GAN - Theory and Applications

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Generative Adversarial Networks

"Adversarial Training (also called GAN for Generative Adversarial Networks) is the most interesting idea in the last 10 years of ML."

— Yann LeCun

Generative Adversarial Networks

Two components, the **generator** and the **discriminator**:

- The **generator** G, aim is to capture the data distribution.
- The **discriminator** D, estimates the probability that a sample came from the training data rather than from G.

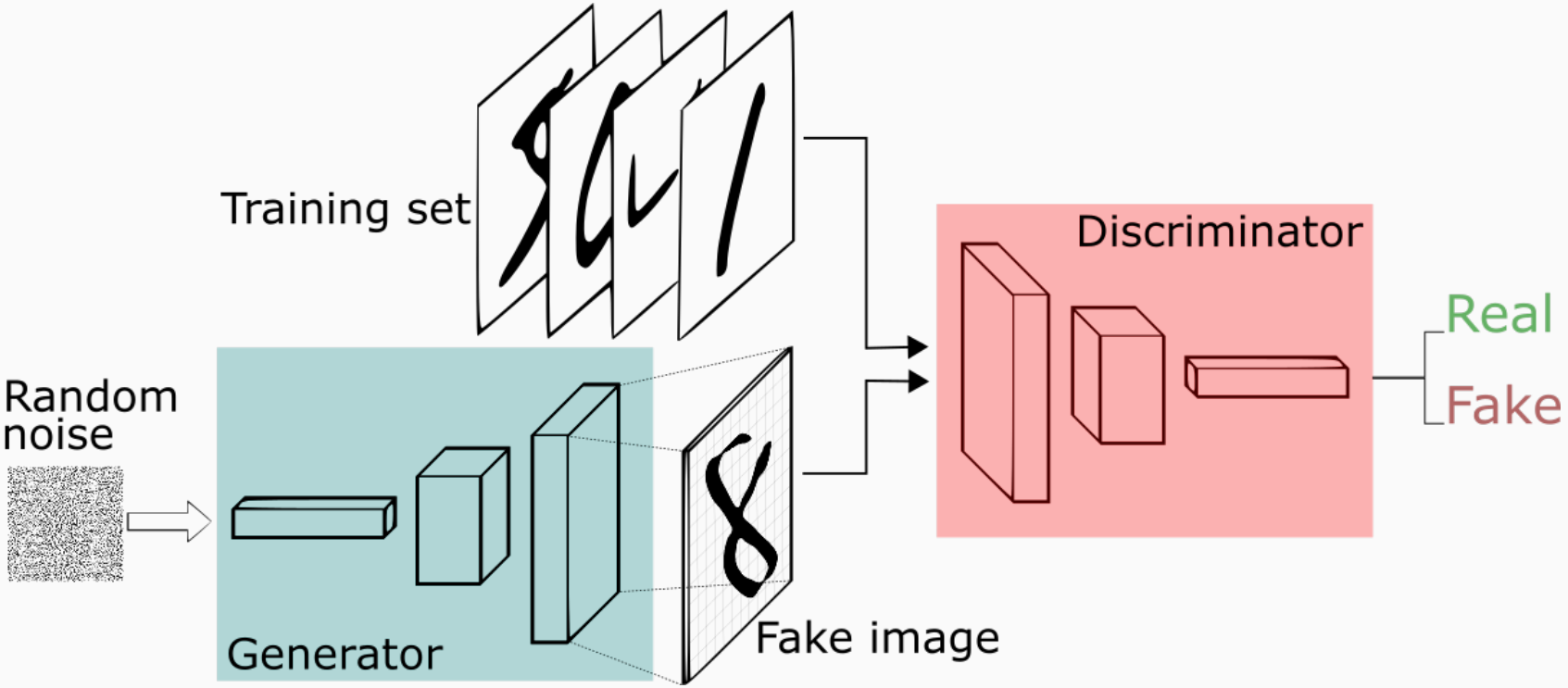

Figure 1: Credits: Reference

Generative Adversarial Networks

Generator and Discriminator compete against each other, playing the following zero sum min-max game with value function $V_{GAN}(D, G)$:

$$\min_G \max_D V_{GAN}(D, G) = \mathop{\mathbb{E}}_{x \sim p_{data}(x)} [\log D(x)] + \mathop{\mathbb{E}}_{z \sim p_z(z)} [\log(1 - D(G(z)))] \tag{1}$$

Generative Adversarial Networks

Intuitive explanation:

- Discriminator needs to:
  - Correctly classify real data:
    maximize

$$\mathop{\mathbb{E}}_{x \sim p_{data}(x)} [\log D(x)] \tag{2}$$

    .
  - Correctly classify wrong data:
    maximize

$$\mathop{\mathbb{E}}_{z \sim p_z(z)} [\log(1 - D(G(z)))] \tag{3}$$

    .