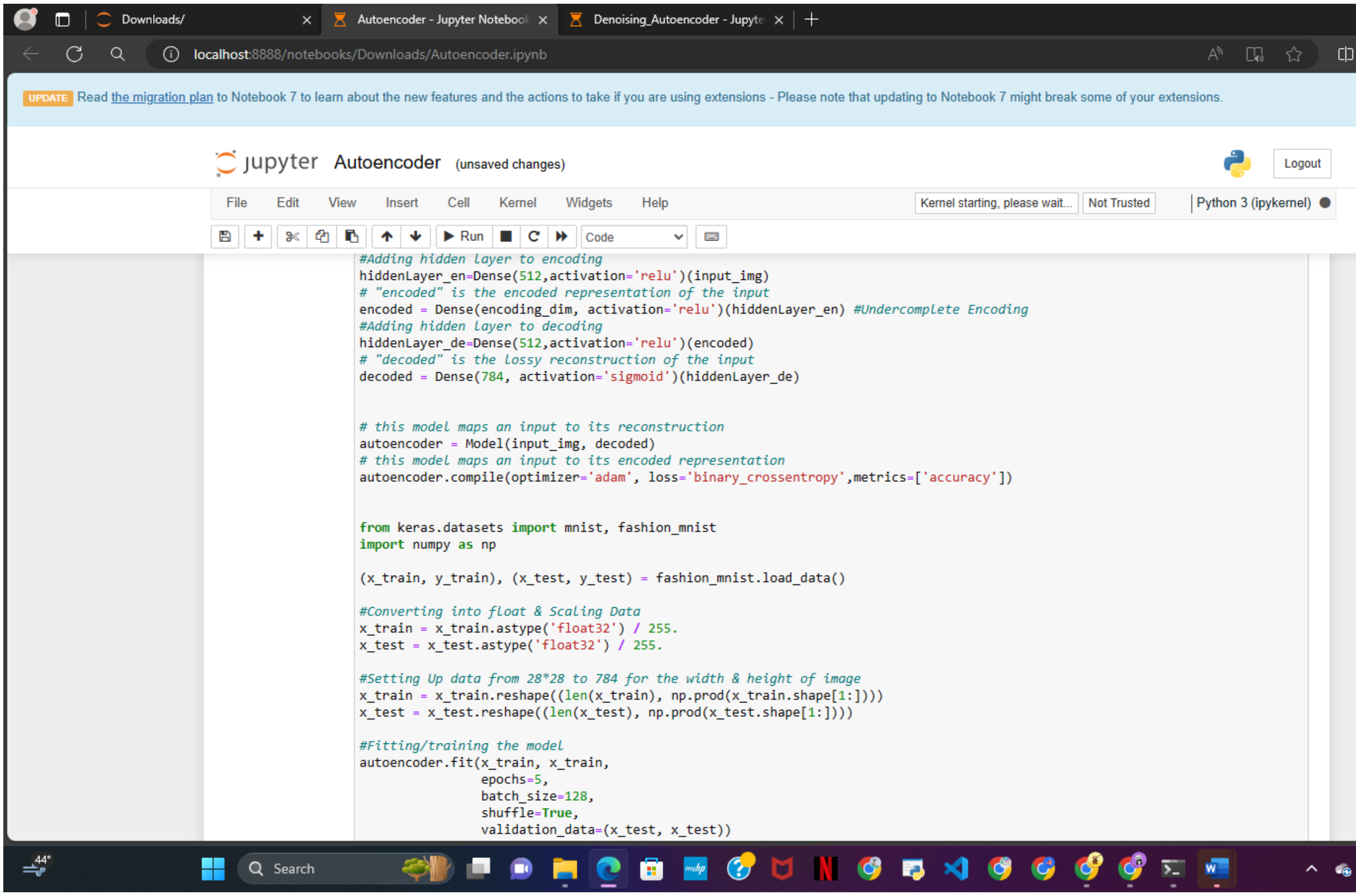
#1. Add one more hidden layer to autoencoder

In [12]:

```
# this is our input placeholder
input_img = Input(shape=(784,))
#Adding hidden layer to encoding
hiddenLayer_en=Dense(512,activation='relu')(input_img)
# "encoded" is the encoded representation of the input
encoded = Dense(encoding_dim, activation='relu')(hiddenLayer_en) #Undercomplete Encoding
#Adding hidden layer to decoding
hiddenLayer_de=Dense(512,activation='relu')(encoded)
```



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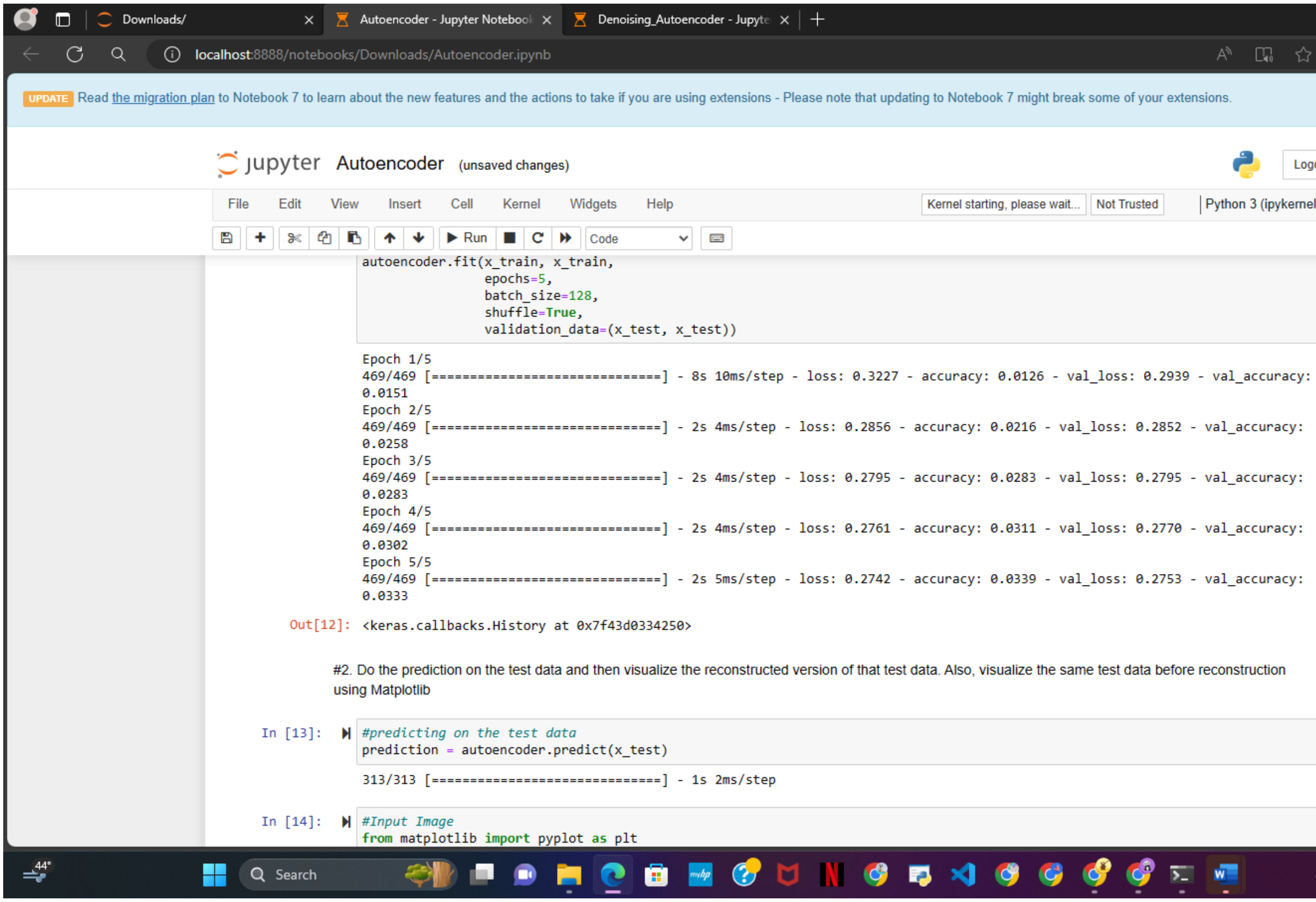
```
#Adding hidden layer to encoding
hiddenLayer_en=Dense(512,activation='relu')(input_img)
# "encoded" is the encoded representation of the input
encoded = Dense(encoding_dim, activation='relu')(hiddenLayer_en) #Undercomplete Encoding
#Adding hidden layer to decoding
hiddenLayer_de=Dense(512,activation='relu')(encoded)
# "decoded" is the lossy reconstruction of the input
decoded = Dense(784, activation='sigmoid')(hiddenLayer_de)


# 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='adam', 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()

#Converting into float & Scaling Data
x_train = x_train.astype('float32') / 255.
x_test = x_test.astype('float32') / 255.

#Setting Up data from 28*28 to 784 for the width & height of image
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:])))

#Fitting/training the model
autoencoder.fit(x_train, x_train,
                epochs=5,
                batch_size=128,
                shuffle=True,
                validation_data=(x_test, x_test))
```



