

New Hardware for Massive Neural Networks

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Abstract:

Transient phenomena associated with forward biased silicon p + - n - n + structures at 4.2K show remarkable similarities with biological neurons. The devices play a role similar to the two-terminal switching elements in Hodgkin-Huxley equivalent circuit diagrams.

The devices provide simpler and more realistic neuron emulation than transistors or op-amps. They have such low power and current

requirements that they could be used in massive neural networks. Some observed properties of simple circuits containing the devices include

action potentials, refractory periods, threshold behavior, excitation, inhibition, summation over synaptic inputs, synaptic weights, temporal integration, memory, network connectivity modification

based on experience, pacemaker activity, firing thresholds, coupling to sensors with graded signal outputs and the dependence of firing

rate on input current. Transfer functions for simple artificial neurons with spiketrain inputs and spiketrain outputs have been measured and

correlated with input coupling.