HUAS 7305-001 Critical Studies in Art and Science
Science Fictions: Art and Science Hybrids

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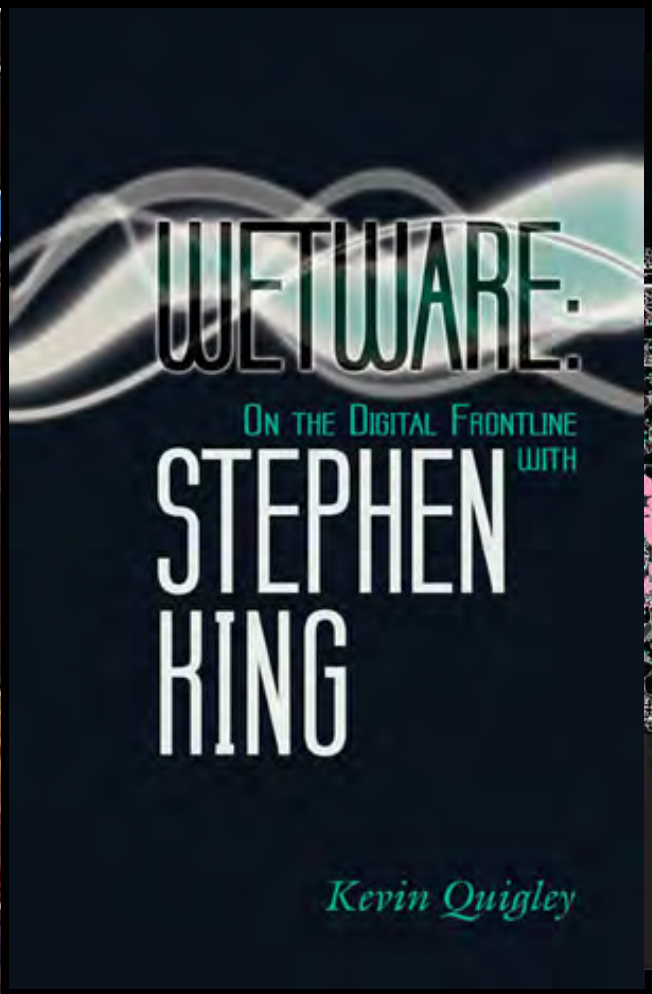
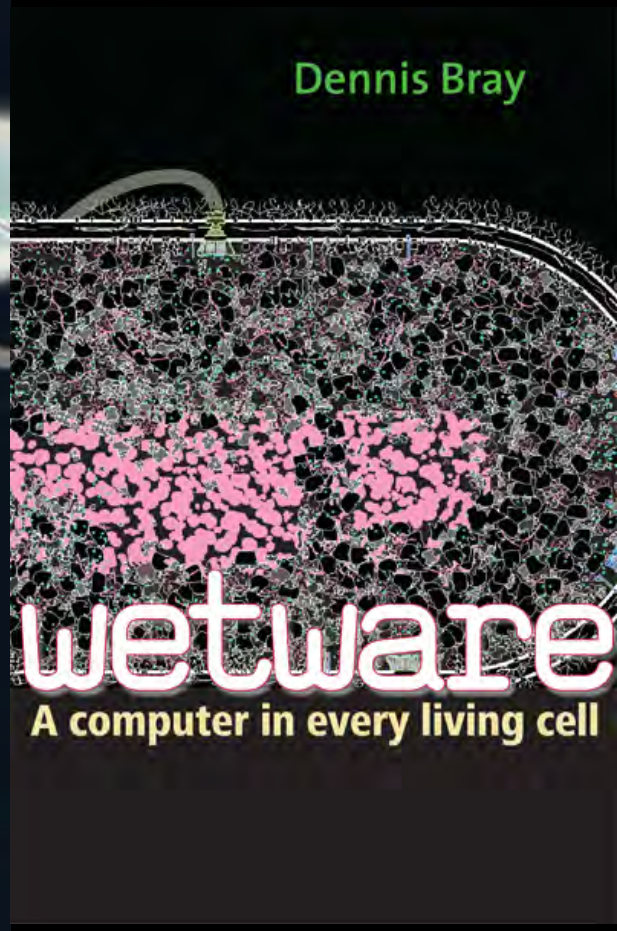
Wetware


Rudy Rucker
Wetware
THE SENSATIONAL SEQUEL TO SOFTWARE, FROM THE CYBERPUNK MASTER!
THE MIND-BLOWING REVOLT OF THE ROBOTS!


