Introduction to Deep Learning (CS474)

Lecture 27

Rupam

Outline

Module 4

- **Introduction to Generative Adversarial Networks (GANs)**

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Recap

To sum up, Discriminator (D) and Generator (G) are playing a "minimax" game with the comprehensive objective function:

$$min_D max_G \{ -E_{x \sim \text{Data}} log D(\mathbf{x}) - E_{z \sim \text{Noise}} log(1 - D(G(\mathbf{z}))) \}.$$

Slide credit: A. Zhang, Z. C. Lipton, M. Li, and A. Smola

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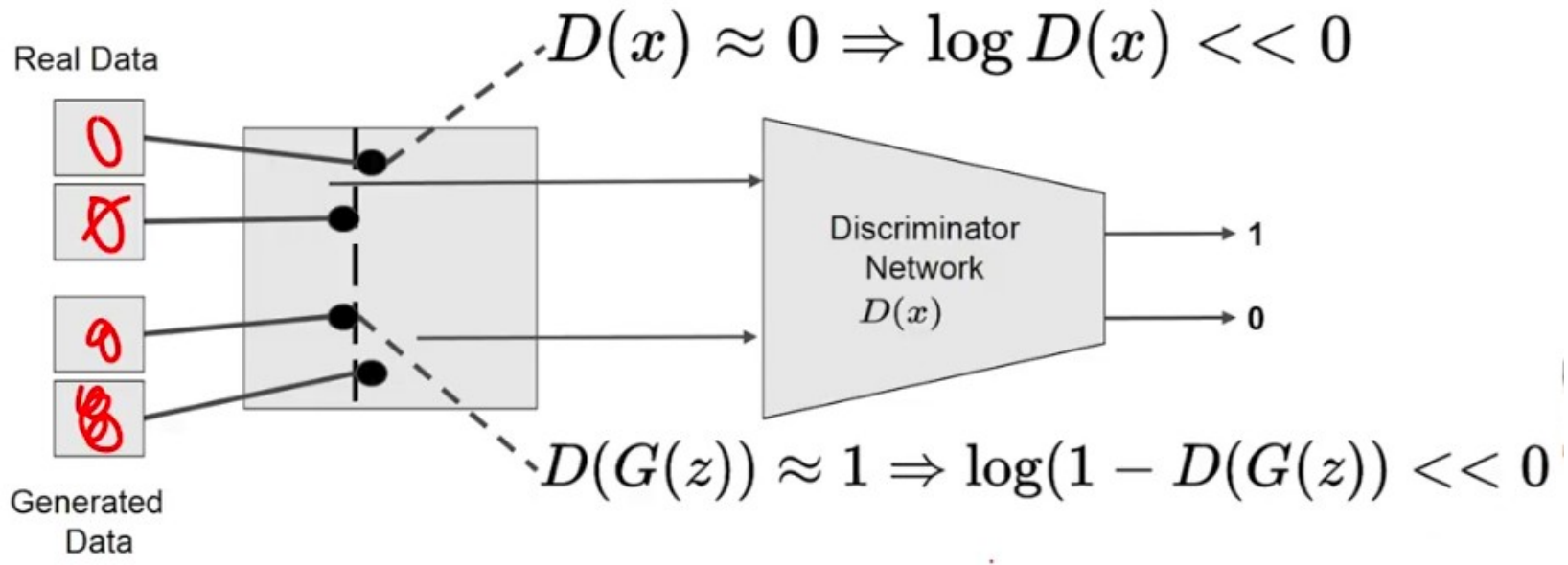
Training Discriminator Network

Before Training

$$\max_D \left[\mathbb{E}_{x \sim P_{data}(x)} log(D(x)) + \mathbb{E}_{z \sim P_z(z)} log(1 - D(G(z)))\right]$$

