Research proposal Jens

With transfer learning, a network is first trained on a different, larger dataset. This dataset can be unrelated (eg. cats when the final task is something medical) but must be of the same type (photos, sound). Medical datasets can be relatively small. Transfer learning can help learning features from larger datasets, that can then be used for the medical datasets.

There are three main strategies that can be used:

* Training from scratch: Random weight initialization and only using data from the target domain for training (no transfer learning)
* Using off-the-shelf features: Training on source data, use pre-trained network to extract features from target data, after this training another classifier
* Training with fine-tuning: Network is trained on source data, then this network is used as initialization for the weights of the network that is used for further training on the target data. Layers can be frozen so their weights do not change.

Papers comparing models that were pre-trained on non-medical and medical image data draw different conclusions when it comes to when performance is best. Some papers conclude that it is better to pre-train a model on non-medical image data, whereas other papers state medical image data is better suited for pre-training. Other papers are inconclusive or do not find a significant difference.

Cheplygina, V. (2019). Cats or CAT scans: Transfer learning from natural or medical image source data sets? *Current Opinion in Biomedical Engineering*, *9*, 21–27. https://doi.org/10.1016/j.cobme.2018.12.005

In the study below, low level and high level features are extracted from different deep CNN architectures. These features are used to train and optimize different classifiers. Low-level features tend to outperform high-level ones in most datasets. A total of five feature were assembled across low-mid and high levels of the CNN architecture. All features were used as input to train and optimize four different classifiers.

The performance comparison showed that the discriminatory power difference of high-level and low-level features is highly dependent on the used model. Densely connected layers may have the superior performance to the other layers. High level features are more specific to a certain task and will be easily affected during the fine tuning step, but may also have high generalization ability. The highest classification accuracy was achieved by a deeper architecture (GoogLeNet).

Qiu, Y., Du, Y., Zhang, R., Zargari, A., Thai, T., Gunderson, C., Moxley, K., Liu, H., & Zheng, B. (2018). A performance comparison of low- and high-level features learned by deep convolutional neural networks in epithelium and stroma classification. *Medical Imaging 2018: Digital Pathology*. https://doi.org/10.1117/12.2292840

We zouden twee networks kunnen vergelijken, een met relatief veel layers en een minder diepe? Vervolgens zouden we kunnen gaan kijken naar high level features en low level features, en deze gebruiken om classifiers te trainen en optimaliseren. Daarna zouden we de model performance kunnen vergelijken.