commentary

Cat-Brain Fever

Two simulations and an angry e-mail reveal the conflicting goals of supercomputer brain modeling

IT'S NOT every day that a leading scientist calls for another leading scientist to be "strung up by his toes" in an open letter. But that's just what neuroscientist Henry Markram called for in a dispute with IBM computer scientist Dharmendra Modha. Their altercation shows that the motivations behind brain simulations are not always clear, even to the main characters.

At the 2009 Supercomputing conference in November, Modha's team from IBM and Lawrence Berkeley National Laboratory reported the creation of supercomputer software that simulated 1.6 billion neurons and their 10 trillion connections, or synapses—about the equivalent number to those in a cat's brain. (It is *not*, as some have called it, a simulation *of* a cat's brain, however.) The team, led by Modha, won the Gordon Bell Prize, a major award in supercomputing. A few days later, Markram, who leads a brain-simulation project at Switzerland's École Polytechnique Fédérale de Lausanne, sent an open letter to IBM and the press refuting Modha's claims and calling the work a hoax.

In Markram's letter, he fulminated that awarding the Bell prize "for such nonsense is beyond belief." He said that the sophistication of the neurons Modha simulated was trivial compared with what would be necessary for an actual simulation of a cat brain.

Markram's letter made waves. Some scientists applauded it, while others decried his tone as unprofessional. Many were cynical, calling all efforts (including Markram's own) at reverse engineering the brain equally spurious. But before getting caught up in the drama, it's important to understand why Markram may have missed the point.

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US $200 000 Price of a ticket to space on Virgin Galactic's recently unveiled *Spaceship Two*. The craft is twice the size of its predecessor and is designed to carry two pilots and six passengers. Virgin Galactic hopes to start commercial flights in 2011.

Reverse engineering the brain is the goal, but different groups have different motives for doing so, and Markram and Modha may represent opposite extremes. Generally, for Markram and other neuroscientists, the goal is to understand how the summed activity of the 100 billion neurons in the human brain lead to phenomena like consciousness and neurological disorders. For computer scientists, the goal is to understand the brain's unique and appealing architecture—and from this architecture, to create new kinds of electronics.

Markram took issue with the fact that Modha's simulation did not use biologically realistic neurons. His own "Blue Brain" simulation at EPFL re-creates about 10 000 neurons, each with an exquisite level of biological realism, on an 8192-processor IBM Blue Gene L.

But when you understand Modha's motivation, biological realism at that level is beside the point. Modha's work is not about creating a conscious brain. It is about addressing three major roadblocks on the way to brainlike computing: speed, scaling, and parallelism.

Consider the fact that the Blue Gene P on which Modha did the work has 147 456 processors. "It's fairly impressive that he showed good scaling up to the size of that machine," says Ben Chandler, a computer scientist and cognitive scientist at Boston University, which competes with Modha's team for funding from the U.S. Defense Advanced Research Projects Agency. "I don't think [other neural simulation environments] can handle 147 456 processors or 144 terabytes of memory." Modha's team was able to use each of the processors more or less equally to do the work of the brain simulation, getting only a 0.3 percent deviation in workloads across cores.

Distributing the work uniformly across the machine means that all the processors were able to complete their work at roughly the same time, allowing the simulation to run reasonably close to real time.

The distribution of work also helped the simulation take advantage of the supercomputer's memory resources. "Part of the reason neural simulations are so difficult is the memory-intensive nature of biological computation," says Chandler.

Modha's cat-*scale* simulation is exactly what the Gordon Bell Prize celebrates: a milestone in computing. It deserves its accolades in full.

—Sally Adee