Simulated brain closer to thought

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A detailed simulation of a small region of a brain built molecule by molecule has been constructed and has recreated experimental results from real brains.

The "Blue Brain" has been put in a virtual body, and observing it gives the first indications of the molecular and neural basis of thought and memory.

Scaling the simulation to the human brain is only a matter of money, says the project's head.

The work was presented at the European Future Technologies meeting in Prague.

The Blue Brain project launched in 2005 as the most ambitious brain simulation effort ever undertaken.

While many computer simulations have attempted to code in "brain-like" computation or to mimic parts of the nervous systems and brains of a variety of animals, the Blue Brain project was conceived to reverse-engineer mammal brains from real laboratory data and to build up a computer model down to the level of the molecules that make them up.

The first phase of the project is now complete; researchers have modeled the neocortical column - a unit of the mammalian brain known as the neocortex which is responsible for higher brain functions and thought.

"The thing about the neocortical column is that you can think of it as an isolated processor. It is very much the same from mouse to man - it gets a bit larger a bit wider in humans, but the circuit diagram is very similar," Henry Markram, leader of the Blue Brain project and founder of the Brain Mind Institute in Switzerland, told BBC News.

He added that, when evolution discovered this "mammalian

secret", it duplicated it many many times and then "used it as it needed more and more functionality".

Virtually there

Professor Markram told the Science Beyond Fiction conference that the column is being integrated into a virtual reality agent - a simulated animal in a simulated environment, so that the researchers will be able to observe the detailed activities in the column as the animal moves around the space.
"It starts to learn things and starts to remember things. We can actually see when it retrieves a memory, and where they retrieved it from because we can trace back every activity of every molecule, every cell, every connection and see how the memory was formed."
The next phase of the project will make use of a more advanced version of the IBM Blue Gene supercomputer that was used in the research to date.
"The next phase is beginning with a 'molecularisation' process: we add in all the molecules and biochemical pathways to move toward gene expression and gene networks. We couldn't do that on our first supercomputer."

Moreover, Professor Markram thinks the exponential rise in computing power will allow the project in 10 to 20 years to integrate many facets of medicine, right down to genomic profile, eventually creating a vast database for "personalised medicine".
Such an approach would allow researchers to simulate, on the level of an individual, how they will respond to a given drug or treatment.
Emerging arts
The conference is a meeting to foster high-risk, multidisciplinary research in information and communication technologies (ICT), and as such is a mix of many types of researchers, from computer scientists to biologists.

Not all of them agree that the lofty ultimate goals of the Blue Brain project are achievable.

Wolfgang Wahlster of the German Research Center for Artificial Intelligence, and a chief German government scientific adviser on ICT, thinks that the reductionist strategy of the project is flawed - that it won't see the forest for the trees.

"Imagine you could follow in one of the most advanced Pentium chips today what each and every transistor is doing right now," he told BBC News.

"Then I ask, 'What is happening? Is Word running? Are you doing a Google search?' You couldn't answer. Looking at this level you cannot figure it out.

"This is very interesting research and I'm not criticising it, but it doesn't help us in computer science in having the intelligent behaviour of humans replicated."

Professor Markram believes that by building up from one neocortical column to the entire neocortex, the ethereal "emergent properties" that characterise human thought will, step by step, make themselves apparent.

"They are not things that are easily predicted by just knowing elements - by definition - but by putting them together you can explore the principles, where they came from. Basically that's what we're after: understanding the principles of emergent properties."

Such emergent properties lead to the very essence of being human - the spatial awareness of lower mammals graduates to political views and artistic expression in humans.

When asked when the simulation would come up with something artistic or an invention, Professor Markram said it was simply a matter of money.

"It's not a question of years, it's one of dollars. The psychology is there today and the technology is there today. It's a matter of if society wants this. If they want it in 10 years, they'll have it in 10 years. If they want it in 1000 years, we can wait."