A comparative evaluation on the generative ability of DCGANs

Kinga Jenei and Jonna Marie Matthiesen

Deep Machine Learning
University of Gothenburg

GÖTEBORGS UNIVERSITET

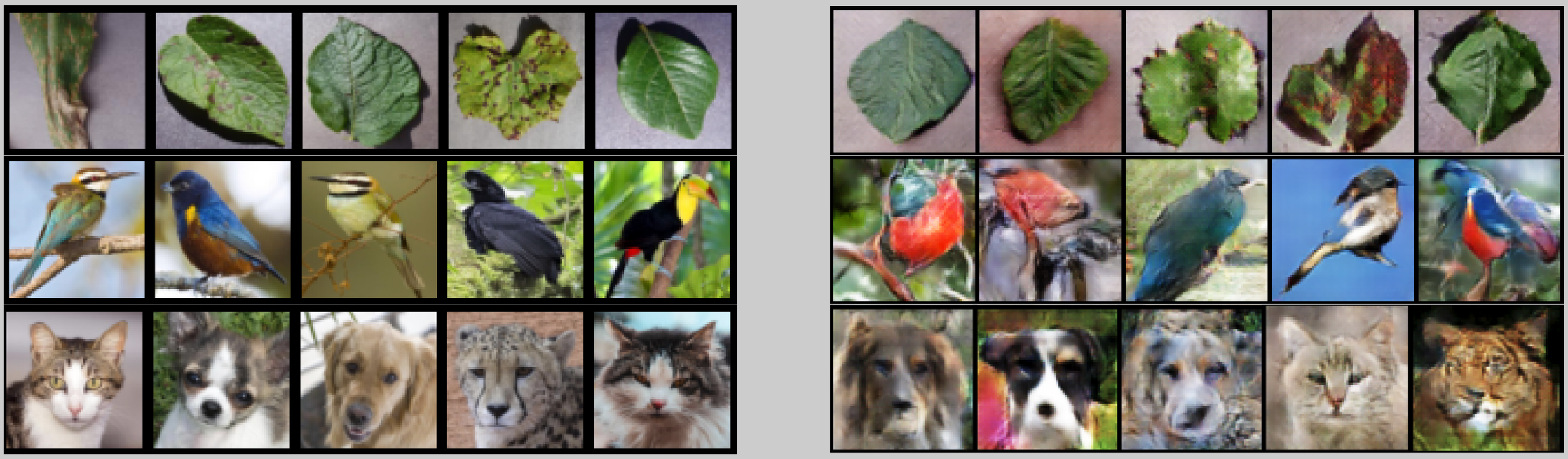

Figure 1: Real (left) and fake / generated (right) images of leaves, birds and animal faces, ordered from top to bottom. Datasets: [3, 2, 1]; Own elaboration.

The results show that the success of the generative model is highly dependent on the size and diversity of the dataset. The leaf dataset being the easiest with about 80.000 training samples and the animal face dataset, with roughly 16.000 training images, the hardest to generate new images from.

$$z=[0.001, 0.254, 0.43, 0.98, 0.33, ...] \sim \mathcal{N}(0, \mathbb{1})$$

Generator

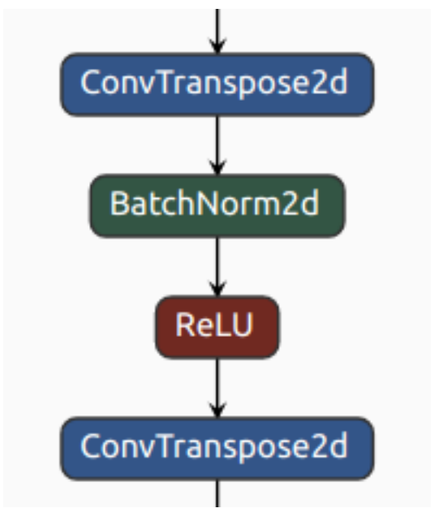

Figure 2: One out of five blocks in the generator network. Own elaboration.

Creates new examples that look like the training images.

