

UNSUPERVISED LEARNING IN NEURAL NETWORKS WITH SHORT RANGE SYNAPSES

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Different areas of the brain are involved in specific aspects of the information being processed both in learning and in memory formation. For example, the hippocampus is important in the consolidation of information from short-term memory to long-term memory, while emotional memory seems to be dealt by the amygdala[1]. On the microscopic scale the underlying structures in these areas differ in the kind of neurons involved, in their connectivity, or in their clustering degree but, at this level, learning and memory are attributed to neuronal synapses mediated by long-term potentiation and long-term depression. In this work we explore the properties of a short range synaptic connection network, a nearest neighbor lattice composed mostly by excitatory neurons and a small fraction of inhibitory ones. The mechanism of synaptic modification responsible for the emergence of memory is Spike-Timing-Dependent Plasticity (STDP), a hebbian-like rule, where potentiation/depression is acquired when causal/non-causal spikes happen in a synapse involving two neurons. The system is intended to store and recognize memories associated to spatial external inputs presented as simple geometrical forms. The synaptic modifications are continuously applied to excitatory connections, including a homeostasis rule and STDP[2]. The rules for synaptic modification include a goal activity to the network and a rather varied set of conditions can be used in the network. In this work we explore the different scenarios under which a network with short range connections can accomplish the task of storing and recognizing memories.

[1] LaBar K.S., & Cabeza R., *Nature Reviews Neuroscience* **7**, 5464 (2006).

[2] The method is similar to the one proposed in Liu, J.K. and Buonomano, D.V., *J. Neurosci.* **29**, 13172 (2009).