Generating AI Task

Report: Generating Leaves With DCGAN

Introduction:

The goal of this project is to generate realistic images of leaves using a generative model, DCGAN (Deep Convolutional Generative Adversarial Network). This report outlines the rationale behind choosing DCGAN, details the training process, and provides an assessment of the quality of the generated leaf images.

Choice of Generative Model:

In selecting a generative model, three primary architectures were considered: GANs, VAEs, and DCGANs where DCGAN is a specific type of GAN with architectural enhancements for image generation tasks.

1. GANs:

While GANs are powerful, they may face challenges in generating high-resolution and detailed images of leaves due to the absence of convolutional structures optimized for image data.

2. VAEs:

VAEs are proficient in learning latent representations, but they might generate blurry images, potentially losing intricate details of leaf structures.

3. DCGANs:

Choice Rationale: DCGANs leverage convolutional layers designed for image data, preserving spatial features and capturing intricate patterns. This makes it an ideal choice for generating detailed and visually appealing leaf images.

Training Process:

Jovian is a platform for sharing and collaborating on Jupyter notebooks

While running python file you can copy paste the below when it asks for Jovian API key:

eyJ0eXAiOiJKV1QiLCJhbGciOiJIUzI1NiJ9.eyJmcmVzaCI6ZmFsc2UsImlhdCI6MTcwMTA5NzUxMywianRpIjoiNjdlZmM4ZGEtNzI3MS00NDIxLThhYTItZjc2ZDNlMmY4NTc1IiwidHlwZSI6ImFjY2VzcyIsImlkZW50aXR5Ijp7ImlkIjozOTE1MjksInVzZXJuYW1lIjoibGFua2FzYWlyYW15YTMxMDMifSwibmJmIjoxNzAxMDk3NTEzLCJleHAiOjE3MDQ5ODU1MTN9.EFtoRoyMGkCP8YEcwz0Tm1sp8G5JOic-foRX6GSd0vM

1. Dataset Selection:

A diverse dataset of leaves was collected from Plant Village Dataset around 15,000 images(Leaves Folder), encompassing various species and types to ensure the model's ability to generate a broad range of leaves.

2. Model Architecture:

Designed a DCGAN architecture with convolutional layers in both the generator and discriminator.

Utilized Leaky ReLU activations and Batch Normalization for stable training and model is executed is executed for 100 epochs.

3. Loss Function:

Implemented adversarial loss for the generator and discriminator.

Included auxiliary losses to ensure convergence and stability.

4. Training:

Trained the DCGAN model on the leaf dataset, monitoring losses and adjusting hyperparameters for optimal performance.

Employed checkpoints to facilitate model evaluation.

Assessment of Output Quality(Generated folder):

1. Visual Fidelity:

The generated leaf images exhibit high visual fidelity, capturing intricate details and colors present in real leaves.

2. Diversity:

The model demonstrates the ability to generate diverse leaf types, reflecting the variability present in the training dataset.

3. Sharpness and Clarity:

The generated images are sharp and clear, avoiding issues like blurriness commonly associated with generative models.

4. Domain-Specific Features:

The model successfully captures domain-specific features like veins, textures, and shapes unique to leaves.

Conclusion:

The choice of DCGAN for generating leaf images has proven effective in capturing the complexity and diversity of leaves than GANs or VAE's. The training process, resulted in a model capable of producing high-quality, detailed, and diverse leaf images. This generative model can be used to generate any images of chosen Dataset such as Human Faces, Objects etc.