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```
autoencoder.fit(x_train, x_train,
                epochs=5,
                batch_size=128,
                shuffle=True,
                validation_data=(x_test, x_test))
```

```
Epoch 1/5
469/469 [==============================] - 8s 10ms/step - loss: 0.3227 - accuracy: 0.0126 - val_loss: 0.2939 - val_accuracy:
0.0151
Epoch 2/5
469/469 [==============================] - 2s 4ms/step - loss: 0.2856 - accuracy: 0.0216 - val_loss: 0.2852 - val_accuracy:
0.0258
Epoch 3/5
469/469 [==============================] - 2s 4ms/step - loss: 0.2795 - accuracy: 0.0283 - val_loss: 0.2795 - val_accuracy:
0.0283
Epoch 4/5
469/469 [==============================] - 2s 4ms/step - loss: 0.2761 - accuracy: 0.0311 - val_loss: 0.2770 - val_accuracy:
0.0302
Epoch 5/5
469/469 [==============================] - 2s 5ms/step - loss: 0.2742 - accuracy: 0.0339 - val_loss: 0.2753 - val_accuracy:
0.0333
```

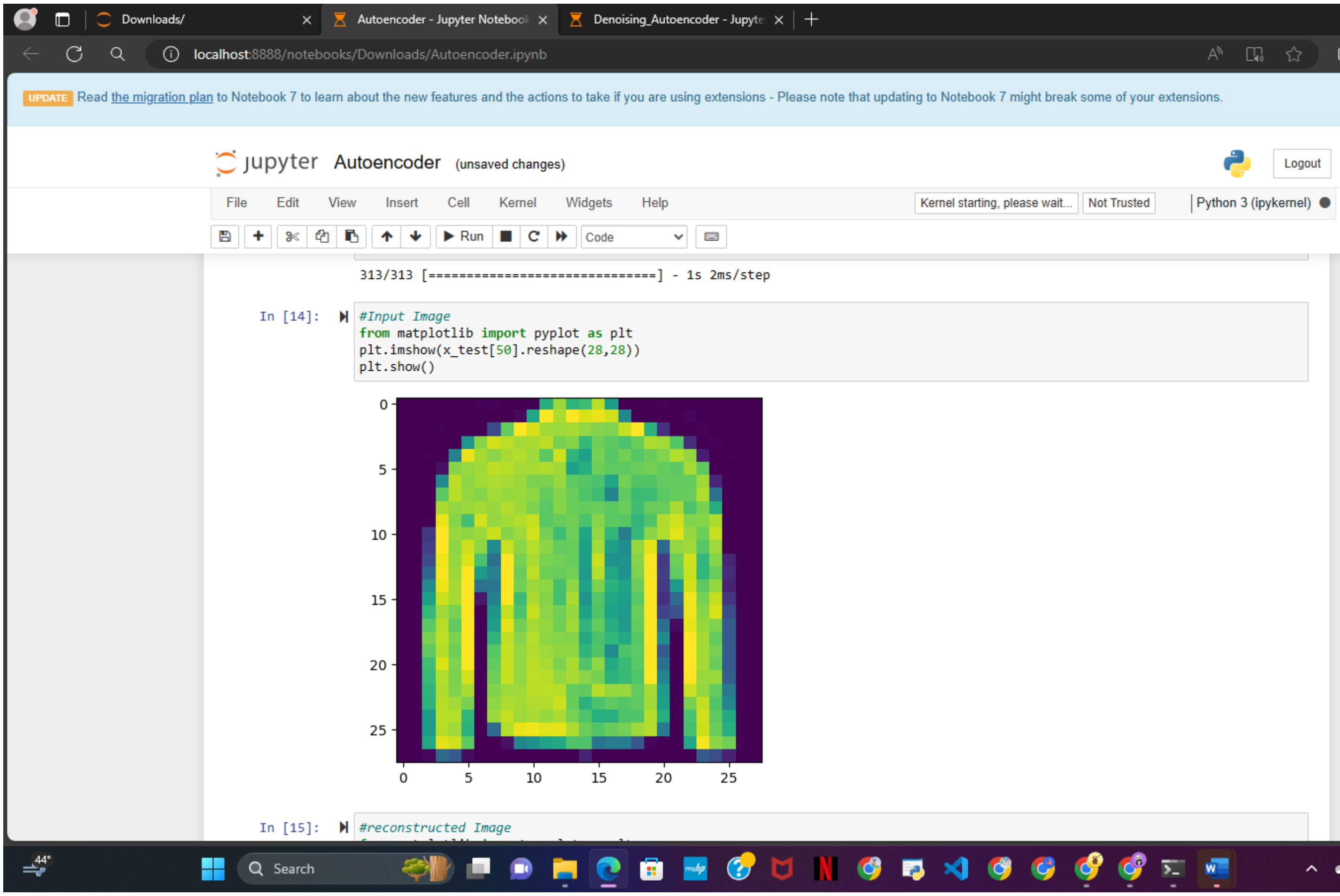
```
Out[12]: <keras.callbacks.History at 0x7f43d0334250>
```

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

