Data Generation with Autoencoders

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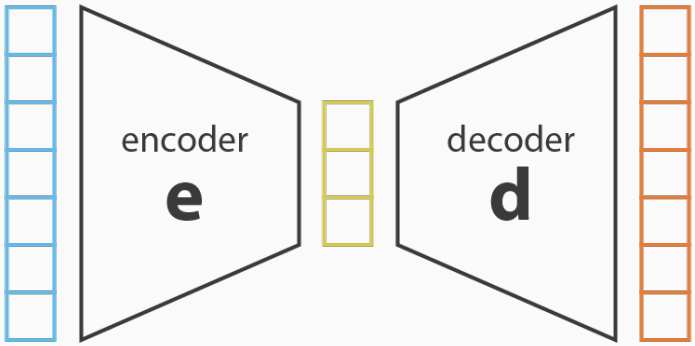
What's an Encoder



x — **initial data** in space R^n

$e(x)$ — **encoded data** in latent space R^m (with $m<n$)

$d(e(x))$ — **encoded-decoded data** back in the initial space R^n

$x = d(e(x))$ ➡ **lossless encoding**
no information is lost when reducing the number of dimensions

$x \neq d(e(x))$ ➡ **lossy encoding**
some information is lost when reducing the number of dimensions and can't be recovered later

