

Nombre del tutor del proyecto

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Complex Systems

Ubicación del centro donde se disfrutará la beca

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Título del proyecto

Identifiability of brain functional networks through Deep Learning classification

Descripción del proyecto (máximo dos párrafos)

During the last decades, the use of statistical physics techniques has shown that brain dynamics shares many characteristics with other complex systems, including multi-scale behaviours, criticality, and non-linearities. It is nevertheless quite evident that the brain is not the same as, for instance, a stock market; both are complex systems, yet, to the best of our knowledge, the latter is not self-aware nor intelligent. A complementary question thus is: what properties are different in the brain, with respect to other complex systems, which may buttress those unique characteristics?

In this project we will reconstruct functional networks of brain activity, using electroencephalography (EEG) data, and compare them to functional networks representing the dynamics of other complex systems, with a special attention to financial markets. The comparison will be performed through Deep Learning (specifically, Graph Neural Networks) models, with the objective of identifying under which conditions those networks are identifiable. In other words, we will study under which conditions brain functional networks are topologically unique, and make a connection with the elements of brain dynamics underpinning them. If time allows, this analysis will be extended to weighted and multi-layer graphs, and to evolving sequences of networks. Beyond tackling a suggestive and challenging problem, the student will have the possibility of working and getting proficient with industry-standard software libraries (Torch for Python) and hardware infrastructure (in-house cluster of Nvidia GPUs).