

# Vascular Lesion Detection Using Weakly/Semi-supervised Learning (MICCAI 2021 Vascular Lesion Detection Challenge [1])

## 1. General Info

Project Title:

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## 2. Project Abstract

In this project, we employ weakly and semi-supervised learning methods for vascular lesion detection in brain MRI images using the dataset of the Vascular Lesion Detection challenge for the MICCAI 2021. We will work on the first track of the challenge (Task 1: Segmentation of Enlarged Perivascular Spaces). The Perivascular Spaces (PVS) are annotated in a few scans and the rest of the scans only contain the number of PVS. The goal is to come up with a methodology that uses the number of PVS in each scan (weak labels) in order to produce segmentation annotations for PVS (thus, weakly-supervised learning). Moreover, we utilize the segmentation annotations available in a few scans (thus, semi-supervised learning). The first subgroup (two students) focus on modeling the weakly supervised learning solution and the second group focuses on the semi-supervised solution. During the project, the team and tutors brainstorm on how to combine the two solutions. In case of achieving competitive results, the method and the result will be submitted to MICCAI challenge.

## 3. Background and Motivation

White Matter Hyperintensities (WMH) in MRI images are one of the main indicators of cerebral small vessel disease (CSVD). To achieve accurate CSVD identification, a few markers along with WHM should be annotated including lacunes, enlarged perivascular spaces and cerebral microbleeds. However, the manual segmentation of these biomarkers is time-consuming and has enormous inter- and intra- variability. Moreover, distinguishing them from each other is too challenging due to their small size and structural similarity.

In this project, we will examine weakly-semi supervised deep learning methods for vascular lesion detection challenge in MICCAI 2021. Several critical issues should be addressed for this challenge including the small size of the lesions, imbalance of the data, and lack of sufficient ground truth.

## 4. Technical Prerequisites

- Background in deep learning
- Python proficiency
- PyTorch experience

## 5. Benefits:

- Learn about medical image segmentation using weakly and semi supervised learning.
- Possibility of Participating in the MICCAI challenge
- Possibility of writing a scientific paper for MICCAI workshop.

## 6. Students' Tasks Description

Students' tasks would be the following:

**Both groups:**

- Get familiar with the first task of the challenge [1], the problem [2], and the dataset
- Set up the pipeline for working with the challenge data
- Setup the evaluation pipeline

**Group 1:**

- Get familiar with weakly supervised learning methods [3] [4]
- Discuss and select a weakly supervised solution for this problem with the help of the tutor
- Implement the solution
- Compare the results with the other team
- prepare final report
- optional: combine the method with the other group

**Group 2:**

- Get familiar with semi-supervised learning methods [4]
- Discuss and select a semi-supervised solution for this problem with the help of the tutor
- Implement the solution
- Compare the results with the other team
- prepare final report
- optional: combine the method with the other group

**7. Work-packages and Time-plan:**

	Description	#Students	From	To
<b>WP1</b>	Get familiar with the dataset	4	22.04	29.04
<b>WP2</b>	Setup pipeline for working with dataset	4	29.04	06.05
<b>WP3</b>	evaluation pipeline	4	06.05	13.05
<b>WP4</b>	Group1: Get familiar with WSS Group 2: Get familiar with Semi-supervised learning	4	13.05	20.05
<b>WP5</b>	Group 1: Implement and Test the base WSS solution (discuss with tutor) Group 2: Implement and Test the base Semi-supervised learning solution (discuss with tutor)	4	20.05	03.06
<b>WP7</b>	Discuss and compare results – prepare for intermediate presentation	4	03.06	10.06
<b>M1</b>	Intermediate Presentation	4	10.06.2021	
<b>WP8</b>	Try more advanced solutions (moreover, explore the possibility of combining methods)	4	10.06	08.07
<b>WP12</b>	Prepare Final Documentation and presentation	4	08.07	15.07
<b>M2</b>	Final Presentation	4	15.07.2021	

## References

- [1] "Vascular Lesion Detection Challenge 2021," [Online]. Available: <https://valdo.grand-challenge.org/Description/>.
- [2] Y. P. A. H. B. G. I. M. N. W. V. M. d. B. M. Dubost F, " Enlarged perivascular spaces in brain MRI: Automated quantification in four regions," *Neuroimage*, 2019 .
- [3] "ECCV 2020 Tutorial on Weakly-Supervised Learning in Computer Vision," [Online]. Available: <https://hbilen.github.io/wsl-eccv20.github.io/>.
- [4] M. Z. Y. Z. J. M. Y. L. B. a. Y. R. 2. Zhang, "A survey of semi-and weakly supervised semantic segmentation of images. Artificial Intelligence Review," pp. pp.1-30.
- [5] H. H. Van Engelen JE, "A survey on semi-supervised learning. Machine Learning," 2020.

