PhD research topic proposal
BME, Doctoral School of Mathematics and Computer Science

Name of supervisor :

Gergő Orbán

Degree:

PhD

Title of the topic:

Deep generative learning for understanding hierarchical computations in the visual system

Short description:

The remarkable success of deep neural networks in image recognition inspires an approach where the properties of the visual system in the brain are explored with deep learning systems. The most widespread deep neural networks, however, are prone to errors that are markedly different from those committed by the human visual system. These differences can be regarded as signatures of the differences between the computations performed by the visual system of primates and those performed by deep neural networks. The goal is to identify computations that can sidestep the limitations of deep neural networks (e.g. feedforward architecture and a lack of the representation of uncertainty) and to link these novel architectures to the way neurons respond to stimuli and to the way we perceive our environment. We capitalize on recent advances in machine learning specifically on deep generative models which provide an efficient framework to explore how the visual system copes with the complexity of natural stimuli. The goal of the PhD is dual: 1, development of deep hierarchical generative models, which is one of the exciting challenges in current machine learning; 2, Application of hierarchical deep generative models to perform inference on natural images in order to formulate predictions on the response statistics of visual cortical neuron populations.   The research topic provides an opportunity to work on a hot topic of machine learning research, to explore how these theoretical advancements can be applied to complex data structures obtained from biological systems, and to collaborate with an international research team of world leading labs (UCLA, Cambridge, Frankfurt)..

Requirements:

calculus, linear algebra, probability theory, introduction to machine learning, coding in a scientific programming language

Contact:

Phone:

E-mail:

Place of work:

Computational System Neuroscience Lab, Dept. Computational Sciences, MTA Wigner Research Center for Physics

Statement: *The conditions of the research above are satisfied, the theme is confirmed by the Head of the Department/Institute*