WETWARE:
On the Digital Frontline
with
STEPHEN KING
Kevin Quigley

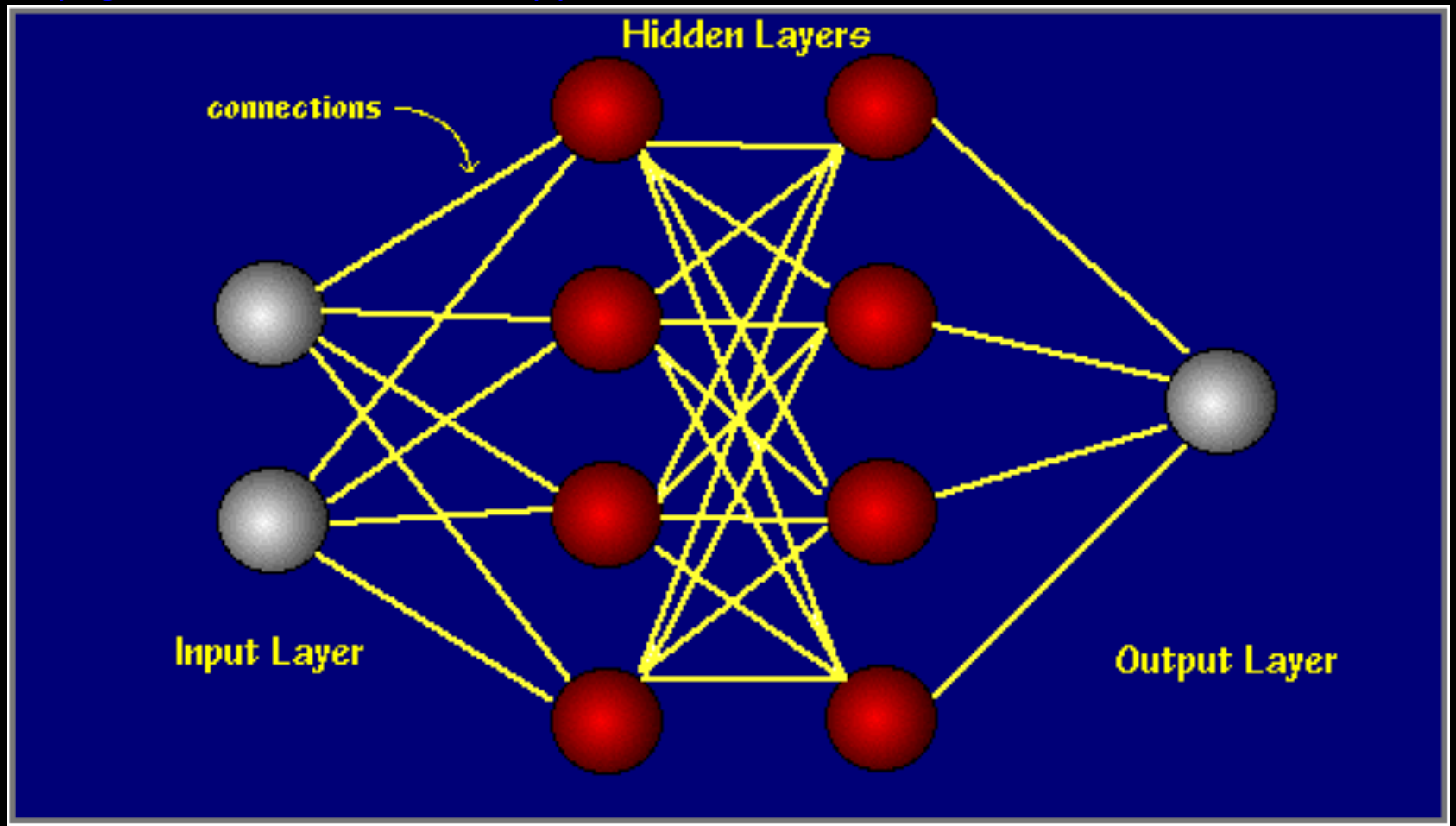

Dennis Bray
wetware
A computer in every living cell

Terms

- Wetware: human brain cells or thought processes regarded as analogous to, or in contrast with, computer systems; (chiefly in science fiction) computer technology in which the brain is linked to artificial systems, or used as a model for artificial systems based on biochemical processes. The "hardware" component of wetware concerns the bioelectric and biochemical properties of the central nervous system, specifically the brain. If the sequence of impulses traveling across the various neurons are thought of symbolically as *software*, then the physical neurons would be the *hardware*. The amalgamated interaction of this *software* and *hardware* is manifested through continuously changing physical connections and chemical and electrical influences that spread across the body. The process by which the mind and brain interact to produce the collection of experiences that we define as self-awareness (mind/consciousness) is still seriously in question. Timothy Leary, in an appendix to *Info-Psychology* originally written in 1975-76 and published in 1989, used the term "wetware", writing that "psychedelic neuro-transmitters were the hot new technology for booting-up the "'wetware' of the brain".
- Meatware: refers to the human element within a computer system. Along with hardware and software, meatware, or a human, is required to operate a computer system.

Artificial Neural Network