```
In [13]: #predicting on the test data
         prediction = autoencoder.predict(x_test)
```

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

```
In [14]: #Input Image
         from matplotlib import pyplot as plt
```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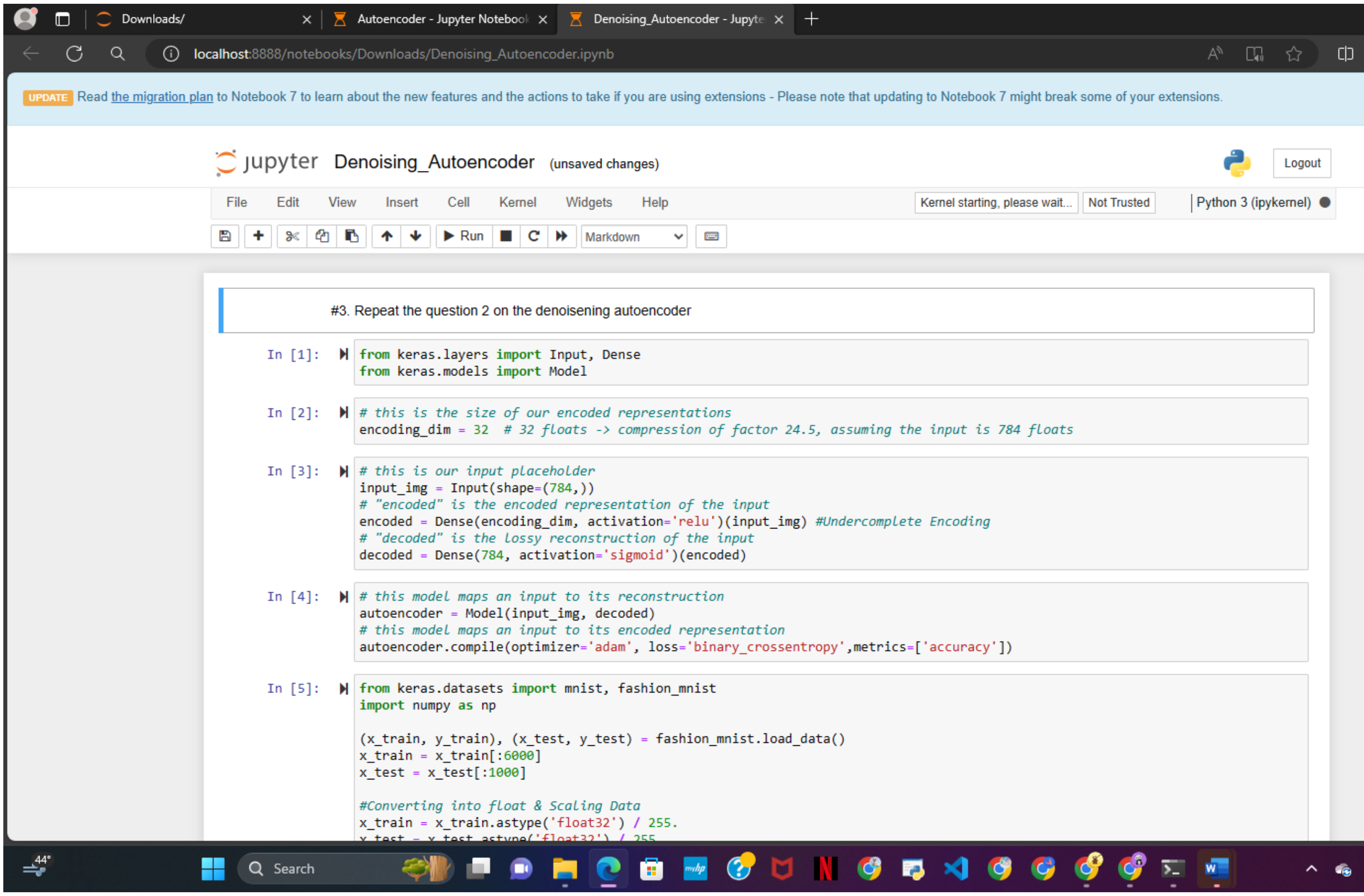
```
313/313 [==============================] - 1s 2ms/step
```

In [14]:

```
#Input Image
from matplotlib import pyplot as plt
plt.imshow(x_test[50].reshape(28,28))
plt.show()
```

In [15]:

```
#reconstructed Image
```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#3. Repeat the question 2 on the denoisening autoencoder

In [1]:
```
from keras.layers import Input, Dense
from keras.models import Model
```

In [2]:
```
# this is the size of our encoded representations
encoding_dim = 32  # 32 floats -> compression of factor 24.5, assuming the input is 784 floats
```

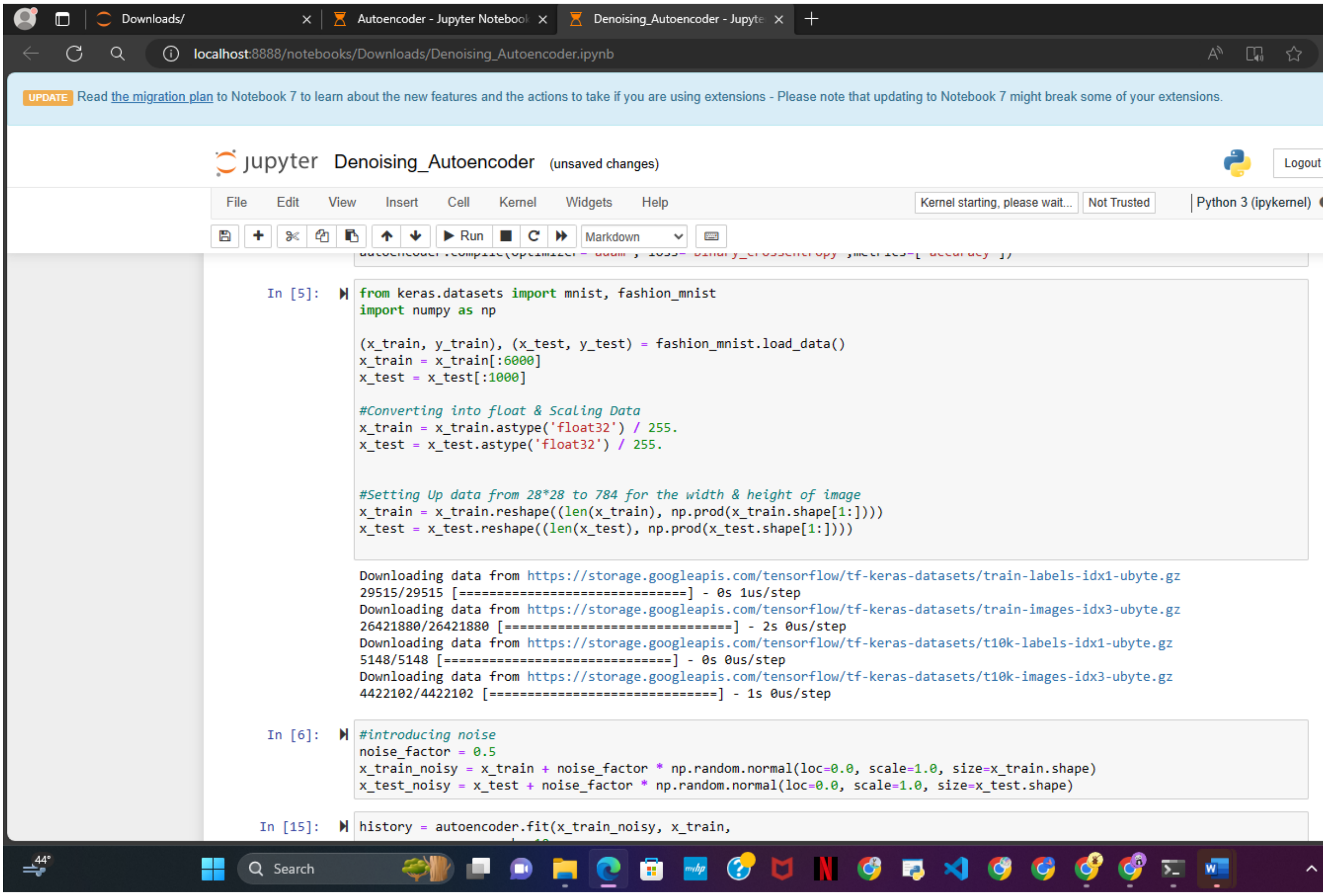
In [3]:
```
# this is our input placeholder
input_img = Input(shape=(784,))
# "encoded" is the encoded representation of the input
encoded = Dense(encoding_dim, activation='relu')(input_img) #Undercomplete Encoding
# "decoded" is the lossy reconstruction of the input
decoded = Dense(784, activation='sigmoid')(encoded)
```

In [4]:
```
# 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='adam', loss='binary_crossentropy',metrics=['accuracy'])
```

In [5]:
```
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[:6000]
x_test = x_test[:1000]

