COV877 Assignment

Submission Deadline : 23rd April 2025, 11:59 PM
Viva Date : 25th April

- The assignment needs to be done *individually*.

- Any plagiarism detected in the assignment will lead to zero in the assignment, and a grade reduction on top of it.

Problem 1: Score-Based Diffusion Models for Image Generation

The objective of this assignment is to implement image generation models from scratch. Use of libraries like **diffusers** etc from Huggingface which have full implementation of such models **are not allowed**. You are allowed to use libraries like (Jax, equinox, optax, diffrax, PyTorch etc.), to write algorithmic parts like Langevin dynamics, SDE, ODE, or neural networks of the diffusion models.

Dataset : CIFAR10. Use official training split for training, test split for evaluation, and analysis.

(a) (20) Implement a score-based diffusion model, using a stochastic differential equation based time conditional noising approach.

(b) (20) Train (a) score-based diffusion model using classifier-free guidance.

(c) (10) Implement a probability flow ODE based sampling process.

(d) (10) Qualitatively compare and analyze the results of (a), (b) and (c).

(e) (10) Quantitatively report the FID scores of (a), (b) and (c).

(f) (10) Select two distinct classes and randomly choose two samples, one from each. Show visual results of latent space interpolation between these two samples. Also, report the FID values of each interpolated sample. Generate interpolated results using all three models (a), (b) and (c).

(g) (20) Viva-voce. This part includes Viva-voce on the submitted report and implementation.

Hint : Refer to the slides for score-based diffusion model or original author Yang-song's paper or blog post.

Submission Requirement :

- Submit your complete assignment as a single .zip file containing PDF and google colab notebook (as described below) over email to lokender.work@gmail.com

- Create a single PDF add following information in it.

- Training and Validation Loss plots of (a), (b) and (c)
- Qualitative comparison of results from (a), (b) and (c). Take 2 random samples from each of 10 classes for comparison.
- Report FID scores on test set using method trained in (a), (b) and (c). Analyze the FID score and give your conclusions.
- Visual results of the interpolation. Randomly sample 3 pairs of distinct classes and show interpolation results.

- A Google colab notebook, **with output logs** (do not clear the outputs of each of the cells in the notebook)