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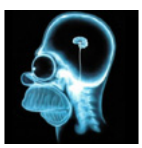

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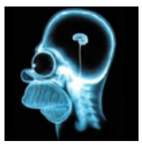
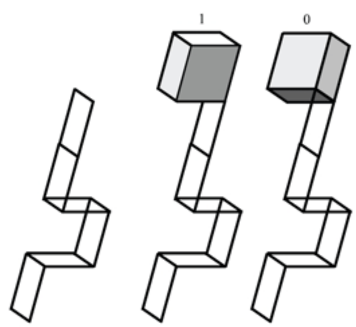


Science Visual Circuits Harness the Power of the Human Brain
Levi Beckerson (Blog) - July 25, 2008 9:34 AM



Looking like something out of an optical illusions book, Mark Changizi's perception based visual circuitry could allow humans to perform powerful logic calculations just be looking down the circuit. (Source: Mark Changizi, Rensselaer Polytechnic Institute)

Think your computer is fast? Check out your brain.

The human brain is faster than any computer in the world, including the new RoadRunner supercomputer at Los Alamos National Laboratory that clocked in last month at a staggering 1.144 petaflop/s, just one part of the cerebral network can perform an as yet immeasurable number of calculations per second. The visual cortex alone, which scientists tried to mimic only a small part of while setting the supercomputer speed record, defies nature with its incredibly ability to process information.

Why not put that power to use to perform artificial calculations? Mark Changizi, Assistant Professor of Cognitive Science at Rensselaer Polytechnic Institute thinks that harnessing human cognizance could produce a powerful system for doing just that.

Changizi has been developing a system of visual cues designed to represent simple circuit logic, much like the basis of all computer programming. His visual circuits so far contain a “wire” and NOT, OR and AND functions, which are important for logic operations.

To get to the heart of the Changizi's visual circuit system, it's all based on perception. The wires and constructs as represented can easily be seen in different ways, like an optical illusion. However, just like binary, the system has 0 and 1 settings, which serve to force a perceived angle onto the drawing. This angle forces the brain to see a particular wire as either a 0 or 1 wire, and can be switched by the different operators and their visual representations.

“A digital circuit needs wire in order to transmit signals to different parts of the circuit. The ‘wire’ in a visual representation of a digital circuit is part of the drawing itself, which can be perceived only in two ways. An input to a digital circuit is a zero or one. Similarly, an input to a visual version of the circuit is an unambiguous cue to the tilt at that part of the circuit," explains Changizi.

He goes on to explain how the various operators influence the information processing being done by the visual cortex. "Visually represented NOT gates flip a box's perceived tilt as you work through a circuit, and OR gates are designed with transparency cues so that the elicited perception is always that the box is tilted toward you, unless overridden. The AND gate is similarly designed with transparency cues, but contrary to the OR gate, it will always favor the perception that it is tilted away from you."

To help make some sense of this, the NOT, OR and AND operators perform specific tasks in logic processing. The NOT operator simply changes a 0 to 1 or 1 to 0. In respect to the Changizi's visual system, this is the same as flipping the perceived tilt of the circuit towards or away from the viewer. The OR operator always outputs a 1 (tilted toward viewer) if either or any of the circuit's inputs are in the 1 state. Finally, the AND operator tilts the wire towards the viewer only if both or all inputs are in the 1 state.

While the system is powerful in scope, at the base of it still lays human perception, which can sometimes be flawed. Not everyone can follow the circuits correctly but Changizi feels this is something that could be learned by viewers, similarly to how humans learn to read. There are also more components a complex virtual circuit would require, which he hopes that other perception experts will help realize.

While new supercomputers continue to the push the limits of processing power, creeping closer to matching the abilities of human cognizance, the idea of using cognizance itself, particularly perception, an easily influenced area of the brain, is a novel approach that may hold promise not only for designing powerful means of calculating, but for unlocking the inner workings of the brain.

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