Neural neworks are typically organized in layers. Layers are made up of a number of interconnected 'nodes' which contain an 'activation function'. Patterns are presented to the network via the 'input layer', which communicates to one or more 'hidden layers' where the actual processing is done via a system of weighted 'connections'. The hidden layers then link to an 'output layer' where the answer is output as shown in the graphic below.
http://pages.cs.wisc.edu/~bolo/shipyard/neural/local.html



What Is A Neural Network?

The simplest definition of a neural network, more properly referred to as an 'artificial' neural network (ANN), is provided by the inventor of one of the first neurocomputers, Dr. Robert Hecht-Nielsen. He defines a neural network as:

"...a computing system made up of a number of simple, highly interconnected processing elements, which process information by their dynamic state response to external inputs.
In "Neural Network Primer: Part I" by Maureen Caudill, AI Expert, Feb. 1989

ANNs are processing devices (algorithms or actual hardware) that are loosely modeled after the neuronal structure of the mamalian cerebral cortex but on much smaller scales. A large ANN might have hundreds or thousands of processor units, whereas a mamalian brain has billions of neurons with a corresponding increase in magnitude of their overall interaction and emergent behavior. Although ANN researchers are generally not concerned with whether their networks accurately resemble biological systems, some have. For example, researchers have accurately simulated the function of the retina and modeled the eye rather well.

Although the mathematics involved with neural networking is not a trivial matter, a user can rather easily gain at least an operational understanding of their structure and function.