#Converting into float & Scaling Data
x_train = x_train.astype('float32') / 255.
x_test = x_test.astype('float32') / 255
```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```
autoencoder.compile(optimizer='adam', loss='binary_crossentropy',metrics=['accuracy'])
```

In [5]:

```
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[:6000]
x_test = x_test[:1000]

#Converting into float & Scaling Data
x_train = x_train.astype('float32') / 255.
x_test = x_test.astype('float32') / 255.


#Setting Up data from 28*28 to 784 for the width & height of image
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:])))
```

```
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/train-labels-idx1-ubyte.gz
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Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/train-images-idx3-ubyte.gz
26421880/26421880 [==============================] - 2s 0us/step
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/t10k-labels-idx1-ubyte.gz
5148/5148 [==============================] - 0s 0us/step
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/t10k-images-idx3-ubyte.gz
4422102/4422102 [==============================] - 1s 0us/step
```
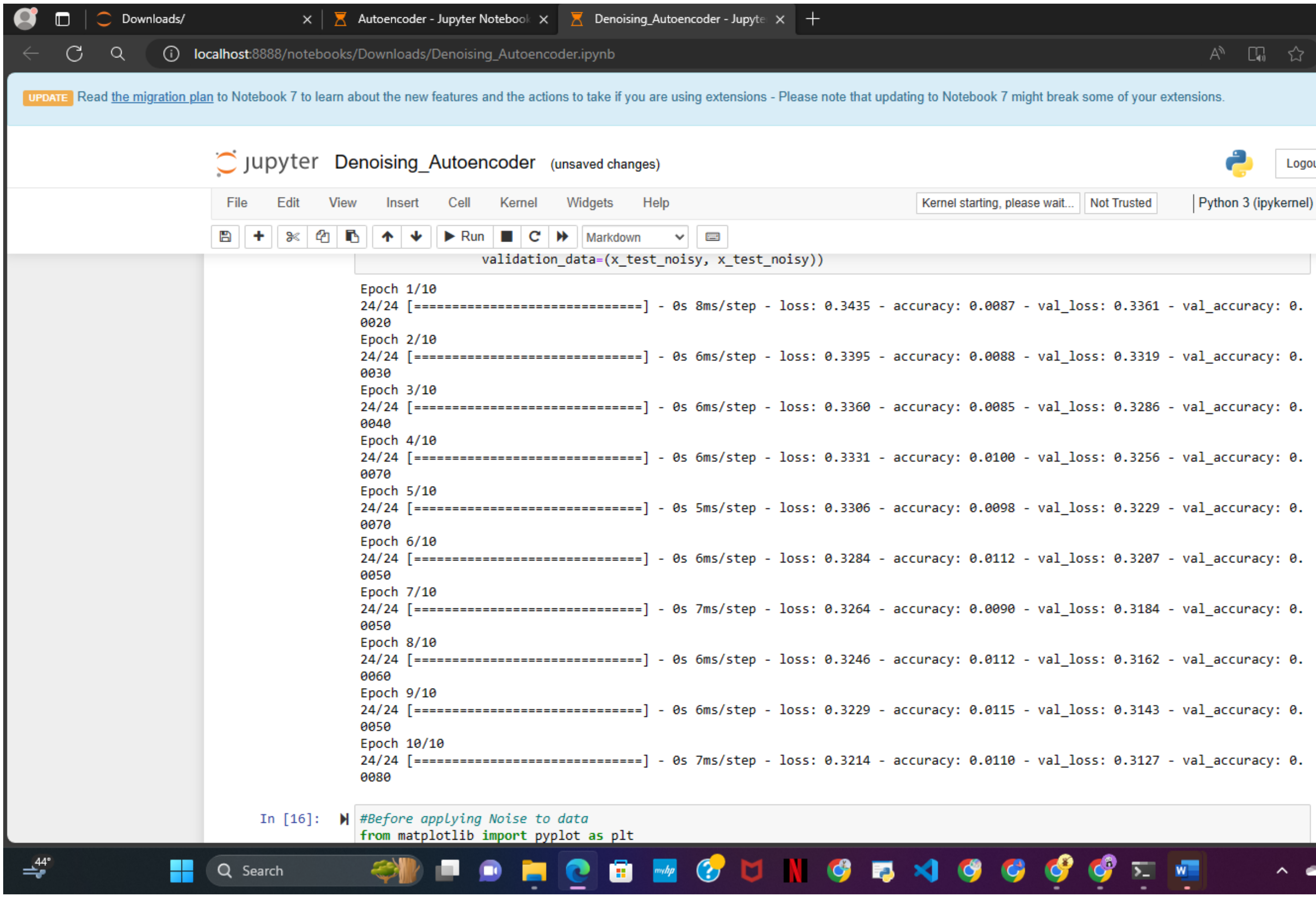

