One Ph.D. position available within the National Ph.D. Program in “Theoretical and Applied Neuroscience”. The Ph.D. will be held in the Brain Dynamics Lab at the Biorobotics Institute of Sant'Anna School of Advanced Studies, Pisa (Italy). Information about the call can be found here. The deadline for applying to the position is the 4th of August.

The project description can be found here under ‘Code 4.5’.

**Project title:** Functional modeling of brain dynamics: investigation of cognitive functions through the lens of dynamical systems.

**Keywords:** neural coding, neuronal manifolds, modeling, dynamical system reconstruction, RNN, statistical mechanics

**Host Institution:** Sant'Anna School of Advanced Studies, BioRobotics Institute

**Reference person/supervisor:** Russo Eleonora; eleonora.russo@santannapisa.it

**Research topic description:**

Understanding the dynamical system governing neuronal activity is crucial for unraveling how the brain performs cognitive functions. Historically, various forms of recurrent neural networks (RNNs) have been suggested as simplified models of the cortex. Recently, owing to remarkable advancements in the field of machine learning, RNNs’ inherent ability to capture temporal dependencies has been leveraged to develop tools for approximating unknown dynamical systems directly by training on observed time-series data. Concurrently, improvements in electrophysiological recording techniques have enabled the simultaneous recording of hundreds of neurons in animals performing complex behavioral tasks. These parallel developments present a unique opportunity to characterize comprehensively population dynamics and parametrize the neuronal manifold, thereby constructing functional models of cognitive functions. The objective of this research project is to further refine RNN-based algorithms, tailoring them to investigate neuronal dynamics, and applying them to experimental data.

**Research team and environment**

The Ph.D. student will carry out his/her studies at the BioRobotics Institute of Sant'Anna School of Advanced Studies. The project will expose the student to a highly interdisciplinary context, in tight collaboration with theoretical and experimental neuroscientists. At the BioRobotics Institute, the research groups involved will be the Brain Dynamics Lab, the Computational Neuroengineering Lab, and the Bioelectronics and Bioengineering Area. During the second year of the Ph.D., the student might be able to spend a period abroad.

**Preferred Research Skills and Competences**

The ideal candidate has computational and programming skills (ideally, knowledge of Matlab and/or Python), a strong interest in neuroscience, and a background in physics/math/biomedical engineering. The ideal candidate must also be able to carry out his/her work in a diligent, independent, and highly collaborative manner.