

Applications of Autoencoder

UTMIST Study Group

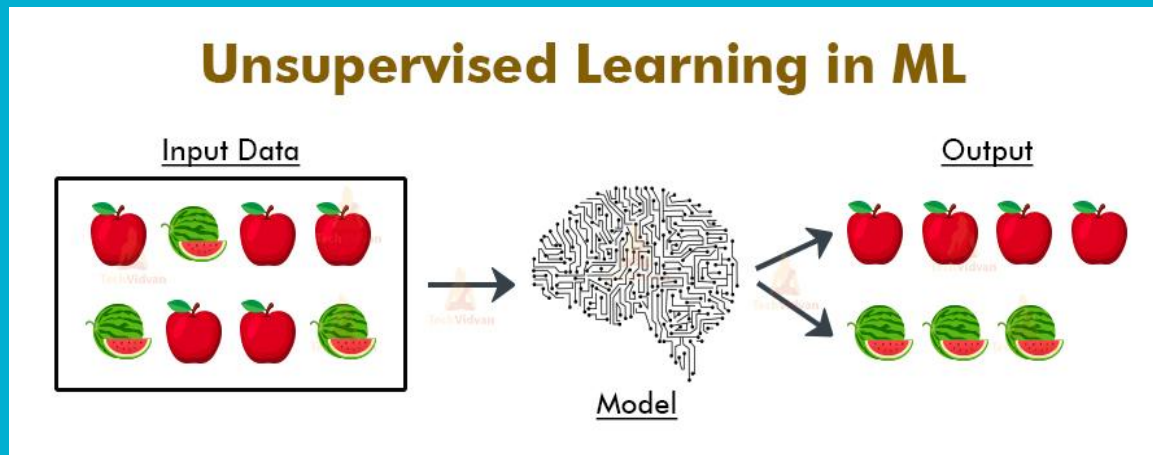
Unsupervised Learning

What?

- No labels

Why?

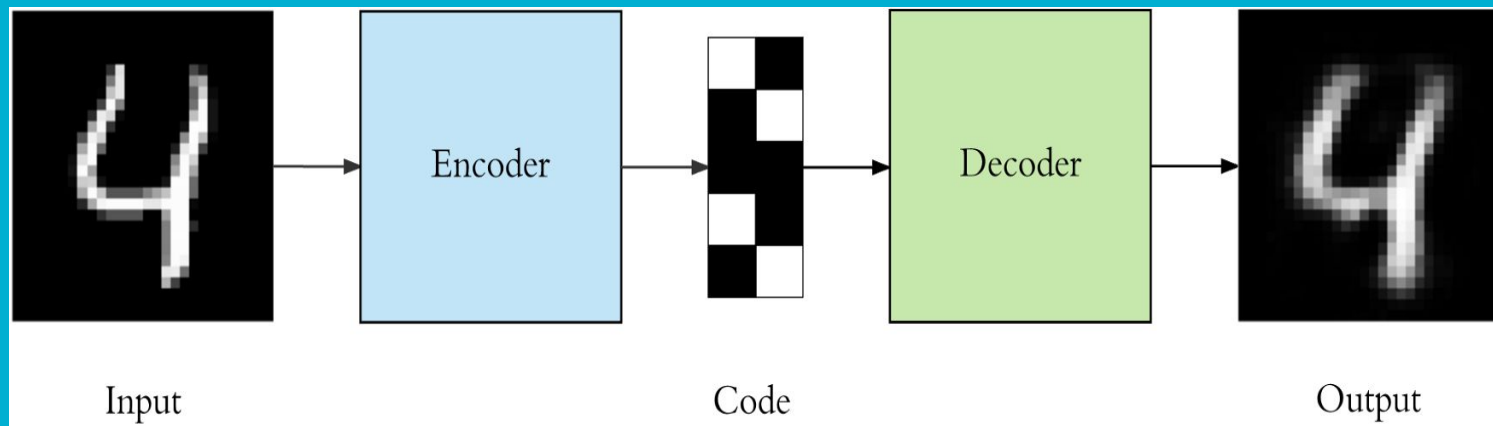
- No label available
- Less costly data
- Extract data features



<https://techvidvan.com/tutorials/wp-content/uploads/sites/2/2020/07/Unsupervised-Learning-in-ML-1.jpg>

Autoencoder: Overview

- **Encoder:** Compresses input
- **Code:** Summary (lower dimension) of input
- **Decoder:** Reconstructs code