Figure 1 – Image reconstruction with noise added in input of the decoder

Variational Auto-Encoders

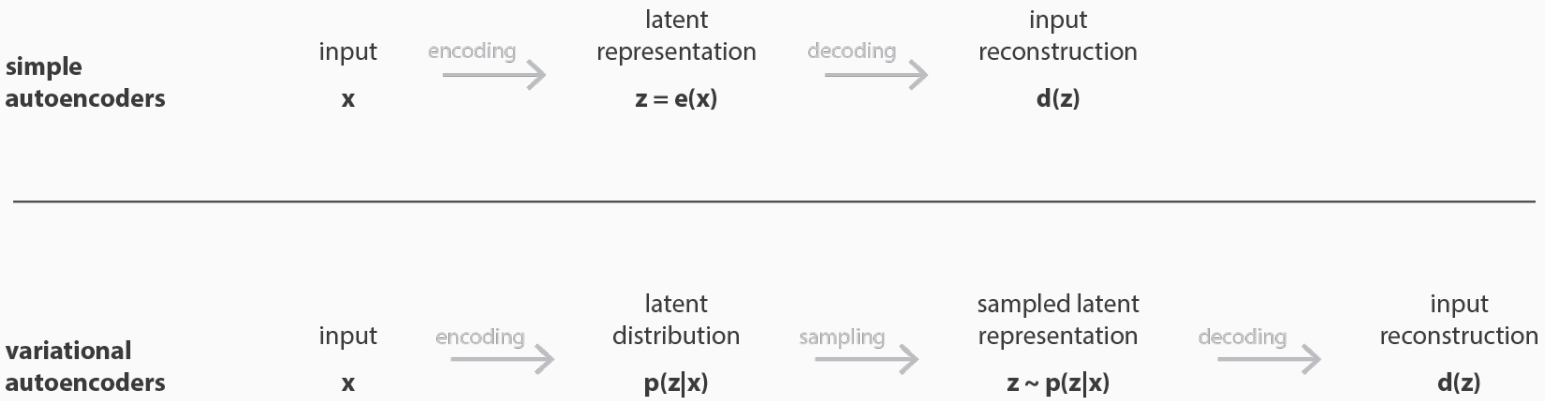


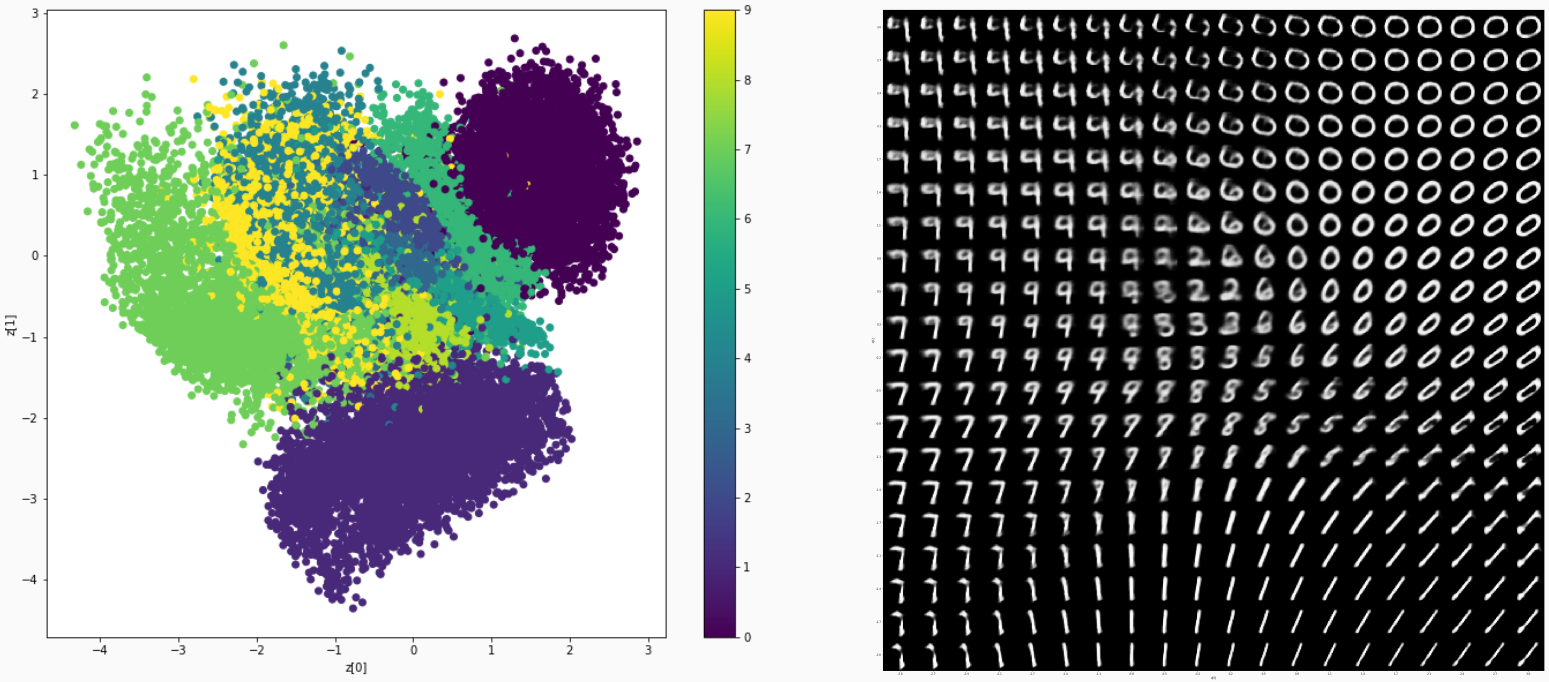
Figure 2 – Auto encoder Pipeline

$$\text{loss} = \|x - \hat{x}\|^2 + KL[\,N(\mu_x, \sigma_x), N(0, I)\,] = \|x - d(z)\|^2 + KL[\,N(\mu_x, \sigma_x), N(0, I)\,]$$

Figure 3 – ELBO Loss decomposition

Implementation and results

Results : MNIST



(a) (b)

Figure 4 – Representations of the latent space for 2 dimensions for MNIST dataset

