MSc Project: Latent Functional Maps for Medical Imaging

Abstract:

Neural Networks (NNs) learn to represent high-dimensional data as elements of lower-dimensional latent spaces. Modeling the relationships between these representational spaces is an ongoing challenge. Successfully addressing this challenge could enable the reuse of representations in downstream tasks, reducing the need to retrain similar models multiple times [1–4]. Recently, Fumero et al. [4] leveraged the internal geometry of representations and proposed applying latent functional maps to align representations across distinct models, demonstrating its relevance for comparing representations. However, these kinds of approaches have not yet been explored in the context of medical imaging datasets, where aligning multimodal representations could significantly enhance the effectiveness of models in medical applications.

This project aims to use latent functional maps to align multimodal medical representations (e.g., text and vision). The first part of the thesis will involve a literature review on representation similarity. This will be followed by experimenting with the latent functional maps approach on a toy dataset of medical images and later applying it to real medical imaging tasks.

Requirements:

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

Affiliation:

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Supervision: Dr. Maxime Di Folco

Application:

Please send an email, including a CV, a current transcript of records and a brief statement on why you are interested in the project, to maxime.difolco@helmholtz-munich.de.

References

[1] Maiorca, V., Moschella, L., Norelli, A., Fumero, M., Locatello, F., Rodolà, E. (2024). Latent space translation via semantic alignment. *Advances in Neural Information Processing Systems*, 36.

[2] Maiorca, V., Moschella, L., Fumero, M., Locatello, F., Rodolà, E. (2024). Latent Space Translation via Inverse Relative Projection. arXiv preprint arXiv:2406.15057.

[3] Moschella, L., Maiorca, V., Fumero, M., Norelli, A., Locatello, F., Rodolà, E. (2022). Relative representations enable zero-shot latent space communication. arXiv preprint arXiv:2209.15430.

[4] Fumero, M., Pegoraro, M., Maiorca, V., Locatello, F., Rodolà, E. (2024). Latent. Functional Map. arXiv preprint arXiv:2406.14183.