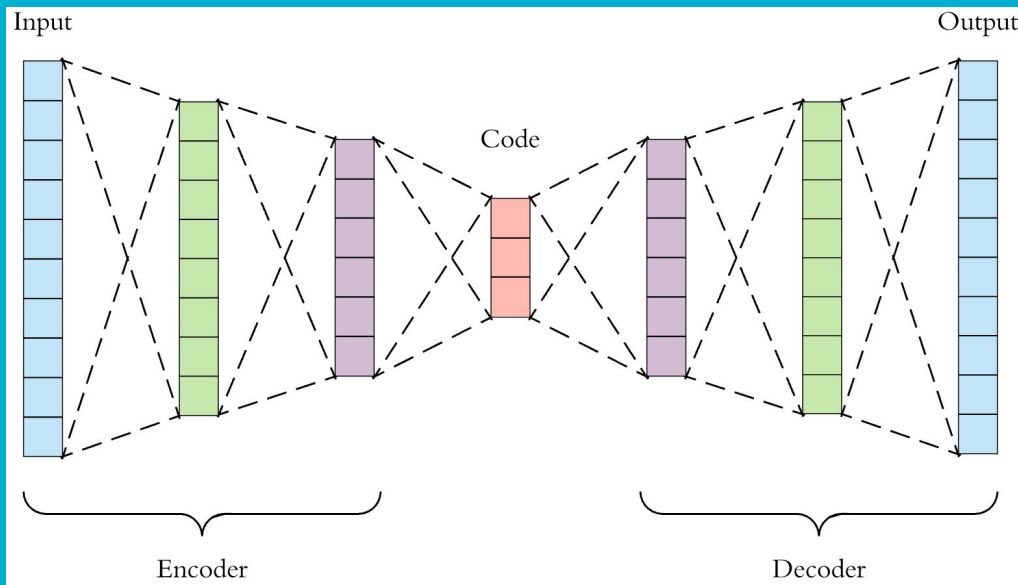
Autoencoder: Architecture

Structure

- Artificial neural network
- Symmetrical

Hyperparameters

- Code size
- # layers
- # neurons/layer



https://miro.medium.com/max/1750/1*44eDEuZBEsmG_TCAKRI3Kw@2x.png

MNIST Fashion Dataset

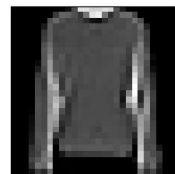
Zalando's article images

Training set: 60,000 samples

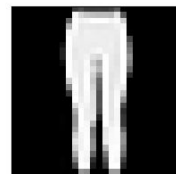
Test set: 10,000 samples

Sample: 28x28 grey-scale image

Label: 10 classes



Pullover (2)



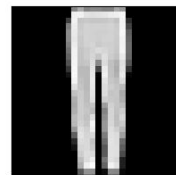
Trouser (1)



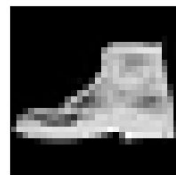
Bag (8)



Coat (4)



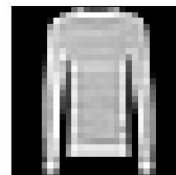
Trouser (1)



Ankle boot (9)



Pullover (2)



Pullover (2)



T-shirt/top (0)

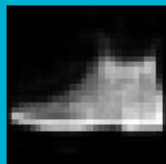
Tensorflow/Keras Implementation

- `tf.keras.Sequential`: groups layers into model
- `layers.Dense`: regular densely-connected NN layer
- `Autoencoder.fit`: train model
- https://www.tensorflow.org/tutorials/generative/autoencoder#first_example_basic_autoencoder

