Donald Hebb

Jocelyn Rego, SPARSE Coding Lab
Donald Hebb: Education

- “Father of neuropsychology”
- B.A. from Dalhousie University
- M.A. in Psychology from McGill University
- PhD at the University of Chicago and Harvard
  - Worked with psychologist Karl Lashley, focusing on spatial learning and behavior.
- Postdoctoral work...
  - Montreal Neuroscience Institute
  - Queen’s University
  - Yerkes Laboratory of Primate Biology
- Professor at McGill University
Donald Hebb: “The Organization of Behavior”

- Connected the brain with the mind
- Hebbian Learning
  - "When an axon of cell A is near enough to excite B and repeatedly or persistently takes part in firing it, some growth process or metabolic change takes place in one or both cells such that A's efficiency, as one of the cells firing B, is increased" (p. 62).
- Cell Assemblies
- Phase sequence
Hebbian Learning

- Applied in neural network modeling to adjust weights between connections.
- \( W_{ij} = x_i x_j \)
  - \( \Delta w_i = \eta x_i y \)
- Limitations...
  - Unstable
  - Simplification
Hebbian learning of geometrical objects

Mathieu N. Galatier
Paul C. May

Article in Network Computation in Neural Systems · May 1998
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Abstract: We show how a Hopfield network learning can encode the underlying geometry of an input space. First, we use a slow/fast analysis to derive an averaged system whose dynamics derive from an energy function and therefore always converges to equilibria points. The equilibria reflect the correlation structure of the inputs, a global object extracted through local recurrent interactions only. Second, we use numerical methods to illustrate how learning extracts the hidden geometric structure of the inputs. Indeed, multidimensional scaling methods make it possible to project the final connectivity matrix on to a distance matrix in a high-dimensional space, with the neurons labelled by spatial position within this space.

An Adaptive Spiking Neural Network with Hebbian Learning

Lyle N. Long, Senior Member, IEEE

Emergence of Complex Computational Structures From Chaotic Neural Networks Through Reward-Modulated Hebbian Learning

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This paper addresses the question how generic microcircuits of neurons in different parts of the cortex can attain and maintain different computational specializations. We show that if stochastic Hebbian learning is used in a virtual reality environment (Jarosiewicz et al. 2008). Finally, in the classical experiments by Fetz and Baker (1975) showed that neural activity in cortical circuits of primates adapted to

Hebbian Learning with Winner Take A Networks
Ankur Gupta1 and Lyle N. Long

Most of the success of the 2nd p can be attributed to the develop algorithms for them, e.g. the backprop algorithm. It is one of the most useful learning networks and it is gradient descent algorithm. It is shown how these 2nd generation scalable and run efficiently on a parallel ANN software package 1 Artificial Neural Network). The identify character sets consisting various levels of resolution and correctly identified all the character sets used in the network. This main

Biologically-Inspired Spiking Neural Networks with Hebbian Learning for Vision Processing
Lyle N. Long1 and Ankur Gupta2
The Pennsylvania State University, University Park, PA 16802

This paper describes our recent efforts to develop biologically inspired spiking neural network software (called Chipk) for vision processing. The ultimate goal is object recognition with both scale and translational invariance. This paper describes the initial software development effort, including code performance and memory requirement results. neural network, image capture code, and graphical display is written in Java. The CPU time requirements for very large number of synapses, but even on a laptop computer billions of lines per second for processing other sensor data and for data fusion.