$D(x)$ should be 1 $D(G(z))$ should be 0



Slide credit: Dr. G. Krishnamurthy

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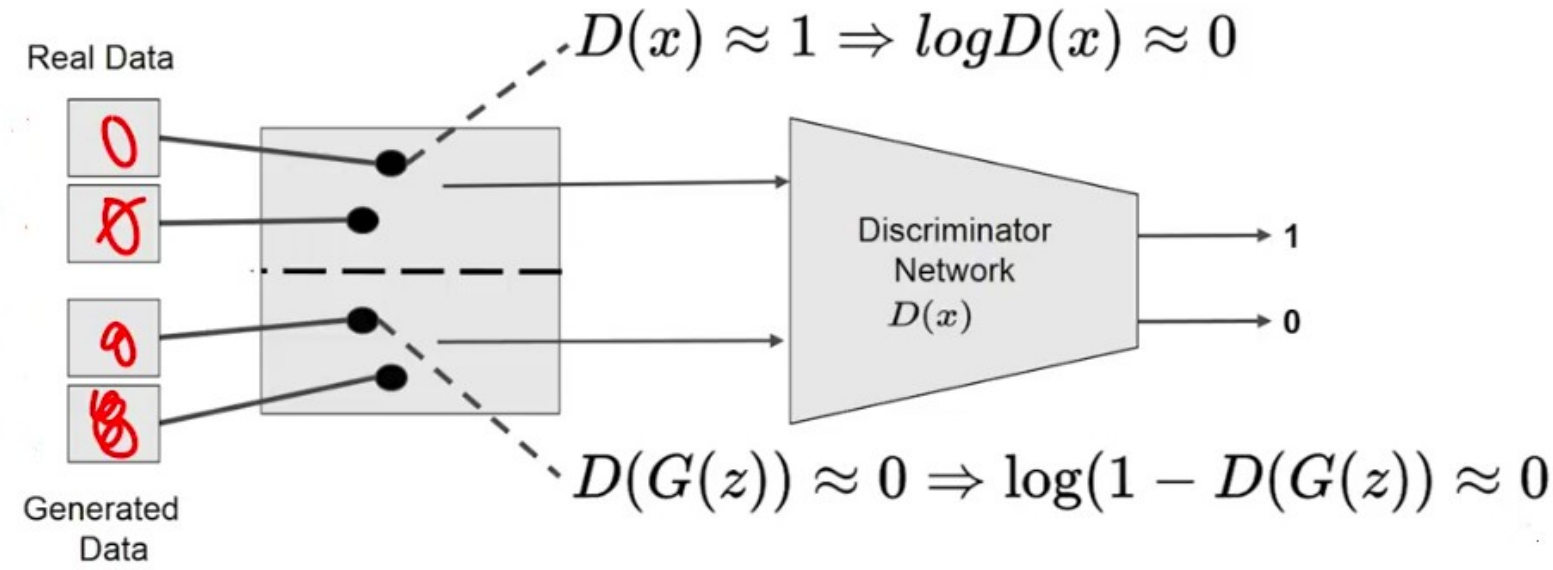
Training Discriminator Network

After Training

$$\max_D [\mathbb{E}_{x \sim P_{data}(x)} log(D(x)) + \mathbb{E}_{z \sim P_z(z)} log(1 - D(G(z)))]$$

$D(x)$ should be 1 $D(G(z))$ should be 0



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Training Generator Network

$$\min_G \left[\mathbb{E}_{x \sim P_{data}} (\log D(x)) + \mathbb{E}_{z \sim P(z)} (\log(1 - D(G(z))))\right]$$

