Universitat Pompeu Fabra Barcelona

Master in Bioinformatics for Health Sciences

Master project 2024-2025

Personal Information

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Project

Computational systems biology

Project Title:

Development of sensitive biomarkers for regional white matter lesions in degenerative diseases

Keywords:

Diffusion tensor imaging, Neurodegenerative Disorders, Neuroimaging, MRI, White matter lesions

Summary:

White matter hyperintensities (WMH) are a very common finding on brain MRI in older subjects and patients with dementia, and represent areas of demyelination, gliosis, and axonal loss within the brain's white matter. It is likely that WMH do not develop abruptly and that tissue changes are already present before the lesions become apparent on MRI. Yet, little is known about the earliest quantifiable changes that can be found in normal-appearing white matter that will convert to WMH. The aim of this project is to identify sensitive metrics from different MRI sequences (T1, T2, FLAIR, DTI) that predict the emergence of WMH in different neurodegenerative diseases. This will include to identify normal-appearing white matter that convert to WMH in the following years using longitudinal FLAIR data, preprocess distinct MRI modalities (especially DTI) to extract metrics of interest (e.g., fractional diffusivity, mean diffusivity) in these regions, and conduct multimodal analyses using the data from >200 individuals. Specifically, the master student will: (1) Acquire knowledge about the pathophysiology of different neurodegenerative diseases in a highly interdisciplinary environment (e.g., alongside PhD researchers, engineers, neurologists, neuropsychologists, nurses, and biologists). (2) Learn about the state-of-art methods to segment WMH and preprocess Diffusion tensor imaging (DTI) (3) Contribute to the development of sensitive markers for white matter lesions adapted to different diseases. (4) Learn programming skills (e.g., R, Python, Matlab) to manipulate data, display results and perform descriptive and inferential statistics (e.g., two-sample t-tests, regressions, linear models). Note that other projects related to neuroimaging in neurodegenerative diseases are also available. Please contact us if you would like additional information.

References:

DOI: 10.1161/STROKEAHA.112.680223; 10.1038/nrneurol.2015.10; 10.1016/j.neuroimage.2021.117839

Expected skills:

Ability to interact in English, interest about the brain and neurosciences, curiosity regarding neurodegenerative diseases.

Possibility of funding:

No

Possible continuity with PhD:

To be discussed

Comments:

(1) Possibility of hybrid work: Yes (2) Remuneration: No. But the Memory Unit provides a highly stimulating research environment with interaction with clinicians, researchers, biologists, etc., as well as a wide range of opportunities including attending clinical activities and weekly scientific session. (3) A previous student from the MSc in Bioinformatics for Health Sciences is doing the PhD with us, and another is planning to start the PhD: they will be available to help with specific questions related to the project and team. (4) Focus on producing publishable work by the end of the TFM that will strengthen applications for a PhD or other research-related work. (5) Vibrant and collaborative working environment.