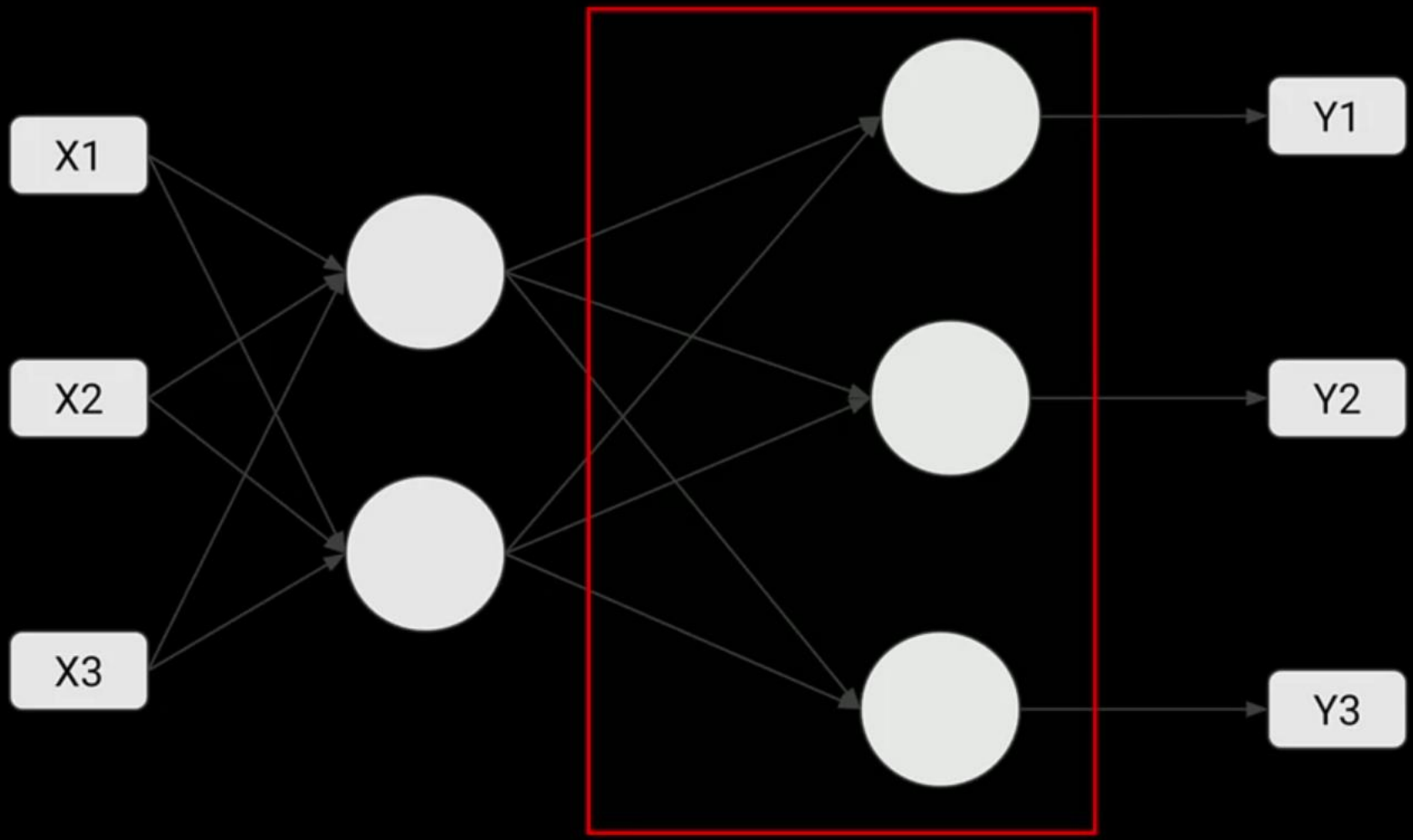
What are AutoEncoders?

- Neural networks capable of learning dense representations of input data without supervision
  - Training data is not labelled
- Useful for dimensionality reduction and for visualization
- Can be used to generate new data that resembles input data
- In practice they
  - Copy input to output
  - They learn efficient ways to represent data

