Task 1:

```
[10] 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,))
```

```
[19] encoded = Dense(128, activation='relu')(input_img)
     encoded = Dense(64, activation='relu')(encoded)
     # "encoded" is the encoded representation of the input
     encoded = Dense(encoding_dim, activation='relu')(encoded)
     # "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)
```

```
[20] # this model maps an input to its encoded representation
     autoencoder.compile(optimizer='adadelta', loss='binary_crossentropy')
```

```
[21] 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))
```

```
Train on 60000 samples, validate on 10000 samples
Epoch 1/5
60000/60000 [==============================] - 3s 48us/step - loss: 0.5275 - val_loss: 0.4324
Epoch 2/5
60000/60000 [==============================] - 3s 49us/step - loss: 0.3911 - val_loss: 0.3793
Epoch 3/5
60000/60000 [==============================] - 3s 47us/step - loss: 0.3701 - val_loss: 0.3640
Epoch 4/5
60000/60000 [==============================] - 3s 48us/step - loss: 0.3577 - val_loss: 0.3518
Epoch 5/5
60000/60000 [==============================] - 3s 46us/step - loss: 0.3446 - val_loss: 0.3408
<keras.callbacks.callbacks.History at 0x7efd5618cd68>
```

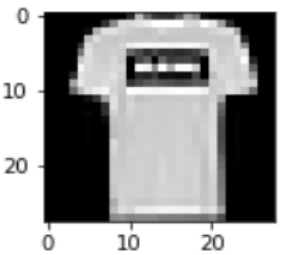
```
[28] prediction = autoencoder.predict(x_test)
```

```
[45] from matplotlib import pyplot as plt
     plt.figure(figsize=(5, 2))
     plt.imshow(x_train[1].reshape(28,28))
     plt.gray()
     plt.show()
```

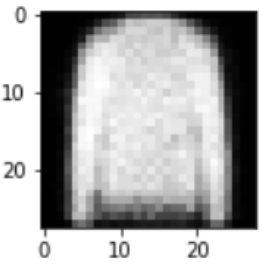
Task 2:

```
prediction = autoencoder.predict(x_test)
```

```
[45] from matplotlib import pyplot as plt
     plt.figure(figsize=(5, 2))
     plt.imshow(x_train[1].reshape(28,28))
     plt.gray()
     plt.show()
```



```
[46] from matplotlib import pyplot as plt
     plt.figure(figsize=(5, 2))
     plt.imshow(prediction[1].reshape(28,28))
     plt.gray()
     plt.show()
```



Task 3:

```
[1] 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)
```

```
Using TensorFlow backend.
```

```
[2] # this model maps an input to its encoded representation
    autoencoder.compile(optimizer='adadelta', loss='binary_crossentropy')
    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:])))
```

```
[2] Downloading data from http://fashion-mnist.s3-website.eu-central-1.amazonaws.com/train-labels-idx1-ubyte.gz
    32768/29515 [==============================] - 0s 3us/step
    Downloading data from http://fashion-mnist.s3-website.eu-central-1.amazonaws.com/train-images-idx3-ubyte.gz
    26427392/26421880 [==============================] - 2s 0us/step
    Downloading data from http://fashion-mnist.s3-website.eu-central-1.amazonaws.com/t10k-labels-idx1-ubyte.gz
    8192/5148 [===============================================] - 0s 0us/step
    Downloading data from http://fashion-mnist.s3-website.eu-central-1.amazonaws.com/t10k-images-idx3-ubyte.gz
    4423680/4422102 [==============================] - 1s 0us/step
```

```
[14] ENCODE_DIR = os.getcwd()
     tensorboard = TensorBoard(log_dir='ENCODE_DIR', histogram_freq=0,
                               write_graph=True, write_images=False)
```

```
[15] from tensorboardcolab import TensorBoardColabCallback
     tbc=TensorBoardColab()

     #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)
```

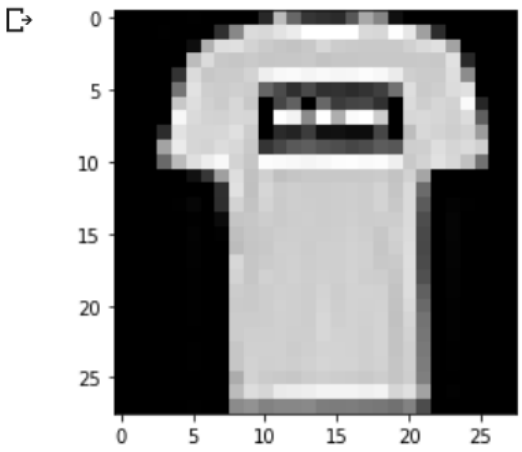
```
    Wait for 8 seconds...
    TensorBoard link:
    https://3bae3650.ngrok.io
```

