Generative Adversarial Networks (GANs)

Conceptual Overview

Your Name

Your Institute

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Outline

1. Why We Need GANs
2. Main Idea of GAN
3. Structure of GAN
4. How Training Works
5. Advantages and Limitations
6. Applications
7. Variants

Why Generative Models?

- Discriminative models classify data.
- Generative models create new data.
- Applications: image synthesis, data augmentation, creative AI.

Why Is It Hard?

- Complex high-dimensional distributions.
- Likelihood often intractable.
- Traditional methods require complex sampling.

Learning by Competition

- Generator produces fake samples.
- Discriminator detects real vs fake.
- Both improve through competition.

Generator and Discriminator

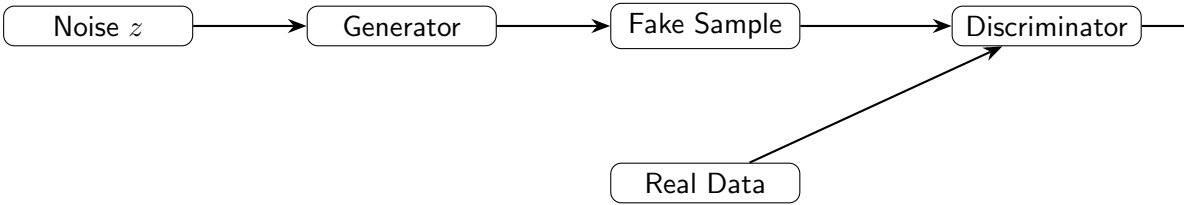
Generator

Input: random noise
Output: synthetic data

Discriminator

Input: real or fake sample
Output: probability of being real

GAN Architecture Diagram



Training Procedure

1. Train discriminator on real and fake data.
2. Train generator to fool discriminator.
3. Repeat until convergence.

Minimax Objective

$$\min_G \max_D V(D, G)$$

Advantages

- Sharp realistic samples.
- No explicit likelihood required.
- Fast sampling via forward pass.

Limitations

- Training instability.
- Mode collapse.
- Hyperparameter sensitivity.

Real-World Applications

- Image generation.
- Super-resolution.
- Image-to-image translation.
- Data augmentation.

Popular Variants

- DCGAN
- Conditional GAN
- WGAN
- StyleGAN

Questions?