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Supercomputer's key to the brain



By David Reid
Reporter, BBC Click Online

The quest to simulate the mammalian brain on the world's most powerful supercomputer is neuroscience's most ambitious project yet. David Reid went to Lausanne in Switzerland to find out how the line is being blurred between man and machine.

Inside your head nestles a forest of millions of neurons which weave together to make your thoughts.

Man has long wanted to discover the secrets of the brain, and has done so with varying degrees of success.



Understanding how neurons work could help with medical treatment

Recently advancements in this area of science have been limited by the power of computers.

But at Switzerland's École Polytechnique Fédérale de Lausanne, the Blue Brain Project aims to change this by simulating the structures and functions of the brain.

The project's head, Professor Henry Markram, says that in the past there was no software environment capable of simulating the brain.

"We haven't had the computing power to really address the complexity of the brain.

"Why is the brain so complex? We need to be able to do simulations addressing the question of complexity."

Now, Blue Gene, a commercially available supercomputer, will help scientists to peer into the most inscrutable part of ourselves.

"We are not trying to build an intelligent device or robot or anything like that," explains Professor Markram.

"We are trying to understand the brain, and one pathway is to take our available knowledge of the brain and put it to a test inside a model.

"That process, we believe, will reveal where our gaps are; what we do understand and what we don't understand."

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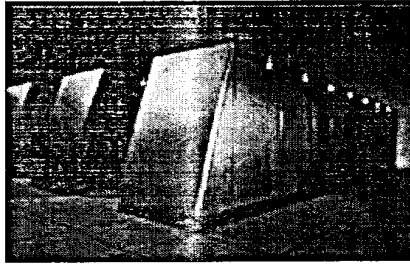
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Neuron by neuron

Easily enough said, but to simulate the brain scientists first have to painstakingly analyse it cell by cell.

They examine the electrical activity in individual neurons and try to decipher the language they use to talk to each other, and how groups of neurons communicate.

Then the conclusions are loaded into the Blue Gene computer, which is pretty brainy itself.



Blue Gene has 8,000 processors, each representing a virtual neuron

With the information gathered in the lab, each of Blue Gene's processors will be programmed to behave like an individual virtual neuron.

Markus Baertschi from IBM, which makes Blue Gene, says: "We've got 8,000 processors all working in parallel, talking to each other.

"Every processor can simulate one neuron and they can communicate among each other to get to the result of thinking, essentially."

The simulation will first build up, neuron by neuron, a working model of a part of the brain called the neocortical column.

The end result of all this research could be useful in predicting how the brain might react to certain drugs and diseases.

Professor Markram adds: "We have to realise that while this circuit gave rise to mammalian intelligence and human cognitive function, and is clearly a very powerful circuit, at the same time a lot of things can go wrong inside that circuit.

"Ultimately if we really want to understand all the things that can go wrong in that circuit we need to have a very detailed model of that circuit."

Artificial intelligence?

But this work does not end with discovering what the matter is with grey matter.

Mix brain research with one of the world's most powerful computers and people start wondering about artificial intelligence and whether a computer will ever be conscious or have, as they often appear to, a mind of its own.



Scientists have long wanted to discover the secrets of the brain

Markus Baertschi says that the computing power is not really up to it at the moment.

"Yes, we have 8,000 processors here, which communicate very rapidly with each other like the brain, but it's only 8,000.

"The brain has millions and millions and millions, so we need to get to that same size.

"But that's only raw power. We then need the knowledge of how to tie these millions of computers together to get to something that works and thinks like a brain does."

Nobody really understands what consciousness is or how it emerges from a biological level, adds Professor Markram.

“ **There are trillions upon trillions of molecules within a tiny little column of neurons, and to accurately capture them is going to be an immense task**

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"The short answer is: we don't really know.

Professor Henry Markram

"The long answer is we're far away from very detailed simulations. We're going to do cellular level simulations in the first phase of two to three years.

"Then we'll begin with molecular level simulations of single neurons and synapses.

"But we have to realise that there are trillions upon trillions of molecules within a tiny little column of neurons, and to accurately capture them is going to be an immense task."

While computers are impressive number crunchers, artificial intelligence seems a long way off.

In the search for startling insights and genius, for the time being at least, we will just have to exercise our own plentiful brain cells.