In [6]:

```
#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)
```

In [15]:

```
history = autoencoder.fit(x_train_noisy, x_train,
```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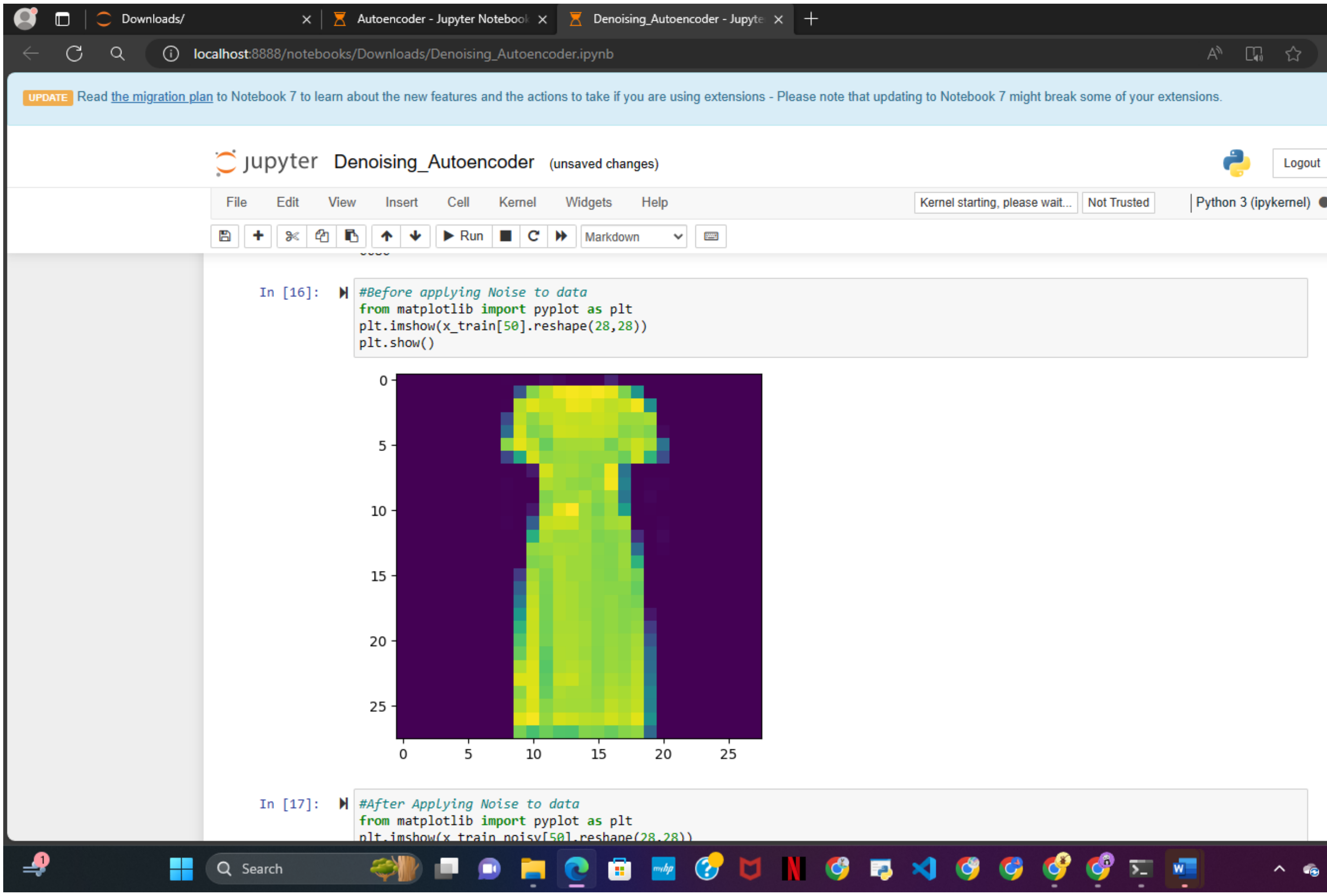
Denoising_Autoencoder (unsaved changes)

```
                validation_data=(x_test_noisy, x_test_noisy))
```

```
Epoch 1/10
24/24 [==============================] - 0s 8ms/step - loss: 0.3435 - accuracy: 0.0087 - val_loss: 0.3361 - val_accuracy: 0.
0020
Epoch 2/10
24/24 [==============================] - 0s 6ms/step - loss: 0.3395 - accuracy: 0.0088 - val_loss: 0.3319 - val_accuracy: 0.
0030
Epoch 3/10
24/24 [==============================] - 0s 6ms/step - loss: 0.3360 - accuracy: 0.0085 - val_loss: 0.3286 - val_accuracy: 0.
0040
Epoch 4/10
24/24 [==============================] - 0s 6ms/step - loss: 0.3331 - accuracy: 0.0100 - val_loss: 0.3256 - val_accuracy: 0.
0070
Epoch 5/10
24/24 [==============================] - 0s 5ms/step - loss: 0.3306 - accuracy: 0.0098 - val_loss: 0.3229 - val_accuracy: 0.
0070
Epoch 6/10
24/24 [==============================] - 0s 6ms/step - loss: 0.3284 - accuracy: 0.0112 - val_loss: 0.3207 - val_accuracy: 0.
0050
Epoch 7/10
24/24 [==============================] - 0s 7ms/step - loss: 0.3264 - accuracy: 0.0090 - val_loss: 0.3184 - val_accuracy: 0.
0050
Epoch 8/10
24/24 [==============================] - 0s 6ms/step - loss: 0.3246 - accuracy: 0.0112 - val_loss: 0.3162 - val_accuracy: 0.
0060
Epoch 9/10
24/24 [==============================] - 0s 6ms/step - loss: 0.3229 - accuracy: 0.0115 - val_loss: 0.3143 - val_accuracy: 0.
0050
Epoch 10/10
24/24 [==============================] - 0s 7ms/step - loss: 0.3214 - accuracy: 0.0110 - val_loss: 0.3127 - val_accuracy: 0.
0080
```

```
In [16]:  #Before applying Noise to data
          from matplotlib import pyplot as plt
```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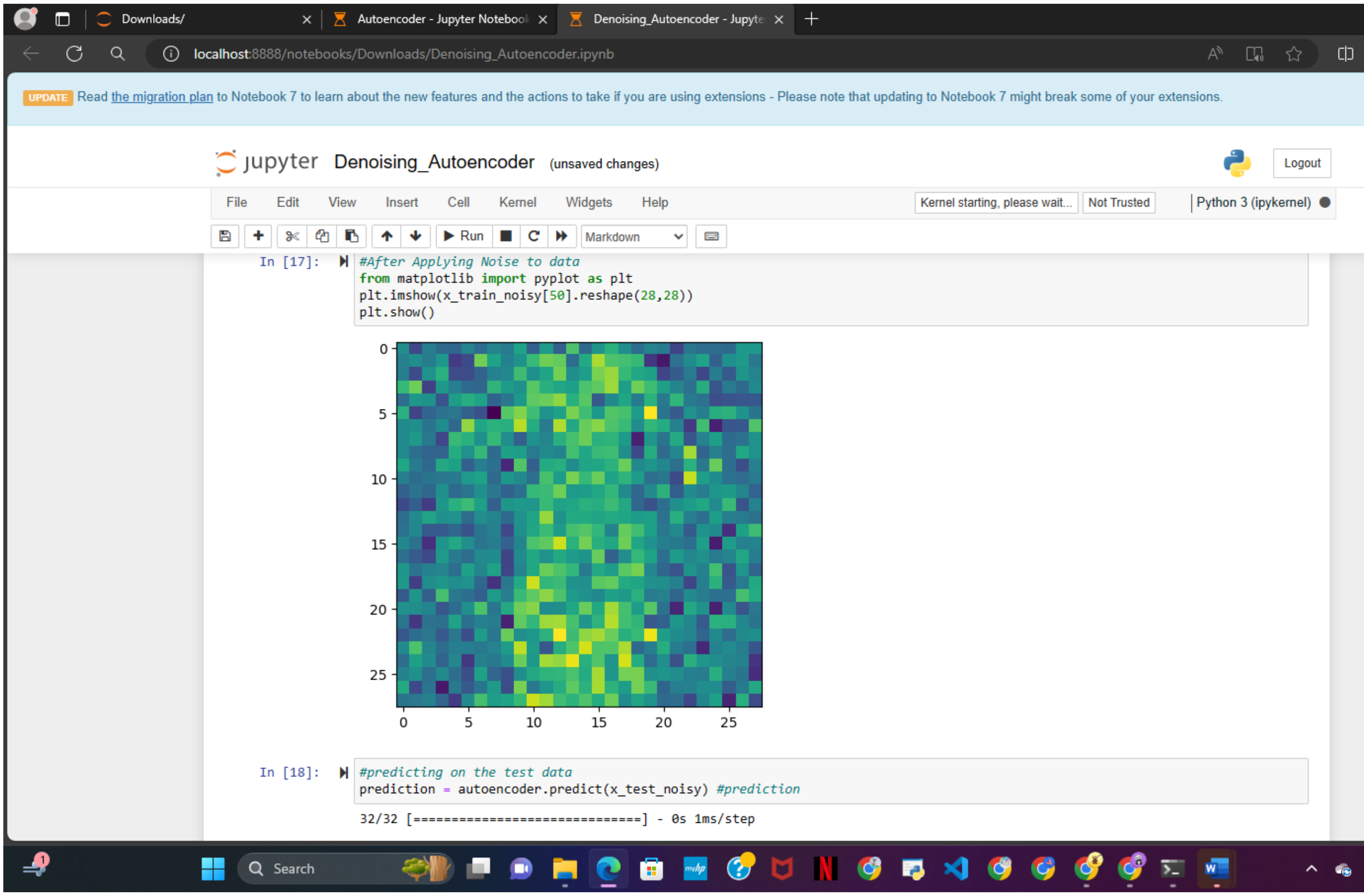
In [16]:

```
#Before applying Noise to data
from matplotlib import pyplot as plt
plt.imshow(x_train[50].reshape(28,28))
plt.show()
```

