Generative Adversarial Networks (GANs)

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Introduction

Generative Adversarial Networks (GANs) is a type of machine learning model that can generate synthetic data that very closely resembles real-world data. A GAN will usually consist of two different neural networks to complete generation. This involves a generator and discriminator that compete to create a realistic style image. The generator will use try to produce an image to the best it can from random noise. The discriminator on the other hand will try to distinguish between real and fake using what the generator has created. Over time this process improves the generator's ability to produce highly realistic outputs.

Experiment Summary

For this project, I used *StyleGAN2-ADA*, which is pretrained GAN from NVIDIA and trained on the *Flickr-Faces-HQ* dataset which includes the high-resolution human faces to use. The model was loaded from .pkl file and ran using PyTorch in a Jupyter notebook *gan_image_generation.ipynb*. For generating images, I used 512x512 dimensions with PyTorch. These vectors are used by the generator, to produce the high-resolution face images. The generated tesnors were scaled from [-1, 1] to [0, 255] and converted into displayable images in RGB using the PIL library.

Observations

I generated multiple images using different latent input vectors and here is what I noticed. I noticed that the realism was consistent across all images. All images appeared with highly realistic facial features and details that made it feel hard to distinguish that it was AI generated or not. Small changes in vectors would give back entirely new faces and different expressions or backgrounds. The model was able to reliably produce this square portrait style images that all had consistent lighting and soft-focus style backgrounds.

Reflection

This project was fun to complete and helped me understand what goes into generative AI especially with pretrained GANs. Before this, I had seen AI-generated images online, but I did not fully understand what went into the process to generate these ultra-realistic images. Using StyleGAN2 in Jupyter notebook helped me understand the process and become more approachable. The latent vector input is like a “seed” for the image, that when altered can lead to a completely different output as it feeds the generator a new set of random noise. It can lead to entirely new outputs with noticeable differences in gender, age, facial features, and background. This project gave me a deeper appreciation and understanding for how these models can generate new realistic style images by GANs which involves the generator and discriminator.