http://pages.cs.wisc.edu/~bolo/shipyard/neural/local.html

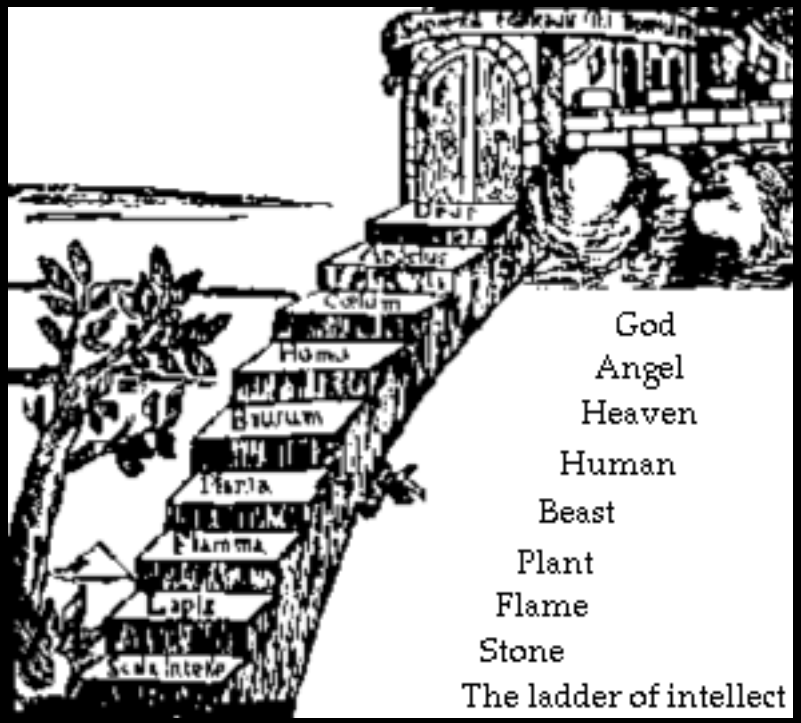
Ch. 7 Cell Awareness

You can see where I am going. If I track an evolutionary staircase from humans to progressively lower organisms, there seems to be continuity. At each step I recognize structures (legs, eyes, mouth-parts, reproductive organs) and behaviors (escape responses, avoidance of pain, searching for food, seeking a mate) from the next-higher species. So if evolution has produced a commonality of structures, behaviors, and molecules, why should not the same be true of such associated subjective feelings as fear, pain, hunger, and lust? It is true that, in the case of feelings, we do not currently understand the cellular and molecular mechanisms involved. But is this reason to deny their existence? p. 135

…From a broad biological perspective we need to ask not "Which human sensations are also experience by animals?" but rather "Which animal sensations are shared by humans?" Surely it is arrogance to declare that we alone experience emotional drives and internal sensations. p. 135

Consciousness in particular may well be a comparatively recent invention, appearing in some advanced animal by a rare conjunction of features, essentially sui generis, without significant precursor. Human language is one attribute that could fit this description, since despite impressive performances by chimpanzees, dogs, and parrots in word recognition, no other animal can communicate as we do. It would be futile to look for a primitive language center in the nervous system of a fruit fly or a nematode. But I nevertheless expect to find in these animals knowledge of the world and their place in it. p. 143

Great Chain of Being



The Great Chain of Being. From Didacus Valades, *Rhetorica Christiana* (1579)

Great Chain of Being

Among the most important of the continuities with the Classical period was the concept of the Great Chain of Being. Its major premise was that every existing thing in the universe had its "place" in a divinely planned hierarchical order, which was pictured as a chain vertically extended. ("Hierarchical" refers to an order based on a series of higher and lower, strictly ranked gradations.) An object's "place" depended on the relative proportion of "spirit" and "matter" it contained--the less "spirit" and the more "matter," the lower down it stood. At the bottom, for example, stood various types of inanimate objects, such as metals, stones, and the four elements (earth, water, air, fire). Higher up were various members of the vegetative class, like trees and flowers. Then came animals; then humans; and then angels. At the very top was God. Then within each of these large groups, there were other hierarchies. For example, among metals, gold was the noblest and stood highest; lead had less "spirit" and more matter and so stood lower. (Alchemy was based on the belief that lead could be changed to gold through an infusion of "spirit.") The various species of plants, animals, humans, and angels were similarly ranked from low to high within their respective segments. Finally, it was believed that between the segments themselves, there was continuity (shellfish were lowest among animals and shaded into the vegetative class, for example, because without locomotion, they most resembled plants).

http://faculty.up.edu/asarnow/greatchainofbeing.htm

God
Angels
Kings/Queens
Archbishops
Dukes/Duchesses
Bishops
Marquises/Marchionesses
Earls/Countesses
Viscounts/Viscountesses
Barons/Baronesses
Abbots/Deacons
Knights/Local Officials
Ladies-in-Waiting
Priests/Monks
Squires
Pages
Messengers
Merchants/Shopkeepers
Tradesmen
Yeomen Farmers
Soldiers/Town Watch
Household Servants
Tennant Farmers
Shephards/Herders
Beggars
Actors
Thieves/Pirates
Gypsies
Animals
Birds
Worms
Plants
Rocks

