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MÁSTER EN MÉTODOS COMPUTACIONALES EN CIENCIAS

Project Nº 13 ASIGNADO

Título: Predicting the cellular composition and molecular makeup of the neurovascular unit using machine learning methods

Departamento/ Laboratorio: Programa Biología computacional

Director: Mikel Hernaez
Correo electrónico: mhernaez@unav.es
Codirector: Ana Garcia-Osta
Correo electrónico: agosta@unav.es

Resumen

The blood-brain barrier (BBB) lines the majority of brain blood vessels and conducts critical brain functions such as regulating cerebral blood flow, delivering essential nutrients for sustaining brain functions, and removing toxic metabolites from the brain. In addition, the BBB serves as a formidable barrier protecting the brain from circulating xenobiotics and immune challenges emanating from the periphery. These BBB functions are conducted in coordination with other brain cells such as astrocytes and neurons, which together form the neurovascular unit (NVU). These BBB functions are disrupted in metabolic and neurological diseases, although the underlying pathological mechanisms are only partially understood. Large-scale bulk-RNA sequencing studies identify altered molecular pathways within the entire brain tissue, but fall short of identifying differences among individual cell types, particularly in less abundant BBB endothelial cells. Moreover, existing deconvolution approaches are inadequate to parse NVU genomic data into individual cell signatures. We propose to address this critical challenge by: (1) Developing a novel data-driven learning framework through a multidisciplinary effort that will combine neuroscience, computational biology, and machine learning expertise. (2) Innovating deep learning methods to accurately quantify neurovascular unit (NVU) cell-types from bulk RNA-Seq data; a challenge that constrains our ability to identify pathophysiological changes in NVU structure and function in health and disease. (3) Achieving systems innovation to produce interpretable visualizations of the strategies learned by the deep-learning models.

ASIGNATURAS OPTATIVAS RECOMENDADAS

1. Análisis e interpretación de datos de alto rendimiento
2. Machine learning
3. Análisis de secuencias y bioinformática estructural
4. Data mining