83 12 21 42 99 18 51

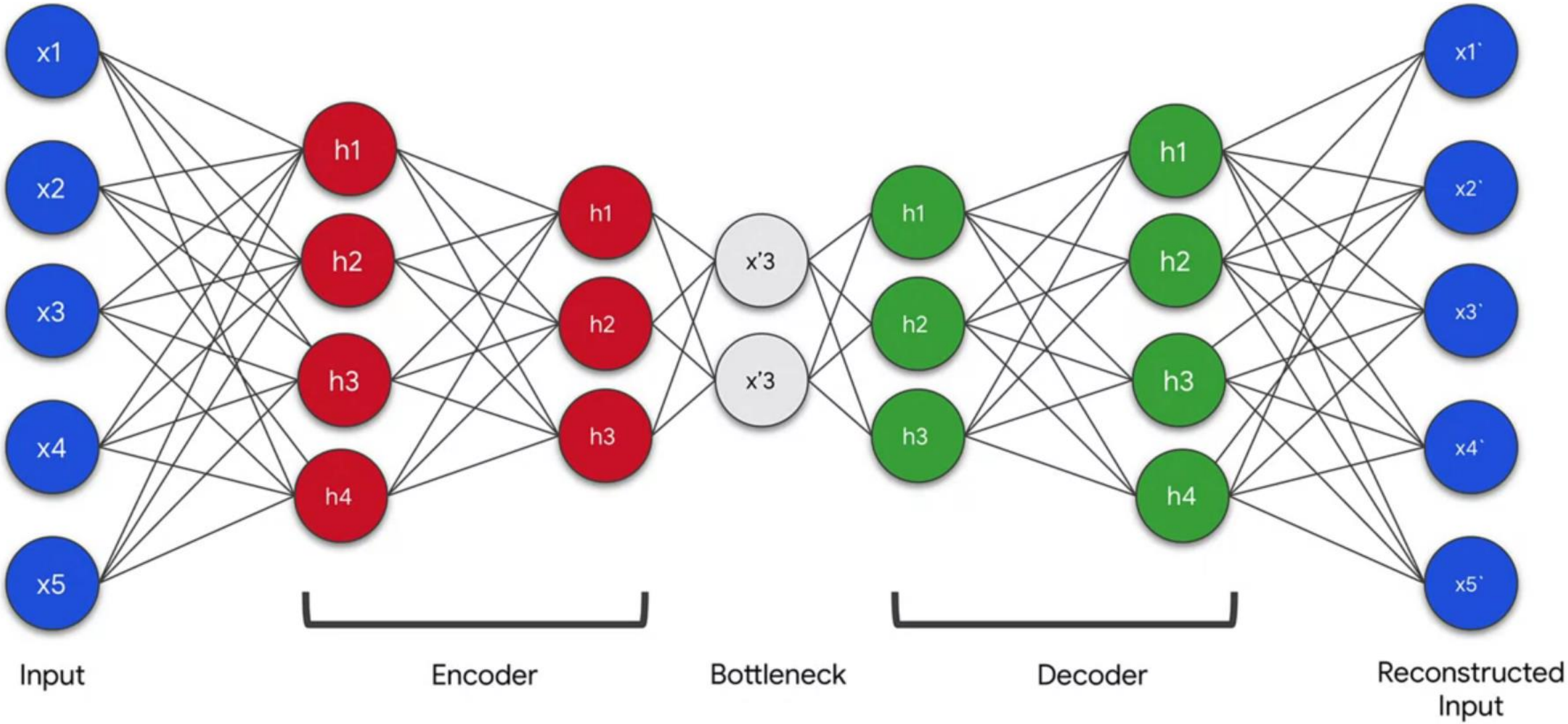
4 9 16 25 36 49 64 81 100 121 144 169

```
encoder = keras.models.Sequential([keras.layers.Dense(2, input_shape=[3])])
decoder = keras.models.Sequential([keras.layers.Dense(3, input_shape=[2])])
autoencoder = keras.models.Sequential([encoder, decoder])
autoencoder.compile(loss="mse", optimizer=keras.optimizers.SGD(lr=1.5))
```

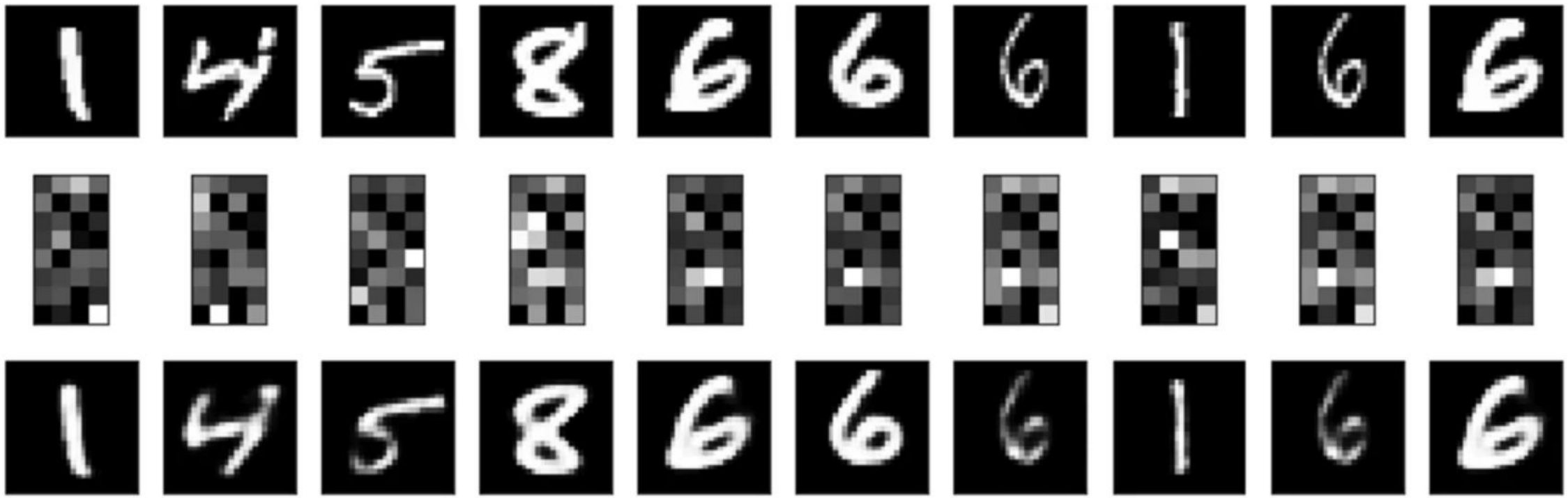


```
inputs =  tf.keras.layers.Input(shape=(784,))

def simple_autoencoder():
    encoder = tf.keras.layers.Dense(units=32, activation='relu')(inputs)
    decoder = tf.keras.layers.Dense(units=784, activation='sigmoid')(encoder)
    return encoder, decoder

encoder_output, decoder_output = simple_autoencoder()

encoder_model = tf.keras.Model(inputs=inputs, outputs=encoder_output)

autoencoder_model = tf.keras.Model(inputs=inputs, outputs=decoder_output)
```