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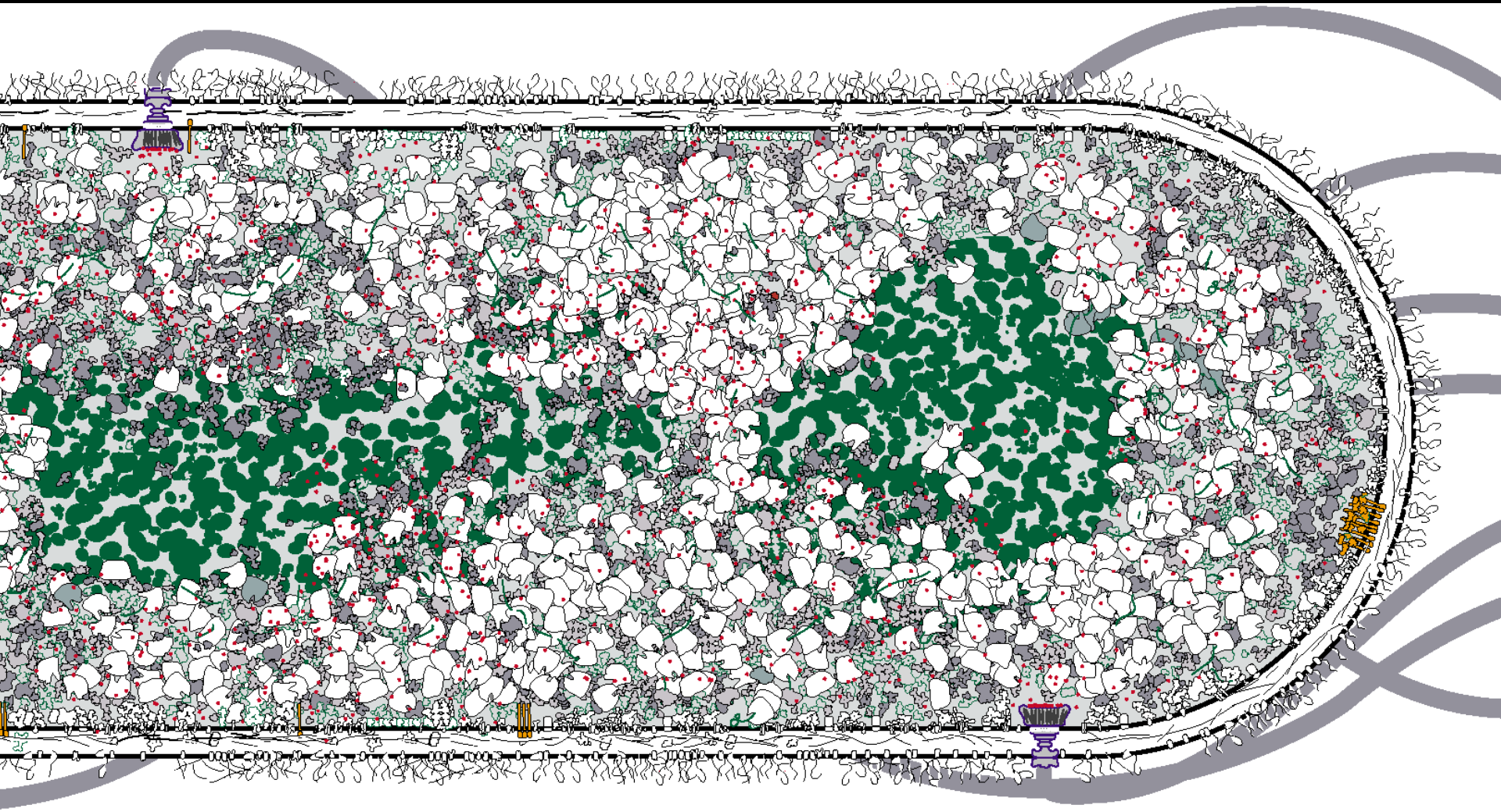
Bacterial Chemotaxis: Using Computers to Represent Biology

The set of biochemical reactions by which an *E. coli* bacterium detects and responds to distant sources of attractant or repellent molecules is probably the simplest and best understood example of a cell-signalling pathway. The pathway has been saturated genetically and all of its protein components have been isolated, measured biochemically and their atomic structures determined. We have used detailed computer simulations, tied to experimental data, to ask how the pathway works as an integrated unit. We found that the physical location of molecular components within the molecular jungle of the cell interior is crucial for an understanding of their function. Signal amplification, for example, appears to depend on the propagation of activity across clusters of receptors and associated molecules.

Because it is relatively simple and well documented, the *E. coli* chemotaxis pathway serves as a benchmark for our understanding of cells in general.How close are we to a complete understanding? Can we expect in the near future to build computer models that capture every essential aspect? Or are there features of living cells that are currently beyond our ability to resolve experimentally or reproduce on silicon chips? Questions such as these are increasingly pertinent in a world populated by intelligent machines.

Bacterial Chemotaxis in Silico

http://www.pdn.cam.ac.uk/groups/comp-cell/index.html



Dennis Bray on the complexity of biological systems and his skepticism that they can be exhaustively emulated anytime soon. At Singularity Summit 2010. http://www.youtube.com/watch?v=kQ2snfsnroM