In [17]:

```
#After Applying Noise to data
from matplotlib import pyplot as plt
plt.imshow(x_train_noisy[50].reshape(28,28))
```



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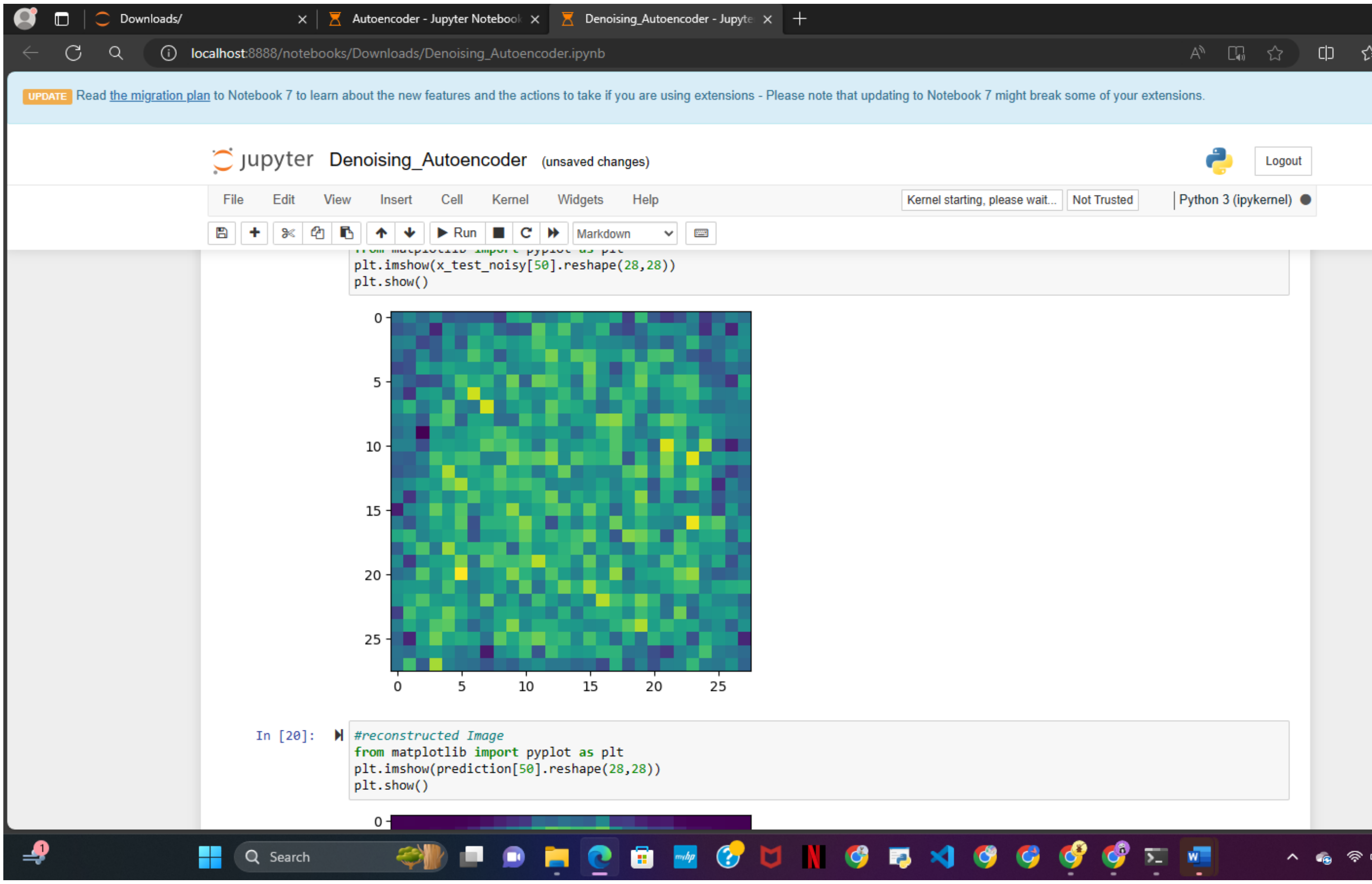
In [17]:

```
#After Applying Noise to data
from matplotlib import pyplot as plt
plt.imshow(x_train_noisy[50].reshape(28,28))
plt.show()
```

