Variational Autoencoder (VAE) Experiments

This project contains a series of experiments to analyze the performance of Variational Autoencoders (VAEs) with different architectures and hyperparameters, using the MNIST dataset of handwritten digit images.

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Requirements

Python 3.6 or higher

PyTorch 1.8.0 or higher

torchvision

NumPy

Matplotlib

scikit-learn

Project Structure

main.py: The main script containing the code for data preparation, VAE model definition, training, and comparison.

samples: A directory for storing generated and reconstructed images from the models.

data: A directory for storing the MNIST dataset.

README.md: This readme file with an overview of the project and usage instructions.

Usage

Ensure you have all the required packages installed.

Run the main.py script to perform the experiments and generate the results.

bash

Copy code

python main.py

Check the samples directory for generated and reconstructed images from the models.

Experiments

The project includes the following experiments:

Comparison of 3-layer and 4-layer VAE models based on optimal loss and visual inspection of generated and reconstructed images.

Comparison of 3-layer VAE models with different hidden and latent layer dimensions.

Comparison of a 3-layer VAE model with a 3-layer autoencoder model based on optimal loss and visual inspection of generated and reconstructed images.

Summary of Findings

The 4-layer VAE model performs slightly better than the 3-layer model in terms of optimal loss.

For 3-layer VAE models with different hidden and latent layer dimensions, models with larger hidden layers and more compact latent spaces perform better.

When comparing the VAE and autoencoder models, the autoencoder has a lower optimal loss but produces less realistic generated images.

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