original



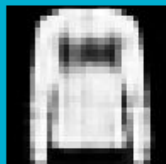
reconstructed



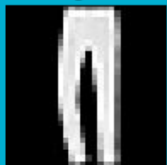
original



reconstructed



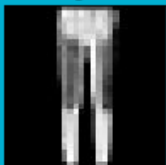
original



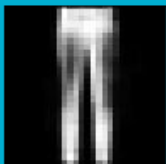
reconstructed



original



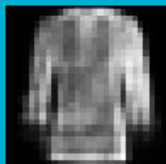
reconstructed



original



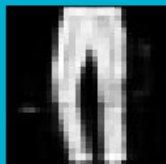
reconstructed



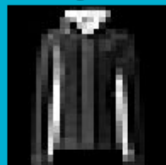
original



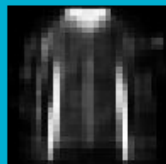
reconstructed



original



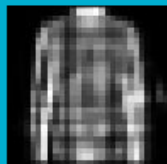
reconstructed



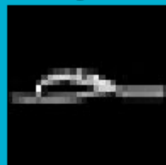
original



reconstructed



original



reconstructed



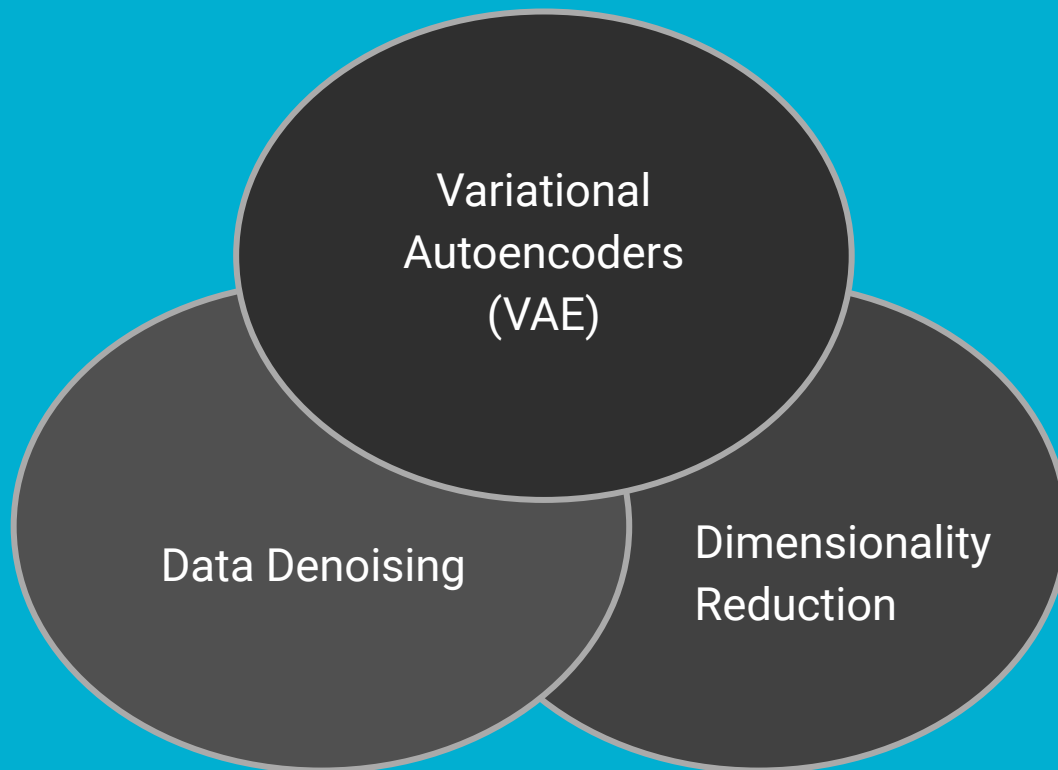
original



reconstructed



Autoencoder Applications: Overview



Dimensionality Reduction

Autoencoder

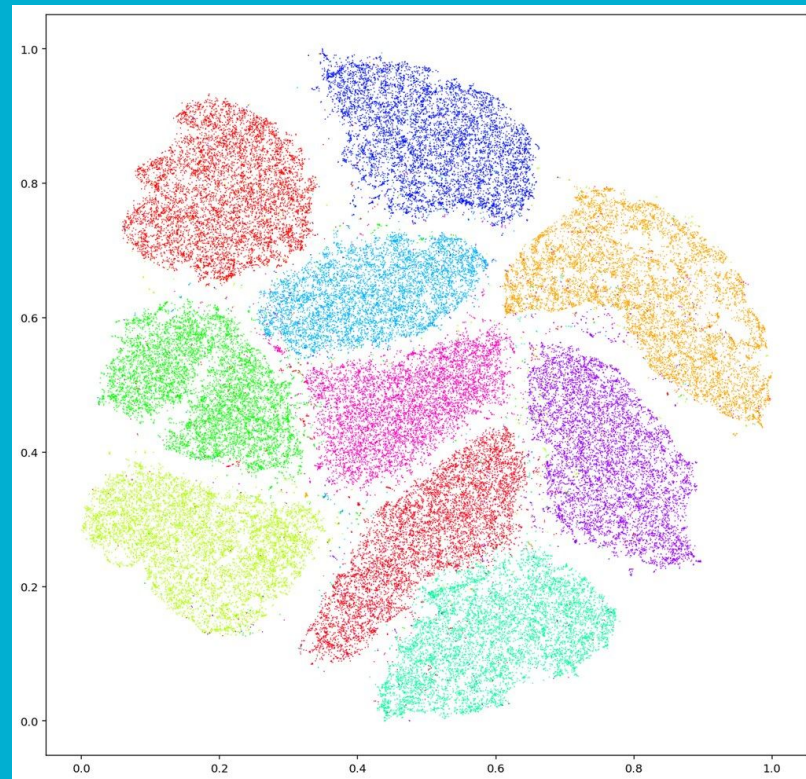
Further reduce dimension size

t-SNE

Visualize higher dimensional data

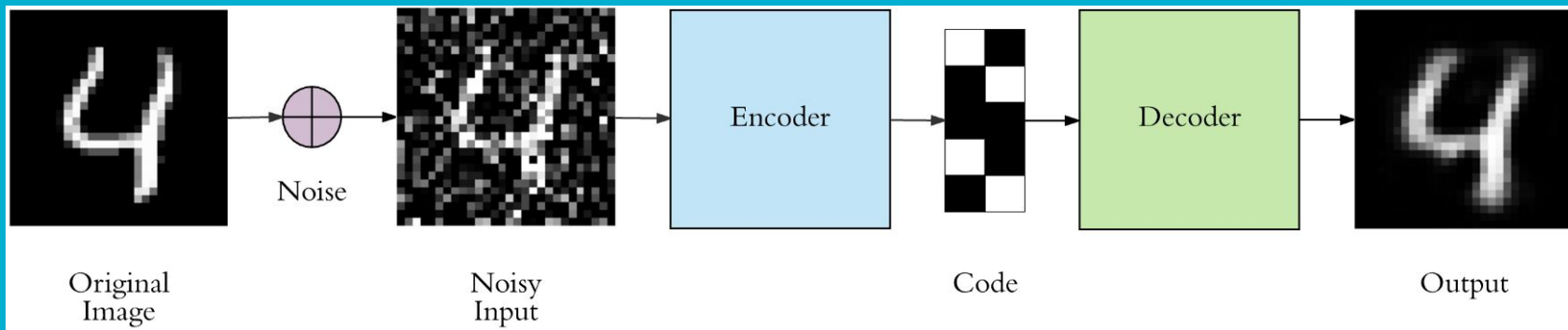
Example

<https://distill.pub/2016/misread-tsne/>



Denoising Autoencoders

- Add noise to input
- Force autoencoder to learn useful features
- Recover original input