$$\Rightarrow \min_G \left[\mathbb{E}_{z \sim P(z)} (\log(1 - D(G(z))))\right]$$

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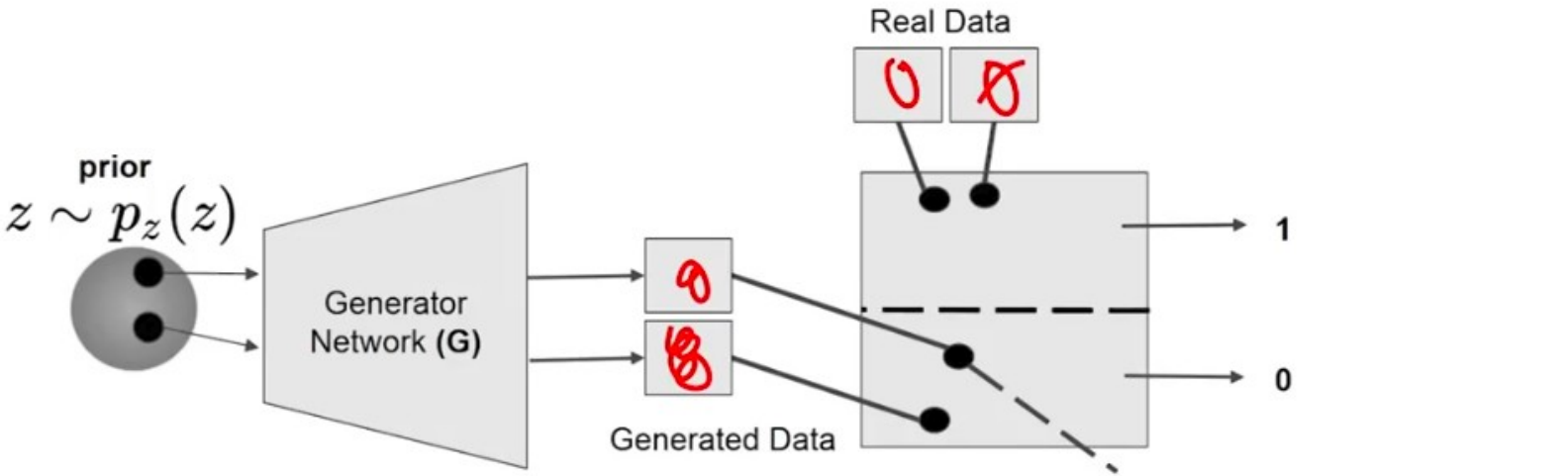
Training Generator Network

Before Training

$$\max_G [\mathbb{E}_{z \sim P_z(z)} log(D(G(z)))]$$

$D(G(z))$ should be **1**



$$D(G(z)) \approx 0 \Rightarrow \log(D(G(z)) << 0$$

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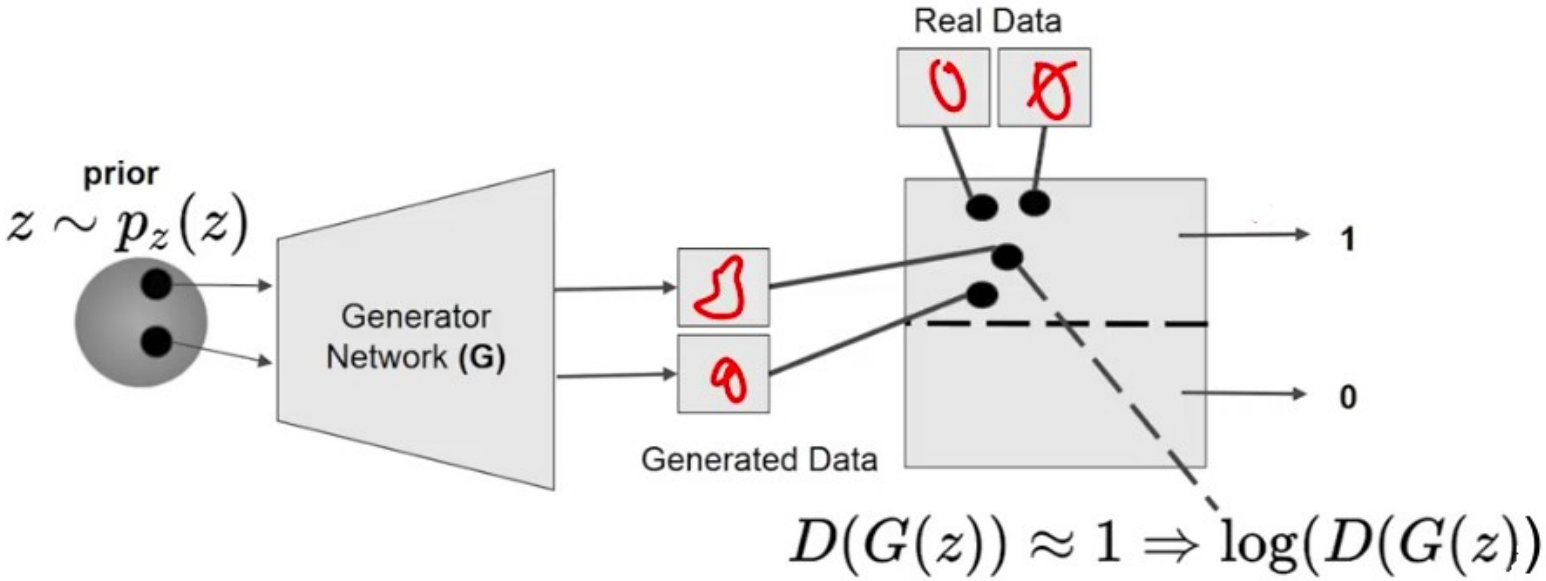
Training Generator Network

