

# U-net CNN model for Segmentation of White Matter Hyperintensities

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## 1 Data

We use 60 MRI scans (T1 and FLAIR) from WMH 2017 Challenge [1]. The images were acquired from 3 sources: Utrecht, Amsterdam, and Singapore. The Data was provided by the 2017 WMH challenge. For the training, we utilized 52 scans, and for validation 8 scans.

## 2 Preprocessing

We use data augmentation with Rotation, shearing, scaling along the horizontal direction, and scaling along the vertical direction ( $y$ -scaling). Originally based on sysu\_media team [2], our preprocessing process on the data is almost the same. The same Voxel normalization procedure in the data is employed. Each slice is normalized using the mean and standard deviation of itself. Then we cropped or padded each slice such that its size became 200X200.

## 3 Methodology

The segmentation model follows the basic architecture of an U-Net. The model has 21 layers following the U-net model, including 15 convolutional layers, 3 up-sampling layers and 3 pooling layers. Figure 1 shows the diagram of the model. The convolutional layers have a 3x3 convolution filter, with the exception of the two first convolutional layers which use a 5x5 filter. After each convolutional layer a RELU activation function is applied. The green boxes represent the max pooling operation with a 2x2 filter. The green layers represent upsampling operations. The number of filters in each layer goes from 64 in the two first convolutional layers, to 128, 256 and 512 filters. In this model We do not use an ensemble model.

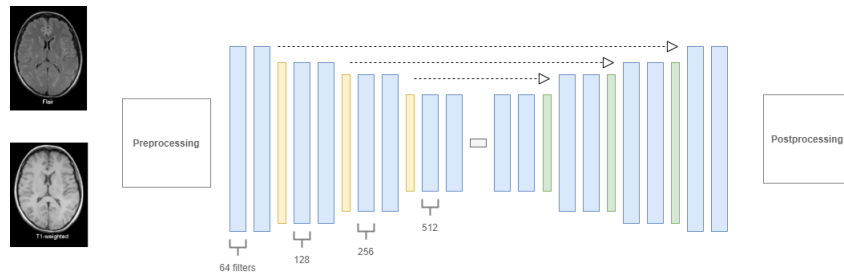


Figure 1: Neural Network Diagram

## 4 Postprocessing

The postprocessing is made over the mask after it is generated from the model. The postprocessing is mostly done to resize the mask to the original T1 and FLAIR images used to produce it. Also at the beginning and end of the mask we set the values to zero, because there is not information in this part of the mask.

## References

- [1] Hugo J Kuijf, J Matthijs Biesbroek, Jeroen De Bresser, Rutger Heinen, Simon Andermatt, Mariana Bento, Matt Berseth, Mikhail Belyaev, M Jorge Cardoso, Adria Casamitjana, et al. Standardized assessment of automatic segmentation of white matter hyperintensities and results of the wmh segmentation challenge. *IEEE transactions on medical imaging*, 38(11):2556–2568, 2019.
- [2] Hongwei Li, Gongfa Jiang, Jianguo Zhang, Ruixuan Wang, Zhaolei Wang, Wei-Shi Zheng, and Bjoern Menze. Fully convolutional network ensembles for white matter hyperintensities segmentation in mr images. *NeuroImage*, 183:650 – 665, 2018.