Realistic Image Generation using GANs

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A deep learning project on generating MNIST images

Abstract

- This project explores the power of Generative Adversarial Networks (GANs) to create realistic handwritten digits. Using a generator and discriminator, the model learns the underlying distribution of the MNIST dataset and produces fake images that become indistinguishable from real ones over time.

Dataset and Preprocessing

- Dataset: MNIST (60,000 images, 28x28 grayscale).
- Preprocessing Steps:
- - Normalize pixel values to [-1, 1]
- - Data loaded in batches using DataLoader

Model Architecture

- Generator:
- - Fully connected layers
- - Batch normalization
- - Activation: ReLU, Tanh (output)

- Discriminator:
- - Fully connected layers
- - LeakyReLU activations
- - Sigmoid for classification

Training Process

- Loss Function: Binary Cross Entropy
- Optimizer: Adam
- Epochs: 50

- Stability Techniques:
- - Label smoothing
- - Batch normalization
- - Gradual improvement with adversarial loss

Results and Observations

- Outputs over time:
- - Epoch 0: Random noise
- - Epoch 10: Slight patterns
- - Epoch 20: Recognizable digits
- - Epoch 50: Clear and realistic handwritten digits

- GANs can effectively learn distributions of complex datasets.

Generated Outputs

- Generated samples are saved in the 'generated' folder:
- - epoch_10.png
- - epoch_20.png
- - epoch_30.png
- - epoch_40.png
- - epoch_50.png

Generated Images - Epoch 10

Generated Images - Epoch 20

Generated Images - Epoch 30

Generated Images - Epoch 40

Generated Images - Epoch 50

THANK YOU