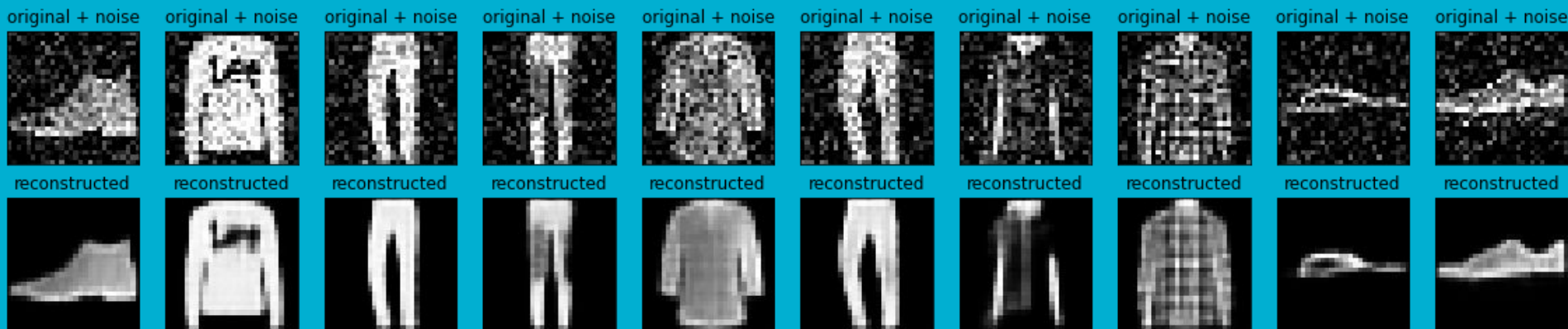


Convolutional Autoencoder

layers.Conv2D: convolution

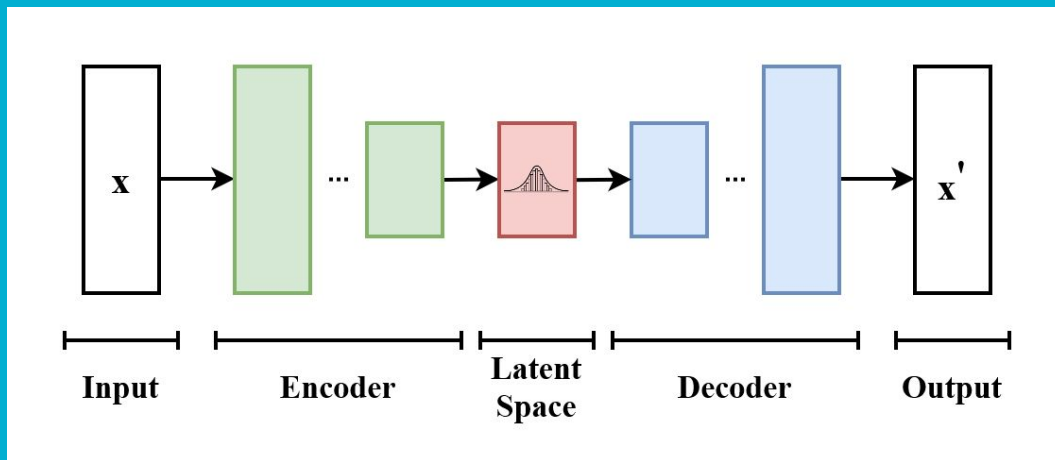
layers.Conv2DTranspose: transposed convolution

https://www.tensorflow.org/tutorials/generative/autoencoder#second_example_image_denoising

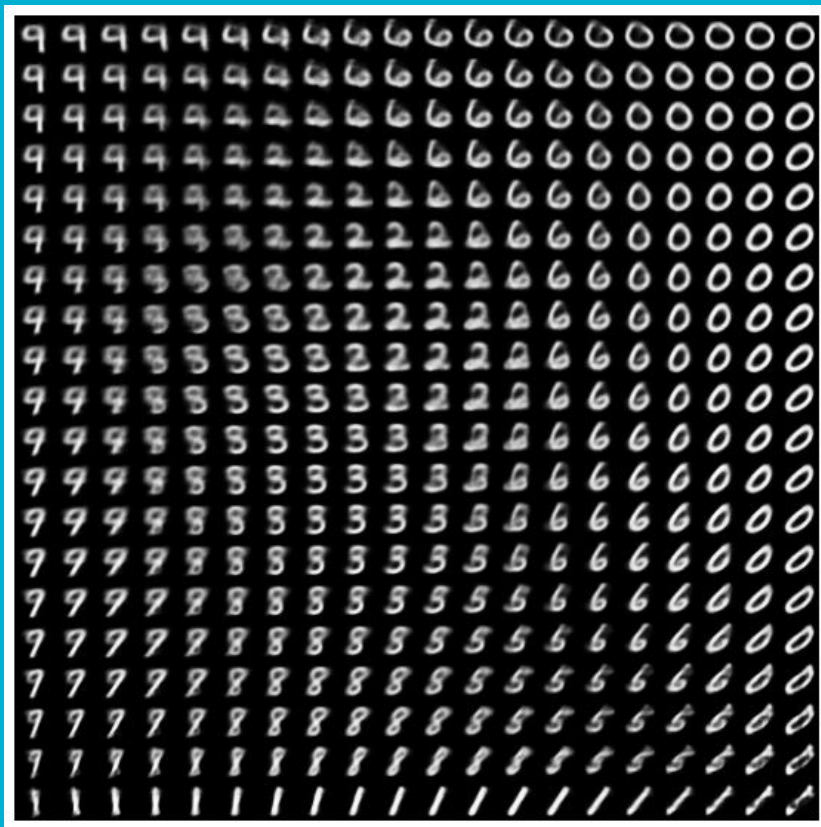


Variational Autoencoder

- Explore variations in existing data
- Generate desired altered data
- Encoder: produce codes of mean + standard variation



https://upload.wikimedia.org/wikipedia/commons/4/4a/VAE_Basic.png



https://www.tensorflow.org/tutorials/generative/images/cvae_latent_space.jpg

https://miro.medium.com/max/1024/1*EhsiaTuiKtvuRDe_wBRX5Q.png

Images generated by VAEs

Thank You! :)