MSc Project:
Latent Diffusion Models For Cardiac Attribute Regularization

Abstract: Diffusion models have recently caught the attention of the medical imaging community by producing realistic synthetic images [1]. Recent efforts have focused on improving model controllability of the generation process by allowing selective modifications of data attributes, such as altering the gender of a person in an image [2]. Pinaya et al. [5] used Latent Diffusion Models (LDMs) to generate realistic data of brain MRI controlled by attributes such as age, sex, and brain structure volumes. Furthermore, Cetin et al. [3] used an attribute regularization loss [4] to regularize cardiac attributes on a learned representation and used it to perform interpretable prediction.

This project aims to use latent diffusion models to generate realistic cardiac MRI and control the generation process by given attributes such as age, cardiac volumes, etc. A second step will consist of comparing with the attributed regularized methods proposed by [3]

Requirements:

- Prior experience and good understanding in machine learning and statistics.
- Very good programming skills in Python (and PyTorch).
- Interest in medical imaging.

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References

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[2] Lample, Guillaume, et al. "Fader networks: Manipulating images by sliding attributes." *Advances in neural information processing systems*, (2017).

[3] Cetin, Irem, et al. "Attri-VAE: Attribute-based interpretable representations of medical images with variational autoencoders." *Computerized Medical Imaging and Graphics*, (2023).

[4] Pati, Ashis, and Alexander Lerch. "Attribute-based regularization of latent spaces for variational auto-encoders." *Neural Computing and Applications 33*, (2021).

[5] Pinaya, Walter HL, et al. "Brain imaging generation with latent diffusion models." *MICCAI Workshop on Deep Generative Models*, (2022).