In [18]:

```
#predicting on the test data
prediction = autoencoder.predict(x_test_noisy) #prediction
```

```
32/32 [==============================] - 0s 1ms/step
```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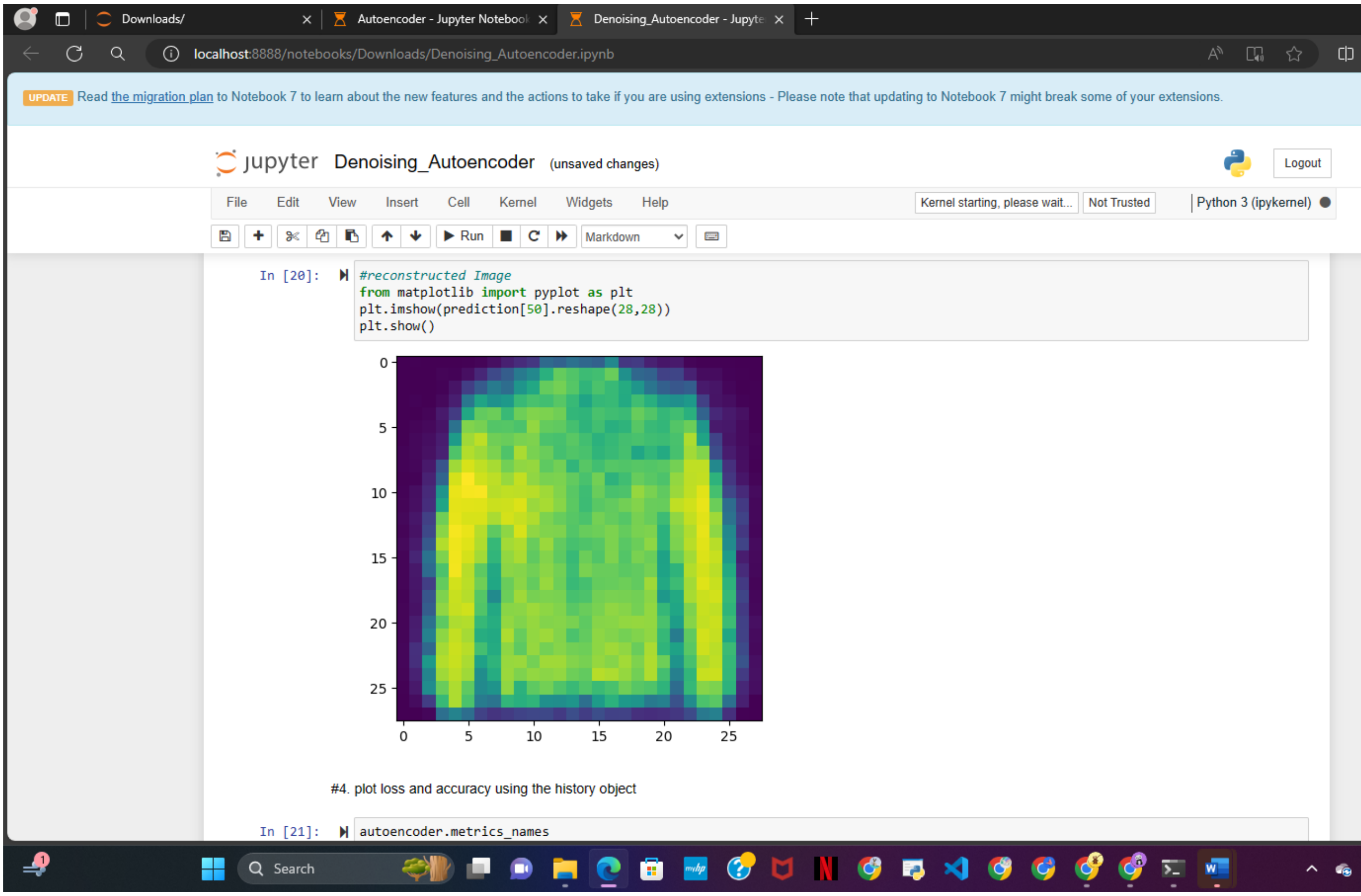
```
from matplotlib import pyplot as plt
plt.imshow(x_test_noisy[50].reshape(28,28))
plt.show()
```

In [20]:

```
#reconstructed Image
from matplotlib import pyplot as plt
plt.imshow(prediction[50].reshape(28,28))
plt.show()
```



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Denoising_Autoencoder (unsaved changes)

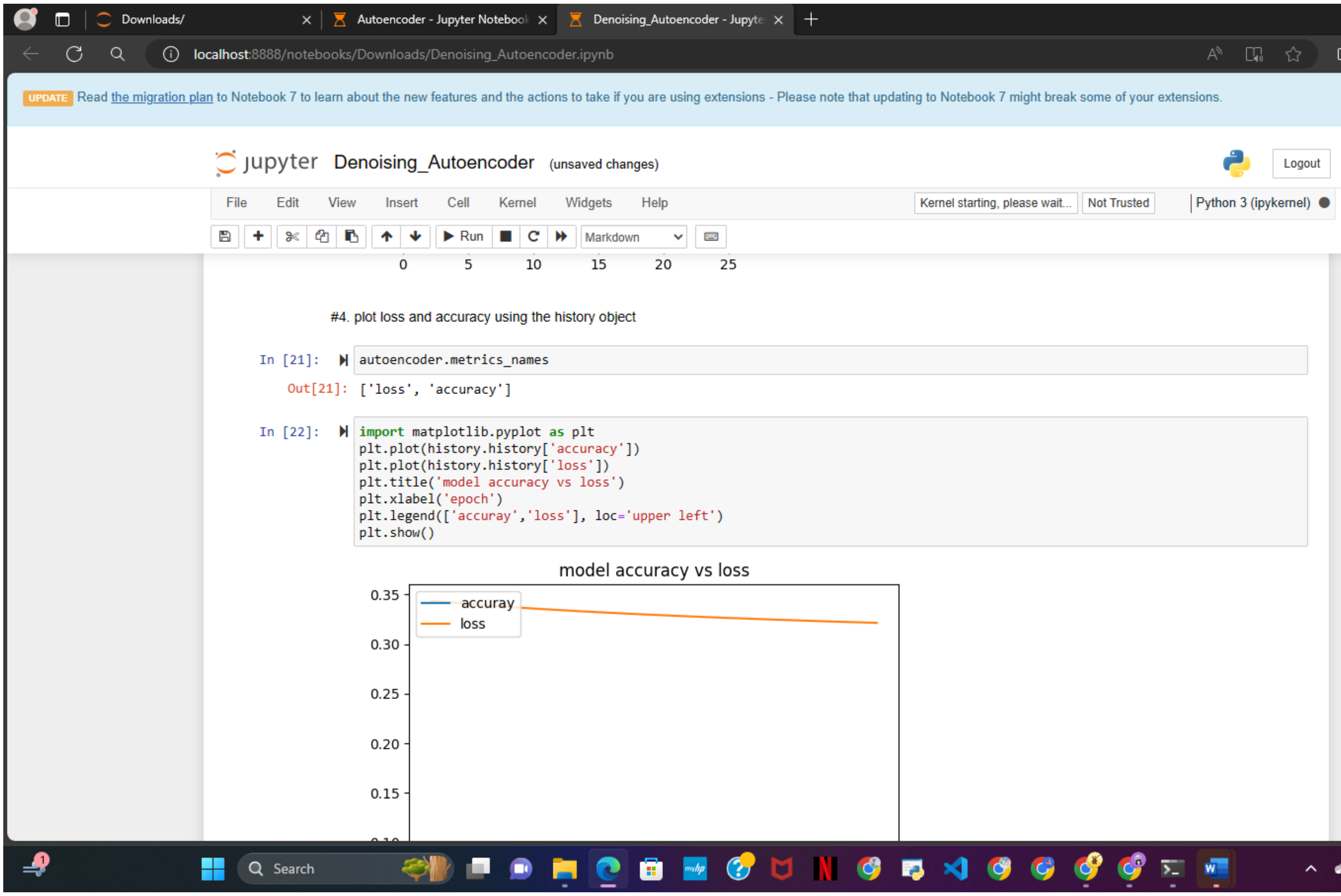
In [20]:

```
#reconstructed Image
from matplotlib import pyplot as plt
plt.imshow(prediction[50].reshape(28,28))
plt.show()
```

