GENERATIVE ADVERSARIAL NETWORKS

11785- Introduction to Deep Learning

AKSHAT GUPTA
“This (GANS), and the variations that are now being proposed is the most interesting idea in the last 10 years in ML, in my opinion”

—Yann LeCun
Video: https://www.youtube.com/watch?v=QiiSAvKjIHo
WHAT ARE GANS?

Generative Adversarial Networks
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Generative Models
We try to learn the underlying the distribution from which our dataset comes from.
Eg: Variational AutoEncoders (VAE)
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\[ x \sim \text{(training set)} \quad \rightarrow \quad \text{Encoder} \quad \rightarrow \quad \text{Decoder} \]

\[ \text{Encoder} \quad \rightarrow \quad P(z) \quad \rightarrow \quad \text{Decoder} \]

\[ \mu \quad \rightarrow \quad \sigma \]
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Adversarial Training
GANS are made up of two competing networks (adversaries) that are trying beat each other.
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Generative Adversarial Networks

Neural Networks
WHAT ARE GANS?

P(z) ➔ Generator ➔ Generated Data
WHAT ARE GANS?

P(z) → Generator → Generated Data → Discriminator

Real/Fake?
WHAT ARE GANS?

P(z) → Generator → Generated Data

Real Data → Discriminator → Real/Fake?
HOW TO TRAIN A GAN?
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At $t = 0$,

- **Latent Vector** $\rightarrow$ **Generator** $\rightarrow$ **Generated Image** (fake image)

- **(fake data)** $\rightarrow$ **Generated Data** $\rightarrow$ **Discriminator** $\rightarrow$ **Real/Fake?**

- **(Real data)** $\rightarrow$ **Given Training Data** $\rightarrow$ **Discriminator** $\rightarrow$ **Real/Fake?**
HOW TO TRAIN A GAN?

At $t = 0$,

- Latent Vector → Generator
- Generator → Generated Image (fake image)

(fake data) → Generated Data

(Real data) → Given Training Data

Discriminator

Real/Fake?

Binary Classifier
HOW TO TRAIN A GAN?

Which network should I train first?
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Discriminator!

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The Discriminator is a Binary classifier.
The Discriminator has two class - Real and Fake.
The data for Real class if already given: THE TRAINING DATA
The data for Fake class? -> generate from the Generator
HOW TO TRAIN A GAN?

What’s next? -> Train the Generator

But how? What’s our training objective?
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But how? What’s our training objective?

Generate images from the Generator such that they are classified incorrectly by the Discriminator!
HOW TO TRAIN A GAN?

Step 1:
Train the Discriminator *using the current ability* of the Generator.
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Step 2: Train the Generator to beat the Discriminator.
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MNIST AND FASHION-MNIST