# Generalizing GANs Through Symmetric Mixtures and Noise Augmentation: Insights from MNIST and Toy Experiments

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# Vanilla GAN

$$\min_G \max_D \mathbb{E}_{x \sim p_{\text{data}}}[\log D(x)] + \mathbb{E}_{z \sim p_z}[\log(1 - D(G(z)))]$$

# Mixture GAN

## Data mixture

$$\text{True Mixture} = x_{\text{d}} \left( \frac{1}{2} + \frac{t}{2} \right) + x_{\text{g}} \left( \frac{1}{2} - \frac{t}{2} \right)$$

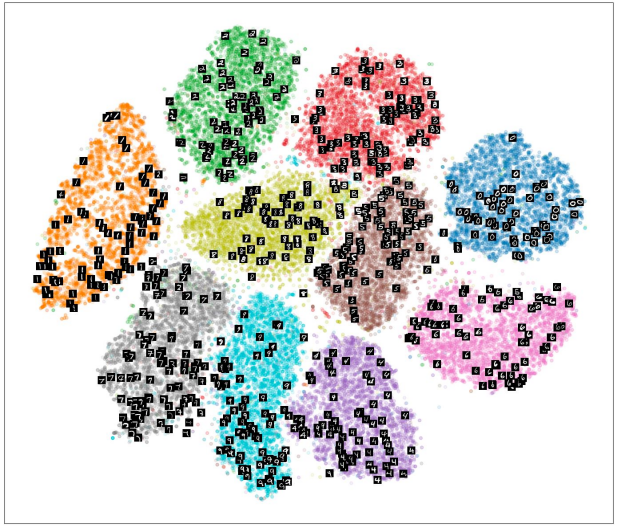
$$\text{Fake Mixture} = x_{\text{d}} \left( \frac{1}{2} - \frac{t}{2} \right) + x_{\text{g}} \left( \frac{1}{2} + \frac{t}{2} \right)$$

## Add noise

$$\text{True Mixture} = x_{\text{d}} \cdot t + \epsilon \cdot (1 - t)$$

$$\text{Fake Mixture} = x_{\text{g}} \cdot t + \epsilon \cdot (1 - t)$$

# t-SNE



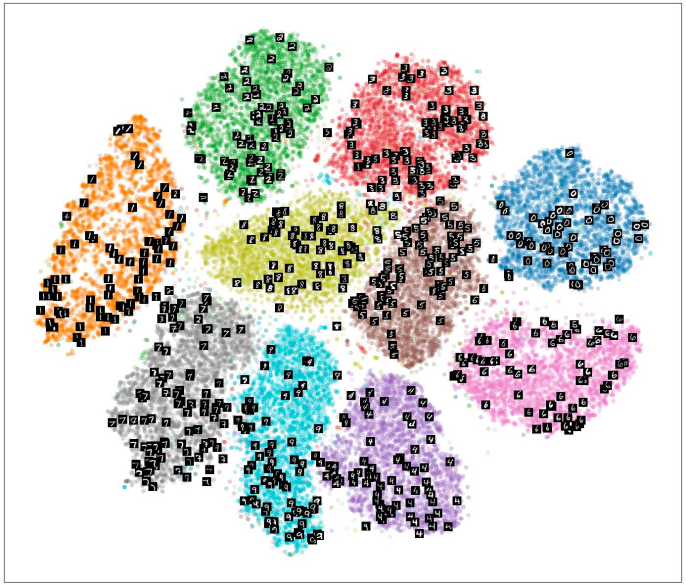
$$p_{j|i} = \frac{\exp(-\|\mathbf{x}_i - \mathbf{x}_j\|^2 / 2\sigma_i^2)}{\sum_{k \neq i} \exp(-\|\mathbf{x}_i - \mathbf{x}_k\|^2 / 2\sigma_i^2)}$$

$$p_{ij} = \frac{p_{j|i} + p_{i|j}}{2N}$$

$$q_{ij} = \frac{(1 + \|\mathbf{y}_i - \mathbf{y}_j\|^2)^{-1}}{\sum_k \sum_{l \neq k} (1 + \|\mathbf{y}_k - \mathbf{y}_l\|^2)^{-1}}$$

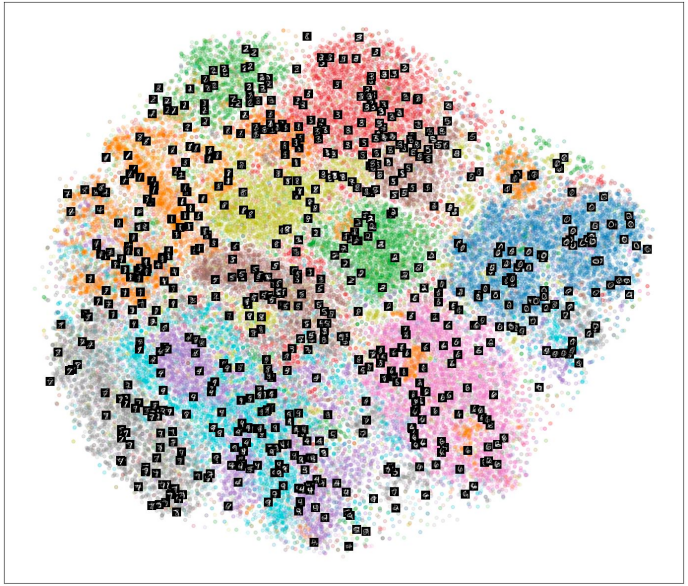
$$\mathrm{KL}\left(P \parallel Q\right) = \sum_{i \neq j} p_{ij} \log \frac{p_{ij}}{q_{ij}}$$

# Vanilla GAN



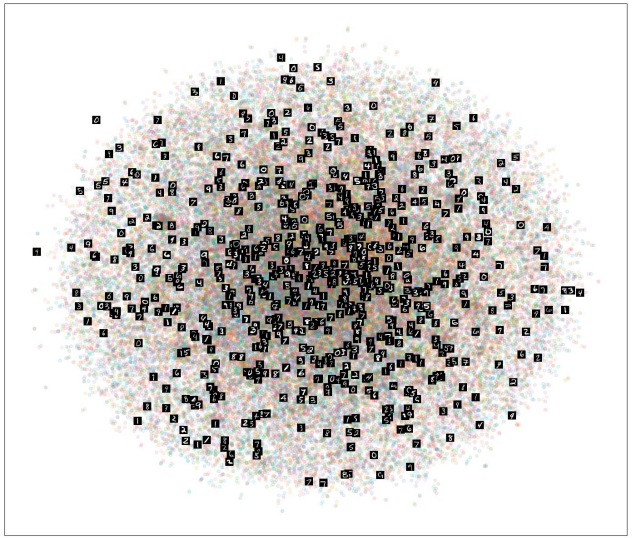
Generated samples

# Data mixture



Generated samples

# Noise adding



Generated samples

# Stable GAN training?