Modelling learning and memory using goal functions and timing-dependent learning rules

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In his seminal work on learning and memory D.O. Hebb focused on synaptic mechanisms for the formation of neuronal assemblies. These concept has been used in numerous studies and triggered many exciting experimental and theoretical results. In recent years a powerful variant of learning rules have emerged, which are formulated on the population level. Using concepts from optimization it has been shown that neurons in primary visual cortex form maximally sparse and maximally stable representations. Furthermore, we demonstrate that these concepts generalize to hierarchical processing as well as to other modalities. Thus, we can understand important properties of cortical processing in a compact and general form.