After Training

$$\max_G [\mathbb{E}_{z \sim P_z(z)} log(D(G(z)))]$$

$D(G(z))$ should be **1**



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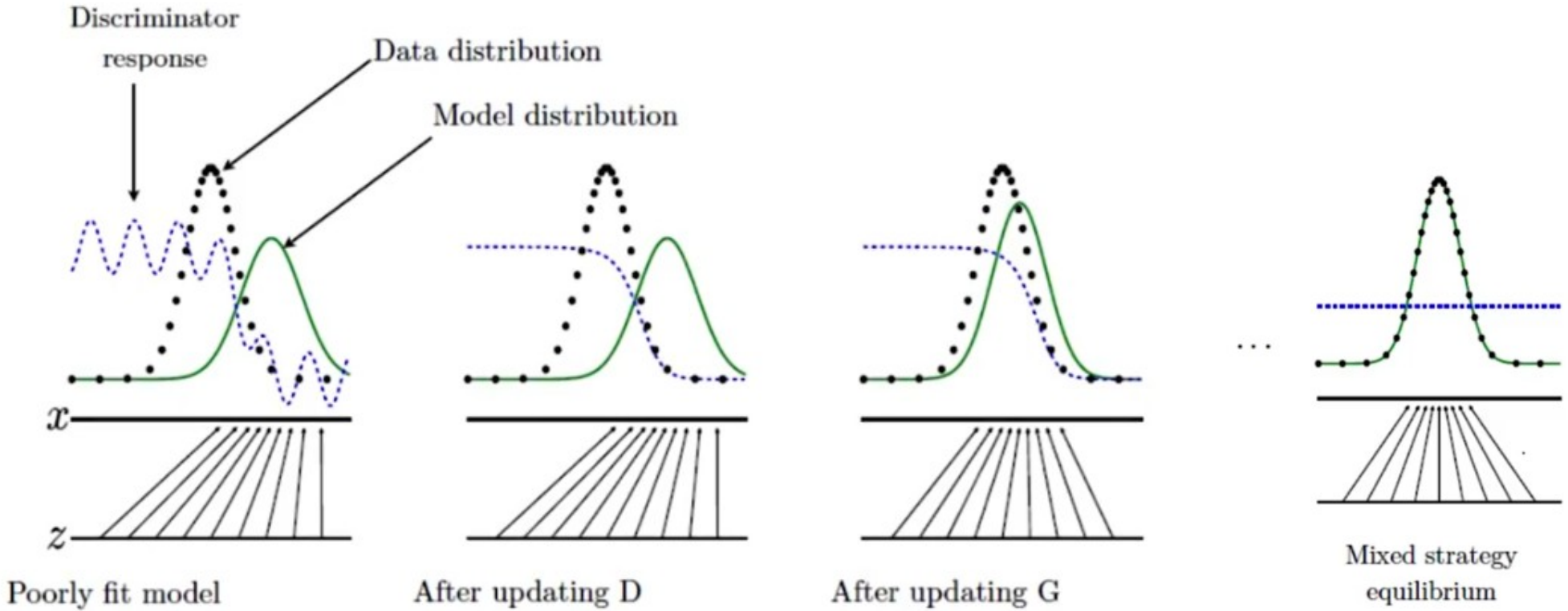
Learning Process



Slide credit: Goodfellow, Ian, et al. "Generative adversarial nets." *Advances in neural information processing systems*. 2014.

References

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