#4. plot loss and accuracy using the history object

In [21]:

```
autoencoder.metrics_names
```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Denoising_Autoencoder - Jupyte
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UPDATE Read the migration plan to Notebook 7 to learn about the new features and the actions to take if you are using extensions - Please note that updating to Notebook 7 might break some of your extensions.

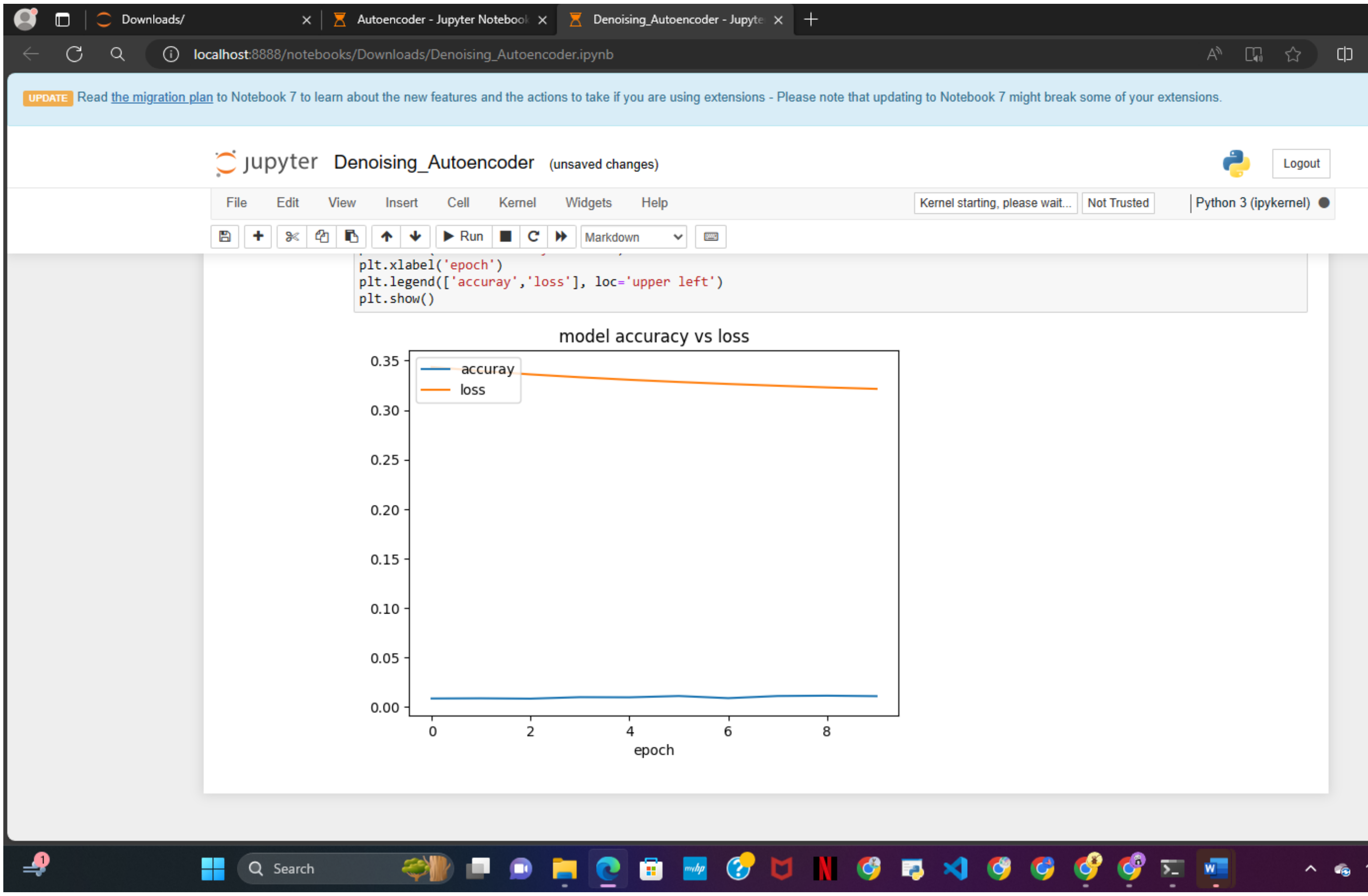
Denoising_Autoencoder (unsaved changes)

#4. plot loss and accuracy using the history object

In [21]:
```
autoencoder.metrics_names
```

Out[21]:
```
['loss', 'accuracy']
```

In [22]:
```
import matplotlib.pyplot as plt
plt.plot(history.history['accuracy'])
plt.plot(history.history['loss'])
plt.title('model accuracy vs loss')
plt.xlabel('epoch')
plt.legend(['accuray','loss'], loc='upper left')
plt.show()
```



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Denoising_Autoencoder - Jupyter
localhost:8888/notebooks/Downloads/Denoising_Autoencoder.ipynb

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```
plt.xlabel('epoch')
plt.legend(['accuray','loss'], loc='upper left')
plt.show()
```

model accuracy vs loss
accuray
loss
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
2
4
6
8
epoch
Search