Bocconi

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Bocconi University
Room 3-E4-SR03
Via Röntgen 1, Milano (3° floor)

Efficient Random Coding by Neuron

Speaker

Rava Azeredo da Silveira
CNRS Directeur de Recherche
Ecole Normale Supérieure, France

Abstract

Efficient coding has served as a guiding principle in understanding the neural code. To date, however, it has been explored mainly in the context of peripheral sensory cells with simple tuning curves. By contrast, ‘deeper’ neurons such as grid cells come with more complex tuning properties which imply a different yet highly efficient strategy for representing information. I will show that a highly efficient code is not specific to a population of neurons with finely tuned response properties: it emerges robustly in a network with random synapses, and, more generally, when neural responses are irregular. Here, the geometry of population responses implies that optimality obtains from a tradeoff between two qualitatively different types of error: ‘local’ errors (common to classical neural population codes) and ‘global’ (or ‘catastrophic’) errors. This tradeoff leads to efficient compression of information from a high-dimensional representation to a low-dimensional one. After describing the theoretical framework, I will use it to interpret recordings of hippocampal neurons—‘place cells’—in rats and bats, where the model yields surprisingly accurate fits and makes new predictions. Finally, if time allows, I will summarize ongoing work on the question of decoding information from random codes, and on implications of decoding limitations on encoding. (In the presentation, I will not assume background knowledge in neurobiology, and will attempt to introduce all quantities of interest.)

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