Neurogrid: Emulating a Million Neurons in the Cortex

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ABSTRACT

I will present a proposal for Neurogrid, a specialized hardware platform that will perform cortex-scale emulations while offering software-like flexibility. Recent breakthroughs in brain mapping present an unprecedented opportunity to understand how the brain works, with profound implications for society. To interpret these richly growing observations, we have to build models—the only way to test our understanding—since building a real brain out of biological parts is currently infeasible. Neurogrid will *emulate* (simulate in real-time) **one million** neurons connected by **six billion** synapses with Analog VLSI techniques, matching the performance of a one-megawatt, 500-teraflop supercomputer while consuming less than one watt. Neurogrid will provide the programmability required to implement various models, replicate experimental manipulations (and controls), and elucidate mechanisms by augmenting Analog VLSI with Digital VLSI, a mixed-mode approach that combines the best of both worlds. Realizing programmability without sacrificing scale or real-time operation will make it possible to replicate tasks laboratory animals perform in biologically realistic models for the first time, which my lab plans to pursue in close collaboration with neurophysiologists.