Open-source Deep-learning Tool for Brain Lesion and Structure Segmentation

Project Management and Software Development for Medical Applications

General Info
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Project Abstract
Accurate segmentation of white matter (WM) lesions and the claustrum structure in brain magnetic resonance imaging (MRI) has become a crucial criterion for diagnosis and predicting prognosis in early disease. Deep learning-based methods were established for the two tasks; however, open-source tools were not ready for the maximum impact of the developed methods. The goal of the project is to develop open-source segmentation tools/software that could be used for research worldwide.

Background and Motivation
White matter (WM) lesions are commonly found in the brains of healthy elderly individuals and have been associated with various neurological and geriatric disorders. In MICCAI 2017, we won the WM lesions segmentation challenge using deep learning techniques [1]. Currently, the team from department of Neuroradiology in TUM hospital is very interested in applying this algorithm into their clinical practice. Pertaining to the function of the claustrum in brains, evidence exists for a role in basic cognitive processes such as selective attention or task switching. Thus, in order to promote our understanding of the claustrum in humans, an objective and accurate, automated segmentation method going beyond the limitations of established methods is needed.

Recently, we have developed a deep-learning based segmentation method for claustrum segmentation [3]. The goal of this project is to pack our segmentation model as open-source tools and contribute to the research community.

Student’s Tasks Description
Generally, the student will first learn the deep learning-based segmentation models and then contribute a package/software to PYPI (https://pypi.org/) so that our method can be easily used by researchers worldwide. Specifically, for the software design, there are three main steps:
1. Test the pre-trained models locally with a few datasets.
2. Description of the usage of the tool like here: https://pypi.org/project/deepbrain/
3. Upload them to PYPI (the student will be the maintainer and will be acknowledged)

Technical Prerequisites
Good knowledge in Python programming is necessary. Knowledge in deep learning is not necessary but preferable.

References
[1] Fully convolutional network ensembles for white matter hyperintensities segmentation in mr images, Neuroimage

Please send the completed proposal to ardit.ramadani@tum.de, zj.jiang@tum.de, jennart.bastian@tum.de and tijinyu.song@tum.de. Please note that this proposal will be evaluated by the BMC coordinators and will be assigned to a student only in case of acceptance.
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