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

```
    Train on 60000 samples, validate on 10000 samples
    Epoch 1/10
    60000/60000 [==============================] - 3s 44us/step - loss: 0.3318 - val_loss: 0.3169
    Epoch 2/10
    60000/60000 [==============================] - 3s 43us/step - loss: 0.3287 - val_loss: 0.3134
    Epoch 3/10
    60000/60000 [==============================] - 3s 42us/step - loss: 0.3261 - val_loss: 0.3105
    Epoch 4/10
    60000/60000 [==============================] - 3s 43us/step - loss: 0.3239 - val_loss: 0.3079
    Epoch 5/10
    60000/60000 [==============================] - 3s 43us/step - loss: 0.3221 - val_loss: 0.3057
    Epoch 6/10
    60000/60000 [==============================] - 3s 44us/step - loss: 0.3206 - val_loss: 0.3038
    Epoch 7/10
    60000/60000 [==============================] - 3s 44us/step - loss: 0.3193 - val_loss: 0.3022
    Epoch 8/10
    60000/60000 [==============================] - 3s 44us/step - loss: 0.3183 - val_loss: 0.3006
    Epoch 9/10
    60000/60000 [==============================] - 3s 43us/step - loss: 0.3173 - val_loss: 0.2992
    Epoch 10/10
    60000/60000 [==============================] - 3s 43us/step - loss: 0.3165 - val_loss: 0.2979
```

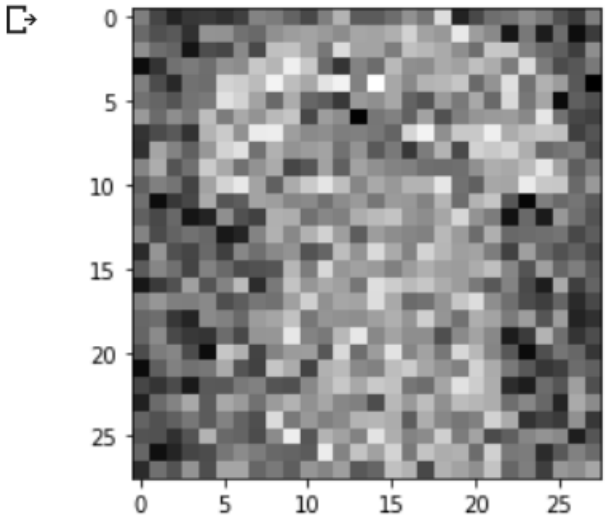
```
prediction = autoencoder.predict(x_test_noisy)
```

```
[19] from matplotlib import pyplot as plt
     plt.imshow(x_train[1].reshape(28,28))
     plt.gray()
     plt.show()
```



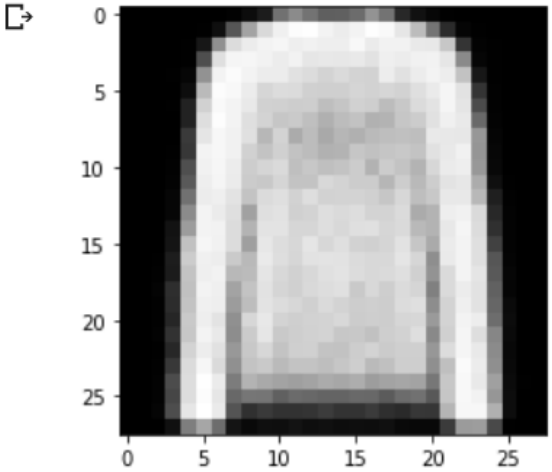

```
[20] from matplotlib import pyplot as plt
     plt.imshow(x_train_noisy[1].reshape(28,28))
     plt.show()
```

```
[20] from matplotlib import pyplot as plt
     plt.imshow(x_train_noisy[1].reshape(28,28))
     plt.show()
```




```
[21] from matplotlib import pyplot as plt
     plt.imshow(prediction[1].reshape(28,28))
     plt.show()
```


```
[21] from matplotlib import pyplot as plt
     plt.imshow(prediction[1].reshape(28,28))
     plt.show()
```

Task 4:

```
[22] plt.plot(history.history['loss'], 'r', linewidth=3.0)
     plt.plot(history.history['val_loss'], 'b', linewidth=3.0)
     plt.legend(['Training loss', 'Validation Loss'], fontsize=18)
     plt.xlabel('Epochs ', fontsize=16)
     plt.ylabel('Loss', fontsize=16)
     plt.title('Loss Curves : ', fontsize=16)
```

```
Text(0.5, 1.0, 'Loss Curves : ')
```