

Mission to build a simulated brain begins

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An effort to create the first computer simulation of the entire human brain, right down to the molecular level, was launched on Monday.

The "Blue Brain" project, a collaboration between IBM and a Swiss university team, will involve building a custom-made supercomputer based on IBM's Blue Gene design.

The hope is that the virtual brain will help shed light on some aspects of human cognition, such as perception, memory and perhaps even consciousness.

It will be the first time humans will be able to observe the electrical code our brains use to represent the world, and to do so in real time, say Henry Markram, director of Brain and Mind Institute at the Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland.

It may also help in understanding how certain malfunctions of the brain's "microcircuits" could cause psychiatric disorders such as autism, schizophrenia and depression, he says.

Until now this sort of undertaking would not be possible because the processing power and the scientific knowledge of how the brain is wired simply was not there, says Charles Peck, IBM's lead researcher on the project.

"But there has been a convergence of the biological data and the computational resources," he says. But efforts to map the brain's circuits and the development of the Blue Gene supercomputer, which has a peak processing power of at least 22.8 teraflops, now make this possible.

Mapping the brain

For over a decade Markram and his colleagues have been building a database of the neural architecture of the neocortex, the largest and most complex part of mammalian brains.

Using pioneering techniques, they have studied precisely how individual neurons behave electrically and built up a set of rules for how different types of neurons connect to one another.

Very thin slices of mouse brain were kept alive under a microscope and probed electrically before being stained to reveal the synaptic, or nerve, connections. "We have the largest database in the world of single neurons that have been recorded and stained," says Markram.

Neocortical columns

Using this database the initial phase of Blue Brain will model the electrical structure of neocortical columns - neural circuits that are repeated throughout the brain.

"These are the network units of the brain," says Markram. Measuring just 0.5 millimetres by 2 mm, these units contain between 10 and 70,000 neurons, depending upon the species.

Once this is complete, the behaviour of columns can be mapped and modelled before moving into the second phase of the project.

Two new models will be built, one a molecular model of the neurons involved. The other will clone the behavioural model of columns thousands of times to produce a complete neocortex, and eventually the rest of the brain.

The end product, which will take at least a decade to achieve, can then be stimulated and observed to see how different parts of the brain behave. For example, visual information can be inputted to the visual cortex, while Blue Brain's response is observed.

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