# Project description and feedback

July 21, 2024

## 1 Project description

### 1.1 Formalities

Hand in a single report in PDF format and your code in a single file (zip or tar archive). The report must include:

- A single page with the main text, including figures and tables. Include names, student numbers, course number, and the title "Mini-project 1".
- Unlimited pages of references.
- A single page of well-formatted code snippets.

Use at least font size 10pt and margins of at least 2cm. Content violating these limitations will not be evaluated.

### 1.2 Project Description

Train and evaluate various deep generative models on binarized MNIST and MNIST. The project has three parts:

#### 1.2.1 Part A: Priors for VAEs

Train VAEs with the following priors:

- Standard Gaussian prior.
- Mixture of Gaussian (MoG) prior.
- Flow-based prior.

For each prior:

- Plot the prior and the aggregate posterior.
- Compare the match between priors and posteriors.
- Evaluate test set log-likelihood using ELBO.

- Report mean and standard deviation over multiple runs.
- Briefly describe encoder and decoder architectures.

Optional: Implement an alternative prior or report a better log-likelihood approximation like the IWAE bound.

#### 1.2.2 Part B: Sampling Quality of Generative Models

Train the following models on standard MNIST:

- Flow-based model.
- Denoising Diffusion Probabilistic Model (DDPM) using a U-Net.

In the report:

- Show four samples for each model and a VAE of your choice.
- Qualitatively compare the sampling quality.
- Briefly describe the architectures used.

Optional: Quantitatively compare sampling quality using metrics like FID.

#### 1.2.3 Part C: Code Snippets

Include snippets showing:

- VAE ELBO evaluation for a non-Gaussian prior.
- Central parts of the Flow-based prior implementation.
- DDPM ELBO implementation.
- DDPM sampling algorithm implementation.

## 2 Feedback

Excellent work, with very few shortcomings. Your technical presentation is very clear. Part A: You have a clear presentation and discussion of plots and ELBO results. Your ELBO results are very low, probably due to using a 2D latent space, and your IWAE results are too high (should be around -80 for binary MNIST). Your plots are very good, but you lack a scale for the density. You implement both the VAMP prior and the IWAE bound. Part B: You have a clear presentation and discussion of samples. You implemented the FID and KID scores and compared the scores to your qualitative results.