Image Colorization and Upscaling using DC-GANs

Nathan Frison[1] Hubert Gruniaux[1] Antoine Groudiev[1]

[1]École Normale Supérieure – PSL
firstname.name@ens.psl.eu

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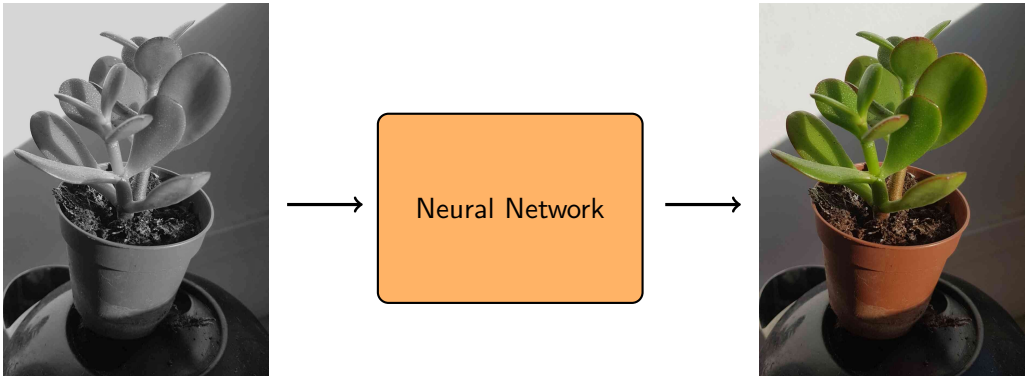
The image colorization problem

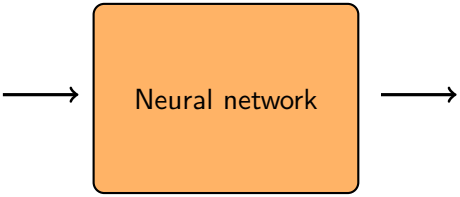


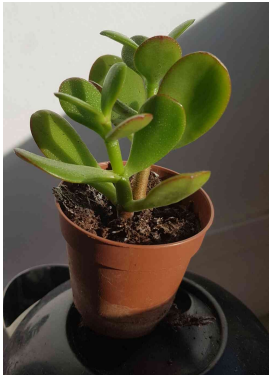
Grayscale image

Colorized image

The image upscaling problem

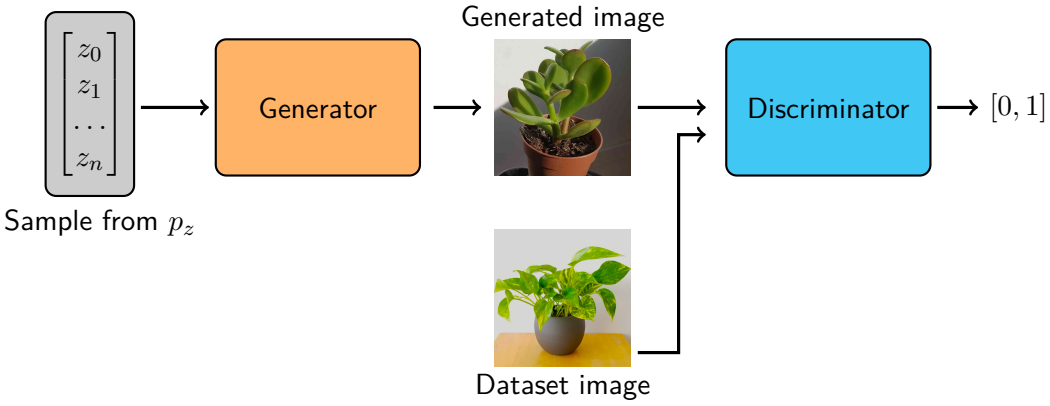
Low-resolution image





High-resolution image

Generative Adversarial Networks (GANs)



Generative Adversarial Networks (GANs)

Generation

- The generator G_{θ_G} takes a random noise vector z as input and outputs an image $G_{\theta_G}(z)$.
- The discriminator D_{θ_D} takes an image x as input and outputs a probability $D_{\theta_D}(x)$ that the image is real.
- Minimax game problem:

$$\min_{\theta_G} \max_{\theta_D} V(G_{\theta_G}, D_{\theta_D}) = \min_{\theta_G} \max_{\theta_D} \mathbb{E}_x[\log D_{\theta_D}(x)] + \mathbb{E}_z[\log(1 - D_{\theta_D}(G_{\theta_G}(z)))]$$

Generative Adversarial Networks (GANs)

Image colorization or upscaling

Change the generator to fit the colorization/upscaling problem using conditional GANs:

- Replace the noise vector z by a grayscale/lows-res image z.
- The generator G_{θ_G} takes a grayscale/lows-res image z as input and outputs an enhanced image $G_{\theta_G}(z)$.
- The discriminator receives both the enhanced image and the enhanced image (condition) as input, and outputs a probability $D_{\theta_D}(x|z)$ that the image is real.

Possible approaches

- Colorize then upscale: train a colorization GAN and an upscaling GAN separately
- Upscale then colorize: train an upscaling GAN and a colorization GAN separately
- Joint training: train a single GAN to perform both tasks

References

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2. Nazeri, Kamyar, Eric Ng, and Mehran Ebrahimi. "Image colorization using generative adversarial networks." *Articulated Motion and Deformable Objects: 10th International Conference, AMDO 2018, Palma de Mallorca, Spain, July 12-13, 2018, Proceedings 10*. Springer International Publishing, 2018.
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4. Wang, Xintao, et al. "Esrgan: Enhanced super-resolution generative adversarial networks." *Proceedings of the European conference on computer vision (ECCV) workshops*. 2018.