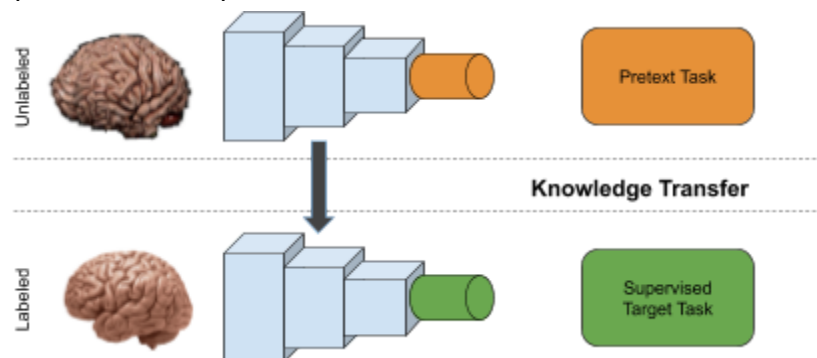


Unsupervised Representation Learning from 3D Medical Images

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Medical imaging plays a vital role in patient healthcare, as it aids in disease prevention, early detection, diagnosis, and treatment. Yet efforts to utilize advancements in machine learning algorithms are often hampered by the sheer expense of the expert annotation required. Generating expert annotations of 3D medical images at scale is non-trivial, expensive, and time-consuming. Another related challenge in medical imaging is the relatively small sample sizes, e.g. when studying a particular disease. Hence, scarcity of data and annotations are some of the main constraints for supervised machine learning in medical imaging.

A viable alternative is to employ self-supervised (unsupervised) methods, which proved successful in multiple domains recently. In these approaches, the supervisory signals are derived from the data. In general, we withhold some part of the data, and train the network to predict it. This prediction task defines a proxy loss, which encourages the model to learn semantic representations about the concepts in the data. Subsequently, this facilitates data-efficient fine-tuning on supervised downstream tasks, reducing significantly the burden of manual annotation. Unlabelled medical images carry valuable information about organ structures, and self-supervision enables the models to derive notions about these structures with no additional annotation cost. A particular aspect of most medical images, which received little attention by previous self-supervised methods, is their 3D nature.



In this Master's thesis, you will work on developing state-of-the-art unsupervised methods for representation learning from 3D images. 3D imaging has numerous applications, such as in Robotic navigation, in CAD imaging, in Geology, and in Medical Imaging. While the focus is on medical imaging as a test-bed for the developed 3D algorithms in this thesis, their applicability to other 3D domains should be ensured. By working on this thesis, you may be advancing the

state-of-the-art for unsupervised representation learning from 3D images. Only little work has been done in this line of research [1,2,3,4].

Your profile

- Master's student in Computer Science (ITSE), Digital Health (DH), Data Engineering (DE), and all related programs.
- Knowledge in areas of Deep Learning (ideally attended deep learning courses offered by the chair)
- Good programming skills (e.g. Python)
- Experience in Deep Learning frameworks (e.g. Tensorflow or PyTorch) would be a great plus
- Quick learner and willing to share knowledge
- Good English language skills

If you find this topic interesting, please contact us.

References

[1] <https://arxiv.org/abs/2006.03829>

[2] <https://arxiv.org/abs/2006.10511>

[3] <https://arxiv.org/abs/1908.06912>

[4] <https://arxiv.org/abs/1910.02241>