Goal: The generator G tries to create an image $G(z) = x$ maximizing $D(x)$,

$$\min_G \log(1 - D(G(z)).$$

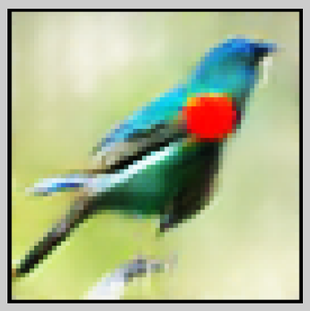

Figure 3: Generated (fake) bird image.

$$\min_G \max_D \mathbb{E}_{s\sim p_{data}}[\log D(s)] + \mathbb{E}_{z\sim\mathcal{N}(0,\mathbb{1})}[\log(1 - D(G(z))]$$

As described in [4] the counter-play of the generator and discriminator can be described as a two-player mini-max game.

GAN Architecture

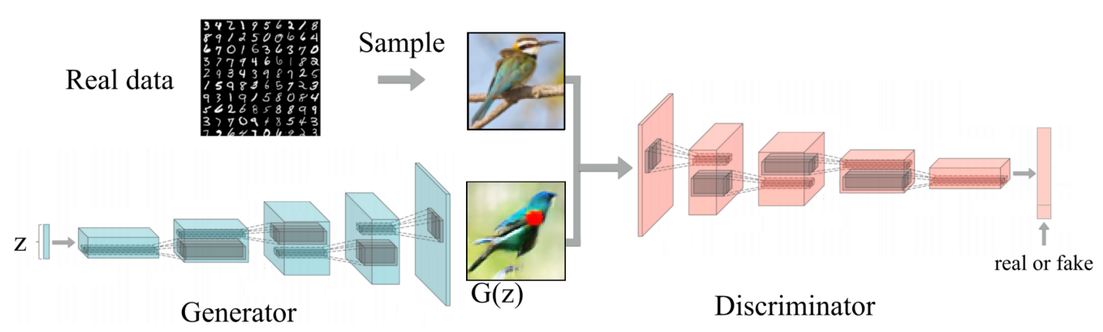

Figure 4: DCGAN generator and discriminator architecture. [5]

Figure 5: Bird image sampled from training data. [2]

Discriminator

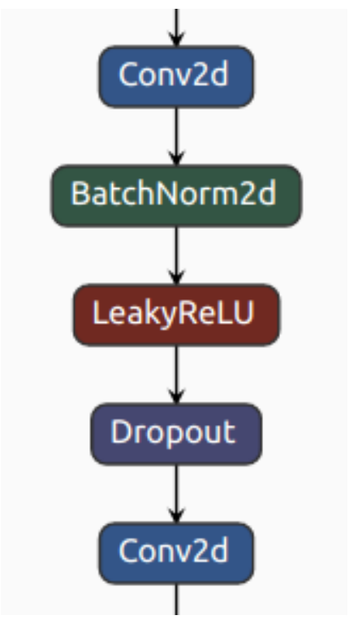

Figure 6: One out of five blocks in the discriminator network. Own elaboration.

Classifies the images as either real or fake.

Goal: The discriminator D tries to maximize the probability of predicting the right label,

$$\max_D \log D(s) + \log(1 - D(G(z)),$$

where s is a random sample from the training data, $s \sim p_{data}$.

References

[1] Animal faces. https://www.kaggle.com/datasets/andrewmvd/animal-faces, Accessed: October 31, 2022.

[2] Birds 450 species. https://www.kaggle.com/datasets/gpiosenka/100-bird-species, Accessed: October 31, 2022.

[3] New plant diseases dataset. https://www.kaggle.com/datasets/vipoooool/new-plant-diseases-dataset, Accessed: October 31, 2022.

[4] I. J. Goodfellow, J. Pouget-Abadie, M. Mirza, B. Xu, D. Warde-Farley, S. Ozair, A. Courville, and Y. Bengio. Generative adversarial networks, 2014.

[5] U. Haputhanthri. Introduction to deep convolutional generative adversarial networks using pytorch, May 2020.

gusjeneki@student.gu.se gusmatjoak@student.gu.se