Results : Fashion MNIST

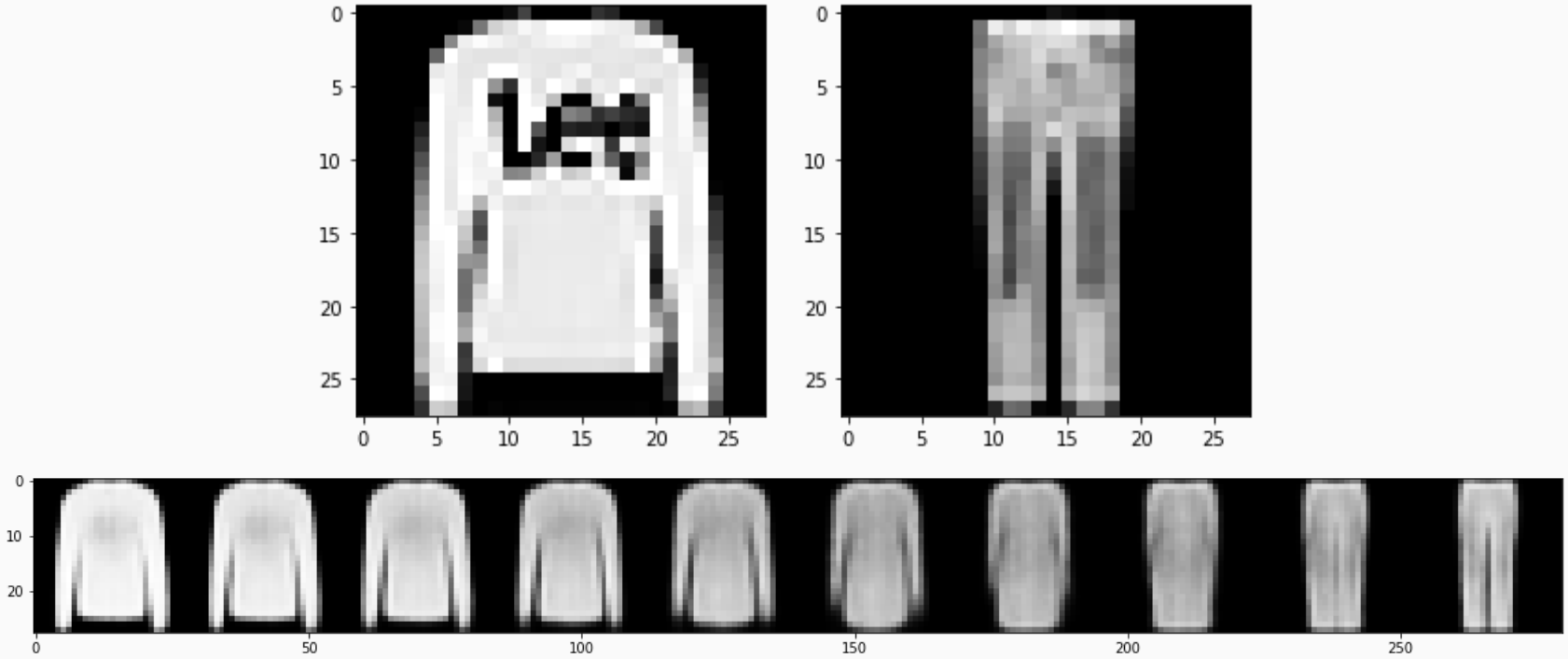


Figure 5 – Pictures generated with CVAE from the Fashion MNIST dataset - 10 epochs

