Neuromorphic Computing: A Neuroscience Perspective

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Brains differ strongly from contemporary von Neumann computers in the types of task they are particularly good at, such as pattern recognition and generalization, and in the amount of energy they consume to perform such tasks. Neuromorphic computing holds out the promise of providing us with systems capable of achieving brain-like capacity and efficiency, by applying principles extracted from neuroscience to develop new hardware and corresponding software. In this talk I present five aspects of biological brains that I consider to be crucial for cognitive computation, but are so far scarcely explored in current hardware and computational applications: stochasticity, plasticity, asynchronicity, connectivity and heterogeneity. In addition to presenting these possible guiding principles for neuromorphic development, I discuss two state-of-the-art neuromorphic computing platforms and analyse their advantages and shortcomings in simulating large spiking neural network, compared to the standard technique of using simulation software on a regular cluster. On the basis of this analysis, I propose some challenges for neuromorphic platform developers, including efficiency at high density, representation of multi-scale interactions and configurability/malleability of the network model and its components.