Circle of Willis Segmentation-based Classification

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1. Brief Explanation of our Approach

Due to lack of time, we only addressed the classification task of the competition, and did not attempt to solve the measuring side of the challenge. Our approach is based on three sub-models that carry out 1) approximate Circle of Willis (CoW) localization (bounding box), 2) CoW segmentation, and 3) CoW configuration classification. In 1) and 2), we trained a five-fold ensemble model with an architecture similar to the dynamic unet proposed in the nnUNet framework (Isensee et al., 2021), but implemented in the Monai library. The organization of CROWN did not provide any segmentation annotations, but we we able to use the annotations supplied in the sister competition (TopCoW).

For 1) we trained a model on downsampled data volumes (at 96x96x48 resolution), as we just required a rough CoW localization. The second model is trained at the same resolution, but instead of on downsampled volumes, it learns from volumetric patches sampled from non-resized data. In test-time, the segmentations are built with a sliding window approach.

Next segmentations are cropped from the initial full-size volume and downsampled to the average shape of 206x180x74. Note that we do not use binary segmentations, but rather each voxel holds the likelihood of being part of the CoW. With this dataset of cropped segmentations, we proceed to train the classifier 3), which again is learned in a five-fold manner, using two architectures, namely Densenet121 and EFficientNet B0. The resulting ten models are ensembled to produce a category prediction on new samples.

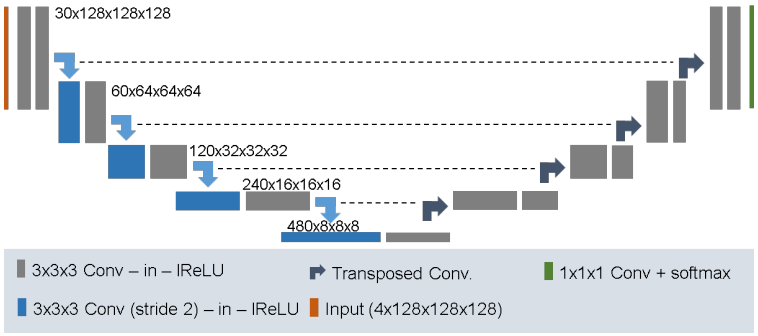

Figure 1: Example of nnUnet architecture, image from (Isensee et al., 2021)

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References

Fabian Isensee et al. nnu-net: a self-configuring method for deep learning-based biomedical image segmentation. *Nature methods*, 18(2):203—211, February 2021.