Universitat Pompeu Fabra Barcelona

Master in Bioinformatics for Health Sciences

# Master project 2024-2025

## Personal Information


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| **Supervisor** | Bejanin Alexandre |
| **Email** | ABejanin@santpau.cat |
| **Institution** | Institut de Recerca Sant Pau, Barcelona |
| **Website** | https://santpaumemoryunit.com/ |
| **Group** | San Pau Memory Unit |


## Project

# Computational systems biology

**Project Title:**

Structural MRI for Early Detection of Alzheimer's Disease in Down Syndrome


**Keywords:**

Structural MRI, Down Syndrome, Alzheimer's Disease, Neuroimaging, Preprocessing


**Summary:**


Individuals with Down Syndrome (DS) are at an ultra-high risk (>90%) of developing Alzheimer's disease, and structural MRI is a valuable tool for understanding the anatomy of DS and detecting early signs of Alzheimer's disease. However, the preprocessing of structural MRI in DS can be complex due to developmental abnormalities, including an overall smaller brain size and regional differences compared to the general population. The aim of this project is to implement and compare different preprocessing pipelines for structural MRI to improve our understanding of the anatomy of DS and optimize the early detection of Alzheimer's disease in this population. This will include the comparison of different neuroimaging softwares (e.g., SPM vs Freesurfer), metrics (e.g., volume, surface, area), methods to adjust for brain size, and normalization approaches (e.g., standard vs DARTEL) using the data from >400 individuals with DS and controls. Specifically, the master student will: (1) Acquire knowledge about the pathophysiology of Alzheimer's disease and Down Syndrome in a highly interdisciplinary environment (e.g., alongside PhD researchers, engineers, neurologists, neuropsychologists, nurses, and biologists). (2) Learn about state-of-the-art methods for processing of structural MRI. (3) Contribute to the implementation of new preprocessing pipelines for neuroimaging in DS. (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:**


10.1016/S1474-4422(21)00245-3; 10.1001/jamaneurol.2021.1893; 10.1016/j.nicl.2017.10.022; 10.1002/dad2.12324


**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.