Results : CIFAR

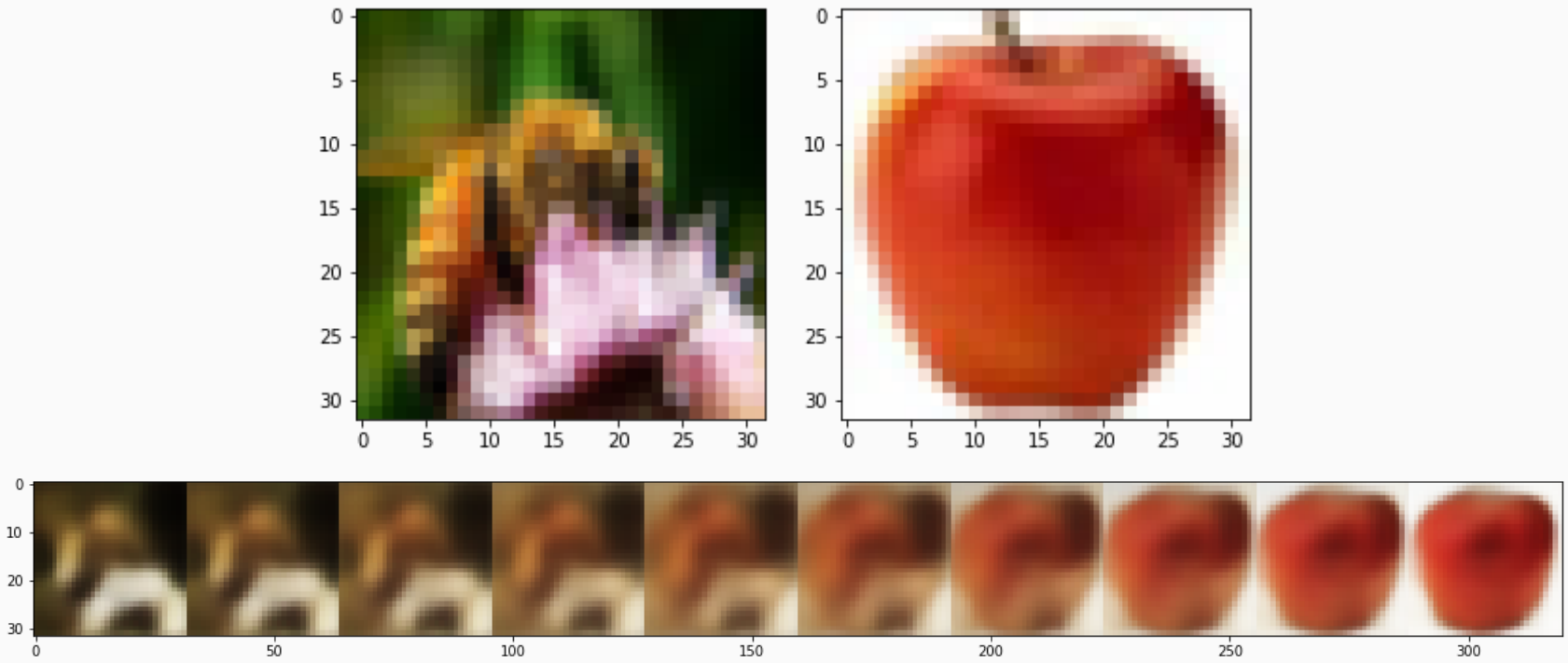


Figure 6 – Pictures generated with VAE from the CIFAR10 dataset - 10 epochs

Results : CVAE

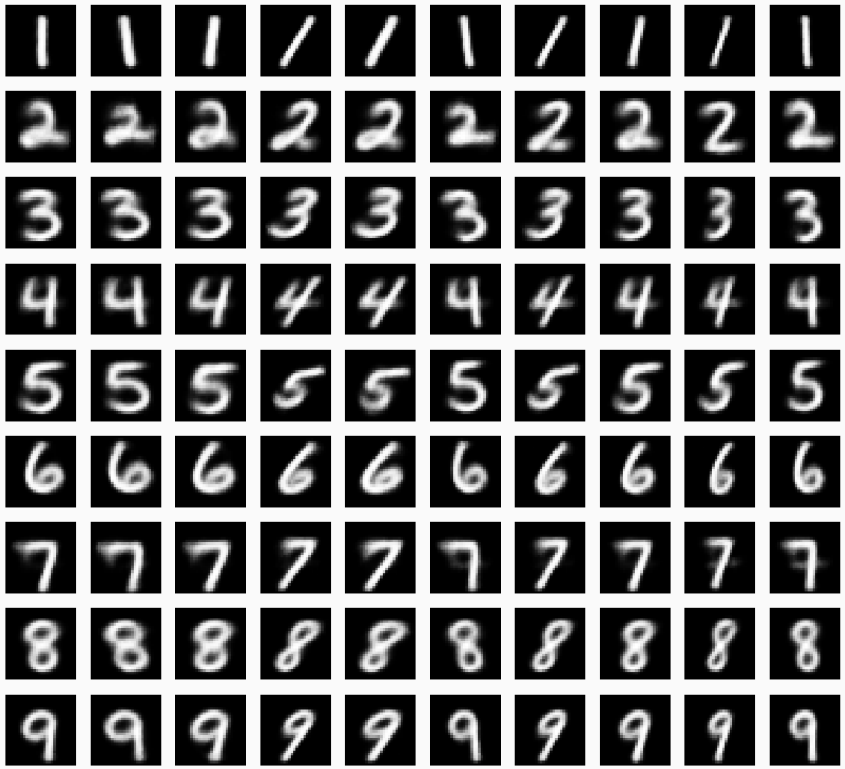


Figure 7 – Pictures generated with CVAE from the MNIST dataset