Stacked Auto-Encoders



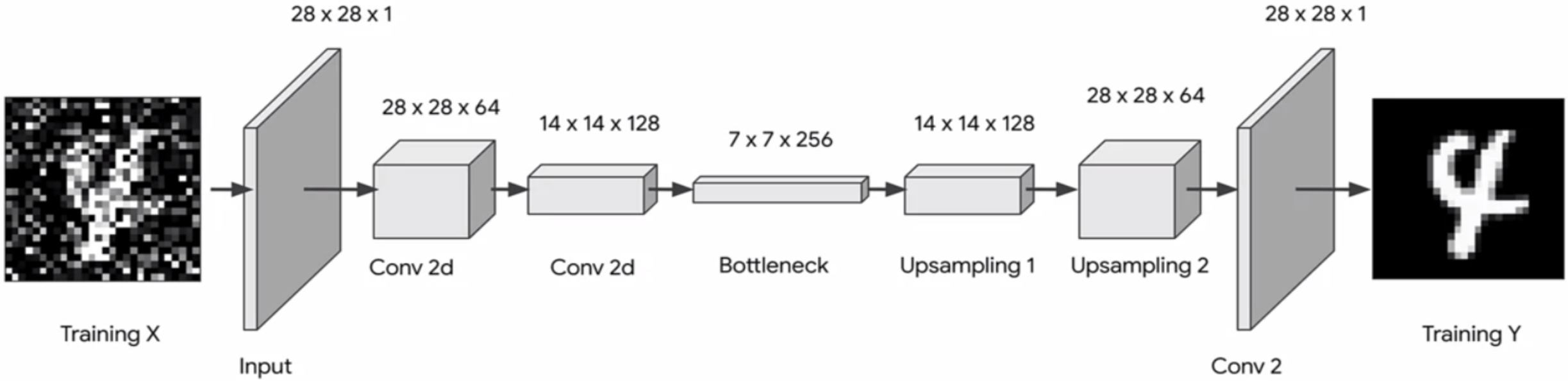
```
inputs =  tf.keras.layers.Input(shape=(784,))

def deep_autoencoder():
 encoder = tf.keras.layers.Dense(units=128, activation='relu')(inputs)
 encoder = tf.keras.layers.Dense(units=64, activation='relu')(encoder)
 encoder = tf.keras.layers.Dense(units=32, activation='relu')(encoder)

 decoder = tf.keras.layers.Dense(units=64, activation='relu')(encoder)
 decoder = tf.keras.layers.Dense(units=128, activation='relu')(decoder)
 decoder = tf.keras.layers.Dense(units=784, activation='sigmoid')(decoder)

 return encoder, decoder

deep_encoder_output, deep_autoencoder_output = deep_autoencoder()

deep_encoder_model = tf.keras.Model(inputs=inputs, outputs=deep_encoder_output)
deep_autoencoder_model = tf.keras.Model(inputs=inputs, outputs=deep_autoencoder_output)
```




NN
CNN

Processing Noises

Convolutional Auto-Encoders



```
def map_image_with_noise(image, label):
  noise_factor = 0.5
  image = tf.cast(image, dtype=tf.float32)
  image = image / 255.0

  factor = noise_factor * tf.random.normal(shape=image.shape)
  image_noisy = image + factor
  image_noisy = tf.clip_by_value(image_noisy, 0.0, 1.0)

  return image_noisy, image
```