DELIRES TP4: Autoencoders and Variational Autoencoders

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1 Autoencoders

Question 3 It should be noted that the convolutional network gave a loss smaller than MLP (0.13 for the first and 0.17 for the second), however, we notice that both networks make errors in the reconstruction of the original image.

I find that the results obtained by CNN are better than those obtained by MLP because the images obtained are sharper and errors are less frequent (see figure 1). This is because there are fewer parameters to train in the case of the convolutional network, as well as the latter is better suited for images than MLP.

Question 4 We added noise to every batch with samples from $\mathcal{N}(0, \sigma)$ with $\sigma = \frac{20}{255}$. The loss achieved is the same as before, and we notice that visually the results are not improved using the same architectures as before (see figure 2).

2 Variational autoencoder

2.1 The VAE loss function

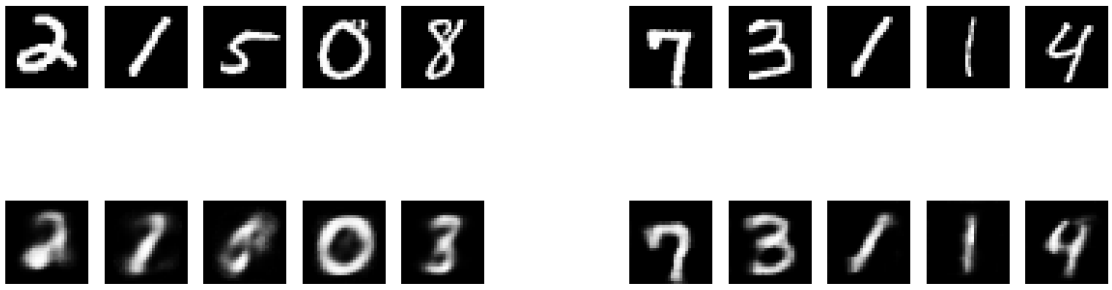
Question 1 After computation, we find:

$$KL(P_1||P_2) = \frac{1}{2}\left(\sum_{i=1}^{d} \sigma_i^2 + \mu_i^2 - 1 - log(\sigma_i^2)\right)$$

Question 2 Given the assumptions, we have:

$$\log(p_\theta(x|z)) = -\sum_{i=1}^{n_pixel}\sum_{c=1}^{2} \mathbb{1}_{y_i \in C_c} log(p(y_i \in C_c))$$

where $p(y_i \in C_c)$ is the probability predicted by the model for the i^{th} observation to belong to the c^{th} category (c=2, binary variable).



(a) MLP (b) Convolutional

Figure 1: Comparison of results of auto-encoder with MLP and CNN

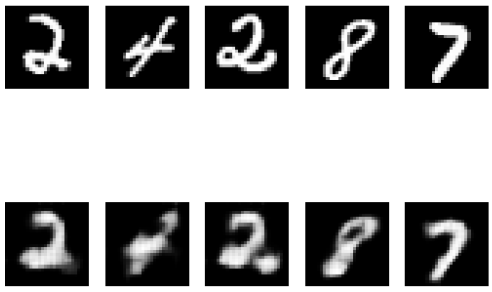
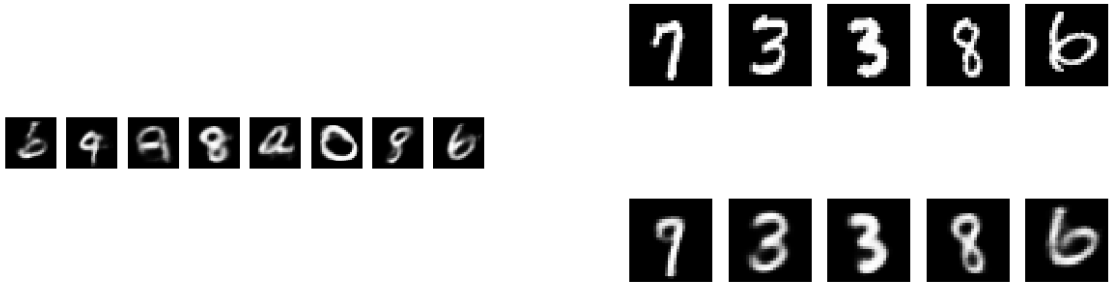


Figure 2: Results obtained by the denoising autoencoder using the CNN architecture



(a) Sampled images (b) Reconstructed images

Figure 3: Results of the VAE using MLP architecture

2.2 Implementing the VAE

Question 2 We can see that the results obtained by VAE are visually satisfying (see figure 3), which is expected.