Preface

This book contributes a circuits and systems approach that emphasizes the authority of electrical principles. Mostly this book is founded on generally accepted properties of neurons, which have been well studied and are sufficient to enable a circuit model for an idealized neuron. This model in turn permits the simulation of neural logic in its various forms. Circuit simulations, executed objectively and transparently using software that is proven to function correctly, such as WinSpice as used for the experiments attached to this book, suggest important neural subcircuits that engineers and neuroscientists should find quite interesting. As a general benefit to all concerned, these subcircuits suggest a plausible new system for consciousness that would not be evident within the limits of molecular biology and biochemistry.

Beyond molecules, a brain is obviously a working complexity of circuits. There is no reason to suspect that a brain violates even the smallest aspect of circuit theory or, for that matter, any known principle of physics. So when explaining a brain, circuits and systems theory is, without question, most relevant.

Engineers often point to computerized chess, supercomputer calculations and useful robots that clean the floor as evidence that we are on the road to intelligent machines. But such achievements are largely expressions of human intelligence, not necessarily examples of intrinsic machine intelligence. The computer as an intelligent entity has a long way to go to match human intelligence. To light the way, it is inspiring to study, or at least glimpse reasonable conjectures about the brain as a system of physical neurons.

In particular, the human brain is modeled below as a system of pulsating neurons, complete with electrical connections to other pulsating neurons. To demonstrate what this system does, it was necessary to model synapses and memory in a more detailed way, employing new and exciting circuit elements without which a brain could not possibly function as a system. The result is a proposed new system for human stream of consciousness.

From an academic point of view, this book introduces an exciting new field of *Neuro circuits and Neuro systems* (NCANS). In this field, proposed circuit elements and proposed systems are introduced and tried in order to explain a brain, and to help formulate meaningful scientific experimentation. Explaining a brain is extremely important since more often than not, we are left with no clear explanations of exactly how stream of consciousness works physically.

Neuro-circuits and Neuro-systems is definitely outside the box of popular engineering areas such as circuits and systems (CAS) theory, artificial neural networks (ANN), and others that normally fall under and tend to focus on hardware systems. The emphasis below is on neural pulses, generation, and coordination, which is very different from AC/DC electronics. Shown below are neuro-synaptic combinations that result in novel implementations of logic, such as dendritic logic and enabled logic, plus a variety of unique timing elements, such as weak synapses and short-term memory neurons, that should be interesting to circuit theorists as well as to neuroscientists and neural network engineers.

A vital question is: How does one duplicate the right choices in artistic appraisal, common sense, truth judgment, understanding, and other hallmarks of human ability? There seems to be unfathomed layers of computational power within the brain not anticipated by today's technology. In view of this observation, new radical concepts continue to be entertained.

Quantum computers and qubits are examples of radical concepts that go far beyond logic circuitry. A qubit, as shown in this book, can be simulated in part by a recursive neuron, that is, one that feeds back on itself. Recursive neurons, appropriately configured, are herein termed *simulated qubits*; they are entirely classical and are of interest biologically and for engineering purposes. For instance, simulated qubits can hold true and false simultaneously, each with a specified probability. Simulated qubits are better than ordinary neurons for certain purposes.

A major advantage of simulated qubits is that they are easily configured into controlled toggle devices. Controlled toggles, when properly developed, constitute a major source of computational power, and may very well underlie consciousness and perhaps the gifted abilities of savants. Controlled toggles may be massively parallel and with the would-be advantages of reversible computing. They may someday be found to be implemented by molecules within neurons, while truly quantum systems are less likely to exist due to thermal activity (and decoherence) at body temperatures.

This book carries a reader to the edge of scientific knowledge by introducing *neuroquantology*, which is a studied mix of neuroscience, quantum physics, and psychological phenomena. The discovery of physical qubits within brain cells would be revolutionary, so much so that reasonable people cannot ignore this possibility. Qubits within a quantum system hold promise for powerful quantum computing, and weird teleportation without fields or waves.

Several asynchronous subsystems are covered in this book, involving neuro-synaptic logic in a worthwhile review of digital analysis and design. Subjects introduced are cue editors, random selection of cues, associative memory design, associative memory search, associative memorization, recall priority digital calculations, and digital selection of maximum priority. Each chapter contains a few easy end-of-chapter exercises as an aid to self-education. An appendix provides an experimental lab revolving around the simulation of neural logic.

This book gives a reader a markedly better understanding of cerebral behavior, including mechanisms for brain sense and stream of consciousness. Such topics are not just discussed verbally; they are explored technically with reference to physical circuits.

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