Image Generation using Diffusion Models

Objective

The goal of this exercise is to understand and implement diffusion models for image generation. You will be working with a dataset of your choice and use a diffusion model to generate new images.

Tasks

1. **Dataset Selection:** Choose an image dataset that you find interesting. It could be anything from handwritten digits (MNIST) to faces (CelebA). Make sure the dataset is large enough for the model to learn diverse patterns.
2. **Preprocessing:** Preprocess the images in your dataset. This might involve resizing the images, normalizing the pixel values, etc.
3. **Model Implementation:** Implement a diffusion model for image generation **or use a pre-trained model**. (You can start with a simple model and then experiment with more complex architectures). If you are using pre-trained models : make sure to understand the underlying principles of the model, including the diffusion process and the reverse process used for generation.
4. **Training:** Train your model on your preprocessed dataset. Monitor the loss function to ensure your model is learning.
5. **Generation:** Use your trained model to generate new images. Start with a random sample from a Gaussian distribution and apply the reverse diffusion process.
6. **Evaluation:** Evaluate the quality of the generated images. This can be subjective.
7. **Report:** Document your process, findings, any issues you faced, and how you resolved them. Include visualizations of the generated images.