Generative Models— Concept Document

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Topic: Generative Models

Concept Overview

1. **Definition:** Generative Models are algorithms that learn data distributions and can create new, realistic samples.
2. **Goal:** Instead of only classifying, they model how data is generated.
3. **Types:** Variational Autoencoders (VAEs) and Generative Adversarial Networks (GANs).
4. **VAE Mechanism:** Encodes input into a latent space, then decodes it to reconstruct or generate new data.
5. **GAN Mechanism:** Two networks—a Generator (creates fake data) and Discriminator (detects fakes)—train against each other.
6. **Training Goal:** The Generator improves until the Discriminator can't tell real from fake.
7. **Applications:** Image synthesis, art generation, text creation, and data augmentation.
8. **Benefits:** Encourages creativity and enables data creation when real data is scarce.
9. **Limitations:** Requires heavy computation and can be unstable to train.
10. **Future Potential:** Key to deepfake detection, creative AI, and simulation research.

Reflection

Through studying generative models, I learned how machines can create realistic new data rather than only analyze it.
Understanding the interplay between a Generator and Discriminator clarified why training GANs is both powerful and tricky.
I also found it interesting how VAEs compress information into a latent space for controlled generation.
This topic showed me the creative side of AI—how models can generate images, music, and text similar to humans.