Universitat Pompeu Fabra Barcelona

Master in Bioinformatics for Health Sciences

Master project 2021-2022

Personal Information

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Project

Computational systems biology

Project Title:

The neuroactive potential of the underexplored fraction of the human microbiome and its association with health and disease

Keywords:

Microbiome, gut-brain axis, metagenomics

Summary:

There is evidence of bidirectional communication between the gut microbiota and the nervous system (gut-brain axis), potentially playing a role in brain development, brain physiology, and behavior. One of the main mechanisms of gut-brain communication is the metabolism of molecules with neuroactive properties (neuroactive compounds) by members of the gut microbiota. Metagenomic sequencing provides insight into both species composition and their functional potential, but dedicated tools are crucial for gut-brain axis systematic analysis and interpretation. To this end, we assembled the first reference catalogue of neuroactivity of human gut microorganisms, which allowed us to perform the first population-level study on the link between the gut microbiome and quality of life and depression (Valles-Colomer et al, 2019). Metagenomics is rapidly evolving, and a wide diversity of the human microbiome remains unexplored. By gathering >9,000 samples from 47 different metagenomic datasets across the world, we assembled >150,000 genomes from metagenomes, and found >75% of them to belong to so far uncharacterized species (Pasolli et al, 2019). The neuroactive potential of this underexplored diversity, as well as its contribution to host health and disease remains unchartered territory. The aims of this project are 1) to expand the manually-curated neuroactivity framework (gut-brain modules) to recently-described microbiota-derived compounds influencing host health, 2) to assemble a reference catalogue of neuroactivity of so far uncharacterized members of the microbiome, and 3) to perform an association study between microbiome neuroactivity and host health and disease on a set of publicly-available and host lab datasets. The project will be carried out under supervision of Dr Mireia Valles-Colomer at the Segata Lab (CIBIO, University of Trento, Italy), an international and multidisciplinary work environment with access to high-performance computing resources and cutting-edge data. Remote working arrangements are possible.

References:

Valles-Colomer, M. et al. The neuroactive potential of the human gut microbiota in quality of life and depression. Nat. Microbiol. (2019). doi:10.1038/s41564-018-0337-x. Pasolli, E. et al. Extensive Unexplored Human Microbiome Diversity Revealed by Over 150,000 Genomes from Metagenomes Spanning Age, Geography, and Lifestyle. Cell 176, 649–662 (2019).

Expected skills::

Familiarity with Python/R programming, notions of microbiology and multivariate statistics..

Possibility of funding::

To be discussed

Possible continuity with PhD: :

To be discussed